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Psychology
VCE Units 3 & 4

4th edition

John Grivas · Nicole Letch
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Contents

Preface

Overview of this textbook

The fourth edition of *Psychology VCE Units 3 & 4* systematically and comprehensively addresses all the units 3 and 4 areas of study, outcomes, key knowledge and key skills specified in the VCE Psychology Study Design accredited for the period 2011 to 2014. The book has been updated to accord with the new Study Design. The text provides a theoretical framework for each outcome, incorporating the theories and research studies prescribed for study, as well as contemporary and relevant Australian research studies, applications and examples. Additional high-interest information is distributed throughout each chapter—as boxes, newspaper articles, colour photographs, diagrams, flow charts and other graphical material.

Our new co-author Nicole Letch is a former teacher of psychology and a member of the Psychology exam-setting panel. Now practising as a clinical psychologist, specialising in child and adolescent mental health, Nicole has contributed accurate and relevant coverage of the new course content on mental health and illness, using numerous examples of contemporary Australian research and contexts.

Each chapter has a similar format. Information that is likely to be examined, or that closely relates to examinable content, is presented in the central text. Review questions and other learning activities are strategically placed throughout each chapter. At the end of each chapter is a short true/false quiz and a 'mini-VCE exam' in the form of a chapter test, similar to the mid-year and end-of-year exams. These are designed to test students on the key knowledge and skills relating to the outcomes. The chapter tests, which comprise multiple-choice and short-answer questions, give students practice with the types of questions in VCE Psychology exams.

A range of interesting and challenging learning activities is presented for each area of study, enabling students to demonstrate achievement of outcomes. Not all learning activities need to be completed. Teachers can choose those activities (or parts of activities) best suited to their courses and students. Among the learning activities are review questions that closely accord with those typically used in Psychology exams, as well as activities that can be used as assessment tasks.

In addition, all chapters offer a broad range of resource material such as media items and detailed research abstracts that will enable students to meet all of the requirements of each assessment task prescribed for school-assessed coursework.

An important feature of the book is the comprehensive glossary. All psychological terms, which appear in the text in bold print, are listed in the glossary along with a thorough definition or explanation of the term as it is used in Psychology. The glossary is a useful compendium for students when they are studying for exams. The detailed index will also help students efficiently locate specific information when required.

The first chapter of the book focuses specifically on the nature and research methods of Psychology specified in the Study Design for both units 3 and 4. All prescribed research methods are explained in detail and supported with examples and graphics that elucidate key concepts and enhance understanding. Research methods are also integrated within each chapter to accord with the specifications of the Study Design. The first chapter includes useful information and guidelines for ethically planning, conducting and reporting research investigations, and practical activities using appropriate reporting conventions.

The learning activities involving research investigations, practical activities, evaluation of research and data analysis will be invaluable in preparing students for assessment tasks in school-assessed coursework and the research methods questions in exams.

The book has been written as a stand-alone text. Students and teachers can thoroughly and comprehensively complete all aspects of VCE Psychology Units 3 and 4 without the need to refer to other resource material.

Answers for the true/false quizzes and multiple-choice questions in the chapter tests are included on page 823. Answers for the short-answer questions in the chapter tests, answers to review questions, and answers and marking guides for the learning activities in the text are available at www.OneStopScience.com.au.

Overview of VCE Psychology

Course outline

Psychology in the Victorian Certificate of Education is offered as a science study. Consequently, there is an emphasis on scientific research methods in all units.

VCE Psychology is made up of four units. Each unit deals with specific content contained in areas of study and is designed to enable students to achieve the two outcomes for that unit. Each outcome is described in terms of key knowledge and key skills. There are no prerequisites for entry to Unit 3, but Unit 3 must be undertaken before Unit 4 can be undertaken.

This textbook covers all the Victorian Curriculum and Assessment Authority specifications for Units 3 and 4. The areas of study of these two units are:

Unit 3: The conscious self

1 Mind, brain and body

2 Memory

Unit 4: Brain, behaviour and experience

1 Learning

2 Mental health

The areas of study in each unit can be taught in any order. Similarly, within each area of study, the content can be covered in any order.

Assessment

Each unit has two outcomes (one for each area of study) that students are required to achieve in order to satisfactorily complete the unit. An outcome is a statement of what a student should know and be able to do on completion of a unit.

Students complete various learning activities throughout each unit to develop the key knowledge and skills that make up the outcomes and those key skills outlined on page 13 of the Study Design (for units 3 and 4) and research methodologies on pages 22–3 (for Unit 3) and page 28 (for Unit 4).

The student's level of achievement (e.g. grade) for each unit is determined by school-assessed coursework throughout each unit and a written exam at the end of each unit. School-assessed coursework involves completion of a variety of assessment tasks specified by the Victorian Curriculum and Assessment Authority.

The final assessment for Psychology Units 3 and 4 is made up in the following way.

Unit 3

17% school-assessed coursework

33% mid-year exam

Unit 4

17% school-assessed coursework

33% end-of-year exam

In each unit, teachers are required to assess each student's achievement of the outcomes on the basis of overall performance on assessment tasks designated for the unit. Assessment tasks must be completed mainly in class and within a limited time frame. Teachers should select a variety of assessment tasks to reflect the key knowledge and skills being assessed and to provide for different learning styles.

Performance on each assessment task will be determined through advice on the assessment tasks and performance descriptors for assessment given by the Victorian Curriculum and Assessment Authority.

As shown in the table on the next page, the two assessment tasks associated with each outcome have a specified number of marks allocated towards an overall score for school-assessed coursework. At the end of each unit, the teacher will calculate an overall score on school-assessed coursework and submit this score to the Victorian Curriculum and Assessment Authority.

Unit 3: The conscious self

Outcomes	Marks allocated*	Assessment tasks
		There are two pairs of assessment tasks. Pair A may be selected for *either* Outcome 1 *or* Outcome 2. Pair B must be utilised for the outcome not covered by Pair A.
Outcome 1 Explain the relationship between the brain, states of consciousness including sleep, and behaviour, and describe the contribution of selected studies and brain research methods to the investigation of brain function.	**Pair A** 30 20	Report of a research investigation conducted by the student *and* one other task selected from: • data analysis • media response • test
		and
Outcome 2 Compare theories that explain the neural basis of memory and factors that affect its retention, and evaluate the effectiveness of techniques for improving and manipulating memory.	**Pair B** 25 25	*Two* tasks selected from: • evaluation of research • data analysis • essay • media response • annotated folio of practical activities • oral presentation using two or more data • types • test • visual presentation
Total marks	**100**	

*School-assessed coursework for Unit 3 contributes 17%.

Unit 4: Brain, behaviour and experience

Outcomes	Marks allocated*	Assessment tasks
		There are two pairs of assessment tasks. Pair A may be selected for *either* Outcome 1 *or* Outcome 2. Pair B must be utilised for the outcome not covered by Pair A.
Outcome 1 Explain the neural basis of learning, and compare and contrast different theories of learning and their applications.	**Pair A** 30 20	Annotated folio of practical activities *and* one other task selected from: • essay • test • visual presentation
		and
Outcome 2 Differentiate between mental health and mental illness, and use a biopsychosocial framework to explain the causes and management of stress, simple phobia and a selected mental disorder.	**Pair B** 25 25	*Two* tasks selected from: • evaluation of research • data analysis • essay • media response • report of a research investigation conducted by the student • oral presentation using two or more data types • test • visual presentation
Total marks	**100**	

*School-assessed coursework for Unit 4 contributes 17%.

Unit 3
The conscious self

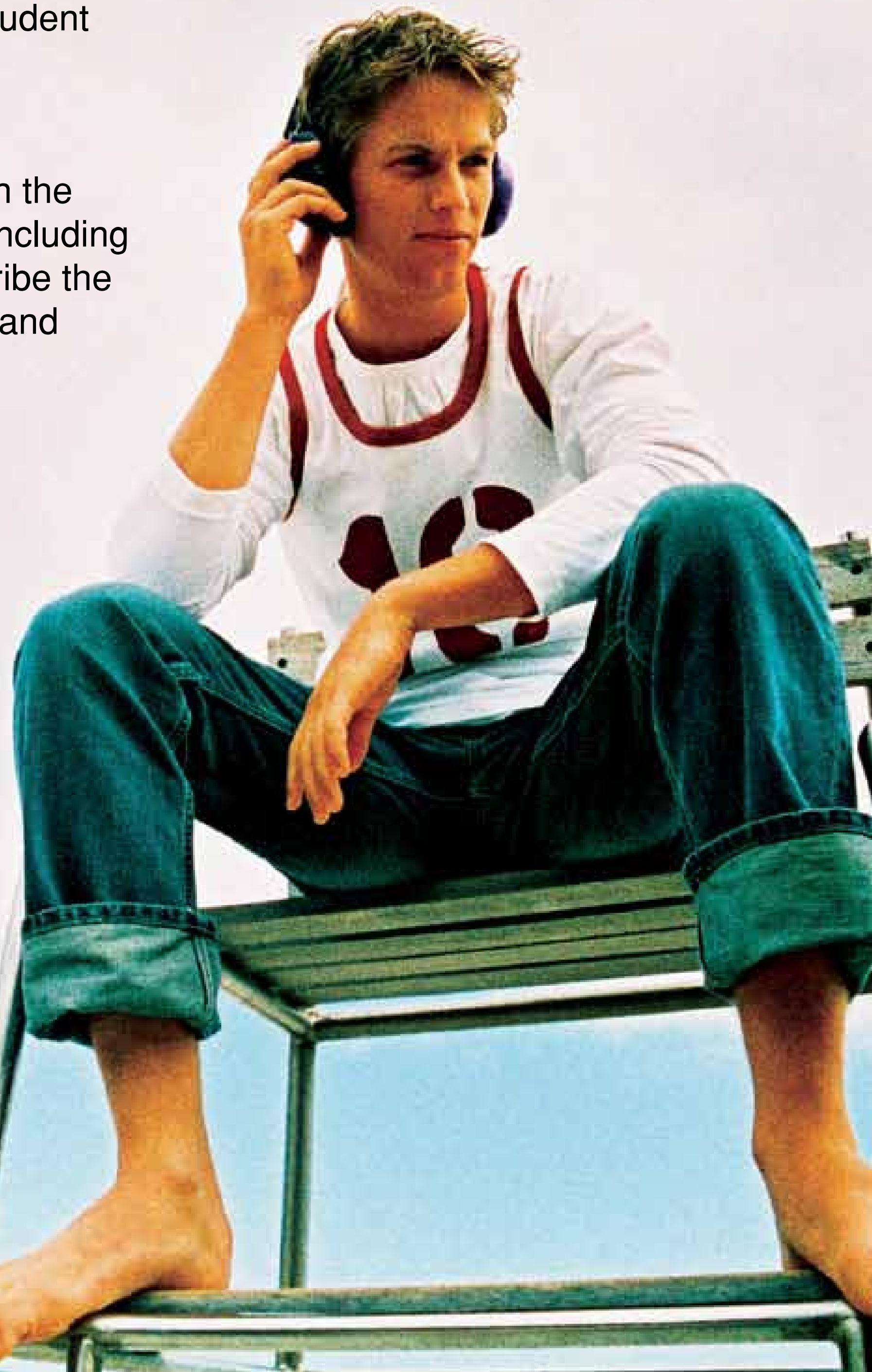
On completion of this unit the student should be able to:

Outcome 1

Explain the relationship between the brain, states of consciousness including sleep, and behaviour, and describe the contribution of selected studies and brain research methods to the investigation of brain function.

Outcome 2

Compare theories that explain the neural basis of memory and factors that affect its retention, and evaluate the effectiveness of techniques for improving and manipulating memory.



Unit 3: Key knowledge

Chapter 1 Research methods in psychology	• experimental research: construction of research hypotheses; identification of operational independent and dependent variables; identification of extraneous and potential confounding variables including individual participant differences, order effects, experimenter effect, placebo effects; ways of minimising confounding and extraneous variables including type of experiment, counterbalancing, single and double blind procedures, placebos; evaluation of different types of experimental research designs including independent-groups, matched-participants, repeated-measures; reporting conventions • sampling procedures in selection and allocation of participants: random sampling; stratified sampling; random-stratified sampling; random allocation of participants to groups; control and experimental groups • techniques of qualitative and quantitative data collection: case studies; observational studies; self-reports; questionnaires; interviews • statistics: measures of central tendency including mean, median and mode; interpretation of *p*-values and conclusions; reliability including internal consistency; validity including construct and external; evaluation of research in terms of generalising the findings to the population • ethical principles and professional conduct: the role of the experimenter; protection and security of participants' rights; confidentiality; voluntary participation; withdrawal rights; informed consent procedures; use of deception in research; debriefing; use of animals in research; role of ethics committees
Chapter 2 States of consciousness	• consciousness as a psychological construct informed by the work of René Descartes and William James • concepts of normal waking consciousness and altered states of consciousness, including daydreaming, meditative and alcohol-induced, in terms of levels of awareness, content limitations, controlled and automatic processes, perceptual and cognitive distortions, emotional awareness, self-control and time orientation • methods used to study the level of alertness in normal waking consciousness: – measurement of physiological responses including electroencephalograph (EEG), heart rate, body temperature and galvanic skin response (GSR) • research methods and ethical principles associated with the study of states of consciousness
Chapter 3 Sleep	• sleep as an altered state of consciousness: purpose, characteristics and patterns of the stages of sleep including rapid eye movement (REM) and the non-rapid eye movement (NREM) stages of sleep • methods used to study the level of alertness in normal waking consciousness and the stages of sleep: – measurement of physiological responses including electroencephalograph (EEG), electrooculargraph (EOG), heart rate and body temperature – the use of sleep laboratories, video monitoring and self-reports • the effects of total and partial sleep deprivation: – loss of REM and NREM sleep – sleep recovery patterns including amount of sleep required, REM rebound and microsleeps – sleep–wake cycle shifts during adolescence compared with child and adult sleep including delayed onset of sleep and need for sleep • research methods and ethical principles associated with the study of states of consciousness

Chapter 4 The central nervous system	• the interaction between cognitive processes of the brain and its structure including: – roles of the central nervous system – roles of the four lobes of the cerebral cortex in the control of motor, somatosensory, visual and auditory processing in humans; primary cortex and association areas – hemispheric specialisation: the cognitive and behavioural functions of the right and left – hemispheres of the cerebral cortex, non-verbal versus verbal and analytical functions – the role of the reticular activating system in selective attention and wakefulness; role of the thalamus in directing attention and switching sensory input on and off • contribution of studies to the investigation of cognitive processes of the brain and implications for the understanding of consciousness including: – studies of aphasia including Broca's aphasia and Wernicke's aphasia – spatial neglect caused by stroke or brain injury – split-brain studies including the work of Roger Sperry and Michael Gazzaniga – perceptual anomalies including motion after-effect, change blindness, synaesthesia • the application and use of brain research methods in investigating the relationship between biological and cognitive factors of human behaviours including: – direct brain stimulation and transcranial magnetic stimulation (TMS) – brain recording and imaging techniques: computed tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), magnetic resonance imaging (MRI), and functional magnetic resonance imaging (fMRI) • research methods and ethical principles associated with the study of the brain
Chapter 5 The peripheral nervous system	• roles of the peripheral nervous system (somatic and autonomic), and autonomic nervous system (sympathetic and parasympathetic)
Chapter 6 Memory	• mechanism of memory formation: – role of the neuron in memory formation informed by the work of E. Richard Kandel – roles of the hippocampus and temporary lobe – consolidation theory – memory decline over the lifespan – amnesia resulting from brain trauma and neurodegenerative diseases including dementia and Alzheimer's disease • comparison of models for explaining human memory: – Atkinson-Shiffrin's multi-store model of memory including maintenance and elaborative rehearsal, serial position effect and chunking – Alan Baddeley and Graham Hitch's model of working memory: central executive, phonological loop, visuo-spatial sketchpad, episodic buffer – levels of processing as informed by Fergus Craik and Robert Lockhart – organisation of long-term memory including declarative and episodic memory, and semantic network theory
Chapter 7 Forgetting	• strengths and limitations of psychological theories of forgetting: – forgetting curve as informed by the work of Hermann Ebbinghaus – measures of retention including the relative sensitivity of recall, recognition and relearning – retrieval failure theory including tip-of-the-tongue phenomenon – interference theory – motivated forgetting as informed by the work of Sigmund Freud including repression and suppression – decay theory
Chapter 8 Manipulation and improvement of memory	• manipulation and improvement of memory: – use of context dependent cues and state dependent cues – mnemonic devices including acronyms, acrostics, peg-word method, narrative chaining and method of loci – effect of misleading questions on eye-witness testimonies including the reconstructive nature of memory informed by the work of Elizabeth Loftus • research methods and ethical principles associated with the study of memory.

1 Research methods in psychology

The nature of psychology

The term 'psychology' originates from two Greek words: *psyche*, meaning soul or mind; and *logos*, meaning study or knowledge. Therefore, by its original definition, psychology was initially described as 'the study of the soul or mind'. By the late 19th century, when psychology became an independent scientific discipline, it was described as 'the science of mental life'. At this time, psychologists studied the mind by asking their research participants to describe their mental experiences, asking questions such as 'What are you thinking?' or 'What are you feeling?'

During the early 20th century, many psychologists adopted the view that a true science can study only overt behavior. *Overt* behaviour is any response that is clearly visible and therefore directly observable and more likely to be measured accurately. They rejected the study of mental experiences, as these are *covert*; that is, internal and hidden from view and therefore not directly observable or easily measured. This led many psychologists to change direction from studying mental experiences, such as aggression or forgetting, to studying the outward expressions of these experiences through observable behaviour, such as displays of anger or performance on a memory test. Consequently, in the 1920s, psychology was commonly defined as 'the scientific study of behaviour' (Sdorow, 1995). This view lasted until the 1970s, when interest in studying the mind returned, primarily as a result of the development of new technologies such as scanning devices that could capture images of the human brain while participants engaged in various experimental tasks. This enabled psychologists to more effectively observe and measure the previously 'hidden' activity of the brain. As the new technologies were refined and the discipline of psychology matured, it became increasingly clear to most psychologists that they could not fully understand human behaviour without also understanding the mental and biological processes underlying and sustaining behaviour.

Currently, definitions of psychology refer to the discipline as involving the systematic study of the mind and behaviour. This is also the definition adopted for VCE Psychology. However, in VCE Psychology, **psychology** is defined more precisely as the scientific study of mental processes and behaviour in humans.

Mental processes and behaviour

Psychologists usually distinguish mental processes from behaviour. The term **mental processes** generally refers to a person's thoughts and feelings, which are personal, or subjective, and cannot be directly observed. What you think about, how you think, how you interpret relationships with others, how you learn and remember, your choice of words in a conversation, your sensations and perceptions, your dreaming when asleep, your daydreaming when awake, your emotions and moods, and what motivates you to do something are all examples involving mental processes. These are private, internal events that cannot be

Figure 1.1 Psychology is the scientific study of mental processes and behaviour in humans.

observed by others in the way that we can see externally expressed actions such as smiling and crying. Consequently, psychologists rely on making careful inferences about mental processes on the basis of observable behaviour. An *inference* is a logical assumption, judgment or conclusion based on available evidence. For example, the process of learning cannot be directly observed, as it is a mental process that occurs within the individual. Instead, psychologists observe performance, or what people do. Then, on the basis of such observations, they make inferences about the learning that may have taken place.

The term **behaviour** refers to any externally expressed action made by a living person that can be directly observed. Behaviour involves doing something—it is an active process. It is the means by which people can physically express their thoughts and feelings when interacting with the environment. Talking, touching, running, perspiring, hugging, flirting, text messaging, watching television, sleeping, socialising, and reflexive responses such as blinking and automatically withdrawing your hand on touching a very hot object are all examples of behaviour that can be observed as it occurs.

Although the definition of psychology distinguishes between mental processes and behaviour, these do not often occur independently of one another. They are interrelated and

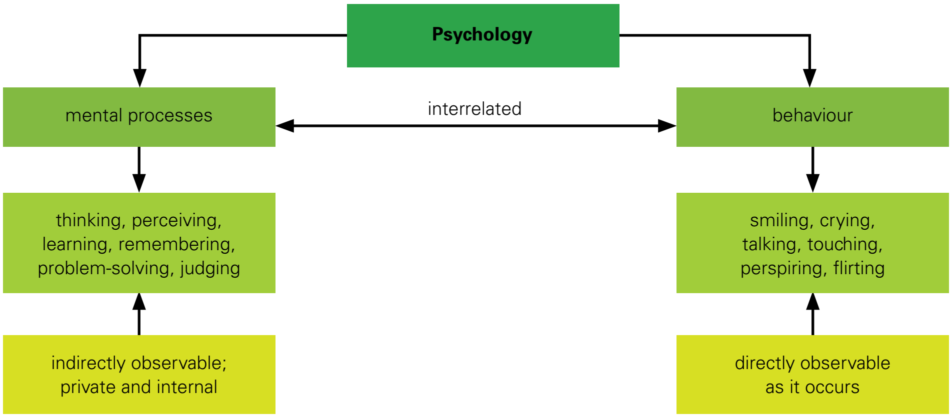


Figure 1.2 Mental processes and behaviour are interrelated and constantly interact.

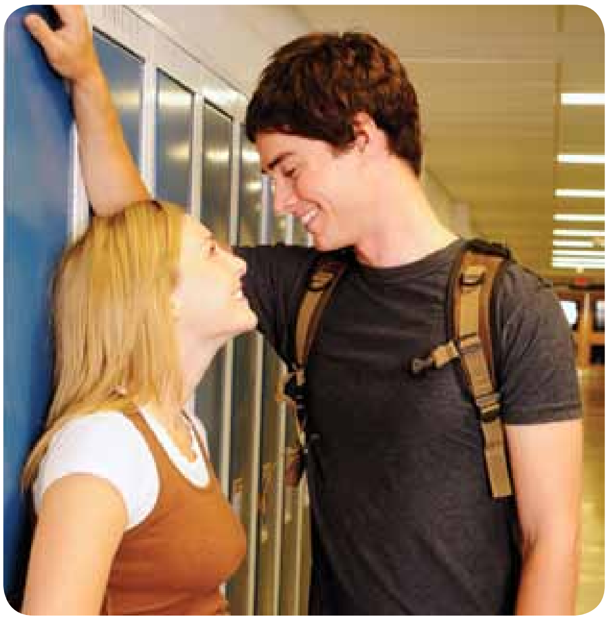


Figure 1.3 In psychology, *mental processes* refers to thoughts and feelings that occur within the person and cannot be directly observed.

Figure 1.4 In psychology, *behaviour* refers to a person's externally expressed actions that can be directly observed.

constantly interact. For example, how you behave in a particular situation will be accompanied by underlying thoughts and feelings about that situation. Similarly, your thoughts and feelings about a situation you are in can influence how you behave and the extent to which that behaviour will be sustained. For example, if you think you are being 'used' by one of your friends and feel angry about it, you may refuse to give them your class notes the next time they ask for them. Mental processes and behaviour are only considered separately for the purposes of scientific study, in courses such as VCE Psychology, and in textbooks such as this.

In studying mental processes and behaviour, many psychologists consider biological structures and activities that underlie our actions, particularly the roles of our brain, brain chemistry and nervous system. Heredity and the activity of our genes may also be considered; that is, the extent to which our thoughts, feelings and behaviour are influenced by characteristics and tendencies passed on genetically by our biological parents. In addition, the important influence of environment is often examined; for example, the extent to which our experiences throughout life affect how we think, feel and behave. More recently, psychologists have given increasing attention to the role of cultural

Figure 1.5 (a) A psychologist studies a chimpanzee's ability to use language; (b) a psychologist studies whether a parrot is capable of self-recognition.

influences; for example, similarities and differences in how people think, feel and behave across different cultures.

Although psychology is defined as the study of people, it also involves the study of animals. People are often studied in groups, but also as individuals; for example, psychologists might study a newborn infant, a teenage 'street kid', a swimmer in training for the Olympics, a person who obsessively (repeatedly) washes their hands throughout each day or a grandmother coping with the stress of raising the heroin-addicted baby of her adolescent daughter. However, the participant in a research study might be a chimpanzee learning to use symbols to communicate, a laboratory-bred rat navigating a maze, a hungry pigeon learning to peck a button to receive food, or a sea snail responding to a danger signal. An individual might be studied in a *field setting* in its natural, 'real life' environment, or in the carefully controlled conditions of a *laboratory setting* (Zimbardo, 1992). Finally, psychology is a *scientific* study.

Psychologists attempt to understand mental processes and behaviour by using the highly disciplined approach and methods of science to systematically collect, analyse and interpret observable data. This typically involves experimental research using carefully controlled observations and measurements. It is this reliance on a scientific approach and use of scientific methods that sets psychology apart from non-scientific disciplines such as history and politics. Sciences share a common approach to studying their respective subject matter. For example, physics, chemistry, biology, environmental science and psychology differ in what they study, yet each discipline uses a scientific approach and method in trying to achieve common goals of description, prediction, control and explanation. While an environmental scientist might pursue these goals in studying the effects of greenhouse gases on global warming and climate change, a psychologist might pursue them in studying thoughts, feelings and behaviour during sleep (Sdorow, 1995).

Box 1.1

Psychologists, psychiatrists and psychoanalysts

Some people think that *psychologists* and *psychiatrists* are the same—that they are 'shrinks' of some kind or other. This view is often based on what has been seen on television or in a movie, or read in a magazine. However, the kind of work undertaken in these specialist professions can vary considerably. Some aspects of psychology and psychiatry are shared, such as their work with people who experience mental health problems. But there are also several important differences between psychology and psychiatry. One difference is in the qualifications required to become a psychologist or psychiatrist.

A *psychologist* completes a recognised four-year course in psychology at a university and is then required to complete a minimum of two years' full-time (or equivalent) training under the supervision of a registered psychologist, or a further two-year full-time (or equivalent) postgraduate course in psychology. Postgraduate studies are usually undertaken in a specialist Masters degree; for example, a Master of Clinical Psychology or Master of Sport Psychology. Masters degrees typically involve coursework, research and supervised training in relevant work settings. Although the pathway and qualifications to become formally qualified as a psychologist can vary between the different states and territories in Australia, six years of full-time study (or equivalent) is typically required in order to become eligible for registration as a psychologist.

All psychologists are required by law to be registered with a state or territory registration board before they can use the title psychologist or work as a psychologist in a state or territory. In most states and territories in Australia, it is illegal for a person to start work as a psychologist or call themself a psychologist unless they are registered.

Compared with psychiatrists, psychologists can specialise in a wider range of areas. As outlined in box 1.2, there are many fields in which psychologists can work, such as education, industry, sport and research. Furthermore, the work setting of a psychologist can vary considerably; for example, a psychologist may work from a home office, a clinic, a commercial site or an educational institution. Most psychologists in Australia, however, work for the public service, such as with the Department of Education and Early Childhood Development and the Department of Human Services. Some psychologists are employed in schools and tertiary institutions, a small number work in private practice or in community mental health centres, and others work as consultants. Clinical psychologists often work in private practice or in psychiatric units in hospitals, helping people with mental health problems as psychiatrists do. However, unlike psychiatrists, psychologists cannot prescribe medications or perform medical procedures such as electroconvulsive shock treatment (ECT). They rely entirely on various forms of counselling and other non-medical therapeutic techniques when working with their clients. Furthermore, unlike psychiatrists, psychologists do not have the legal authority to hospitalise involuntary patients, to require a person living in the community to receive treatment or to order 'seclusion' (isolation from others) or 'restraint' of a patient.

A *psychiatrist* is a qualified medical doctor who has obtained additional qualifications to be a specialist in the diagnosis, treatment and prevention of mental illness and emotional problems (RANZCP, 2010). Psychiatrists first undertake six years of university study and training to gain their basic medical qualifications. They then work as interns in a hospital for a further 12 months to gain practical experience in medicine and surgery. This enables them to become fully registered as medical practitioners. Following their internship, they must complete a further year as a Resident Medical Officer. This year must include experience in psychiatry during which their suitability for psychiatric training is assessed. Postgraduate training in psychiatry takes a further five years, sometimes more. During their training, the doctors work under the supervision of psychiatrists in hospitals and clinics that provide mental health services, gaining experience in dealing with a broad range of mental health problems. In all, a psychiatrist completes at least 13 years of full-time study (or equivalent) in medicine, surgery and psychiatry (RANZCP, 2010). When qualified, a psychiatrist usually works in private practice, a mental health clinic or a hospital. Because they are qualified medical practitioners they are able to prescribe medications and perform medical procedures to treat and control the symptoms of mental health problems and disorders such as schizophrenia, depression or phobias. In the ideal setting, psychologists and psychiatrists work side by side, conferring and referring.

Some people think that a *psychoanalyst* works in much the same way as either a

psychologist or a psychiatrist. This is incorrect unless a psychologist or a psychiatrist uses psychoanalysis. *Psychoanalysis* is a form of 'talking' therapy, developed by the Austrian doctor Sigmund Freud (1856–1939) and adapted by his followers. It is one of a number of different therapies that a psychologist or psychiatrist may use to help people with mental health problems. Psychoanalysis is not widely practised in Australia. It generally involves finding out about a person's early experiences, desires and conflicts, which may be hidden in their unconscious mind and can't be brought into conscious awareness under ordinary circumstances. The techniques used in psychoanalysis can include hypnosis and dream interpretation for clues to the underlying causes of a problem.

The form of therapy most commonly used by contemporary psychologists and psychiatrists is called cognitive behaviour therapy (CBT).

Box 1.2

Areas of specialisation in psychology

There are many different areas in which psychologists can specialise and apply their knowledge and skills. Most psychologists specialise in one area only, but may work in different settings. For example, a clinical psychologist may offer psychological services through a private practice and also work in the psychiatric unit at a public hospital. Similarly, a forensic psychologist may lecture at a university while also providing consultancy services for the County Court or Barwon Prison. Following are outlines of some of the specialist areas in psychology.

Academic psychology usually involves lecturing in the psychology department of a university, supervising the research of postgraduate psychology students and conducting own research on problems and topics of research interest.

Biological psychology studies physiological ('biological') structures, systems and activities that may influence mental processes and behaviour.

Clinical psychology involves diagnoses and treatment of mental health problems and illnesses.

Clinical neuropsychology assesses changes in mental processes and behaviour associated with brain damage and irregularities in brain function.

Cognitive psychology studies 'higher' mental processes such as thought, memory, perception, language and creativity.

Counselling psychology overlaps with clinical psychology but tends to deal with problems of a less severe nature; for example, non-life-threatening problems such as relationship problems and personal issues.

Educational and developmental psychology involves assessment, intervention and counselling on educational and developmental issues across the lifespan.

Forensic psychology applies psychological knowledge and skills to assessment, intervention and research in the legal system and correctional services.

Health psychology focuses on links between physical and mental health and factors that influence them.

Organisational psychology focuses on the effective functioning of people in relation to their working environments.

Psychometrics involves research and development on psychological tests to measure various human characteristics, such as intelligence tests, vocational interest tests and personality tests.

Social psychology studies ways that people interact and social influences on mental processes and behaviour.

Sport psychology assists athletes to develop mental skills that enhance performance.

Box 1.3

The Australian Psychological Society

The Australian Psychological Society (APS) is the peak body for the psychology profession in Australia, representing a high proportion of Australian psychologists and providing a strong voice for psychology in the community.

The APS is a national organisation that looks after the interests of psychology and psychologists. The goals of the APS include disseminating psychological knowledge, promoting scientific research in psychology, improving research methods and conditions of psychologists, and developing both the qualifications and abilities of psychologists by setting appropriate standards in education, ethics and professional practice. Membership of the APS is not compulsory, but it is highly regarded and is often required by employers.

To become a full member of the APS it is necessary to have completed four years of full-time study (or equivalent) in an approved psychology course at a university and a minimum of two years' full-time (or equivalent) postgraduate study in an approved psychology course. It is possible to join the APS as a student of psychology before gaining full qualifications. There is also a Teacher Affiliate category of membership for teachers of Years 10–12 Psychology in secondary schools or TAFE colleges. However, full membership of the APS is not granted to individuals who are not fully qualified.

Steps in psychological research

Most of what psychologists know about mental processes and behaviour comes from psychological research that has been conducted in a scientific way.

Scientific research involves using an appropriate research method to collect data (information) relating to a problem or topic of interest, then organising the data and drawing valid conclusions about it. The research is based on scientific assumptions, 'rules' and procedures, and is planned, conducted and reported in a systematic way. This approach is commonly referred to as *scientific method*.

If scientific method is not used, it is difficult to reach a valid conclusion about a *phenomenon* (an 'observable event'). Observations or data are likely to be incorrectly interpreted, and the conclusion(s) will be based on faulty or insufficient evidence. Generally, the scientific method used for psychological research can be described in seven steps.

Step 1 Identification of the research problem

The first step involves identifying the problem or topic of interest to be researched. For example, a researcher might be interested in ways of improving memory. To do this, they may conduct a literature search to find reports of research that has already been conducted on their chosen topic. For example, research studies on memory located by the researcher may include reports on experiments that have tested specific techniques for improving memory such as 'narrative chaining' and the 'method of loci'; reports on experiments that have compared 'maintenance rehearsal' involving simple, continuous repetition of the information to be remembered with 'elaborative rehearsal' involving manipulation of the information to be remembered to make it more meaningful; and so on. A literature search enables the researcher to become more familiar with their topic of research interest, to refine their ideas and to propose a relevant research question that can be investigated, or 'tested'. For example, the researcher might decide to investigate the question 'Is narrative chaining a more effective technique for improving memory than the method of loci?'

Step 2 Construction of the research hypothesis

The second step involves constructing an appropriate hypothesis for the research. A *research hypothesis* is a testable prediction of the relationship between two or more events or characteristics. It is essentially an educated guess about what the results of the research will be. This is because the hypothesis is usually based on knowledge gained from other research or theories on the topic being studied and is 'thoughtfully' constructed. The research hypothesis is constructed before actually conducting the study, and provides the focus for the research and is tested by the research procedures used in the study. The research hypothesis is written as a very specific statement; for example, a hypothesis for the research problem on improving memory could be 'Year 6 students who use narrative chaining to learn new information will have a better memory of that information (as measured by a test of recall) than Year 6 students who learn new information using the method of loci (as measured by the same test of recall)'.

Step 3 Design of the method

The third step involves determining which research method is best for testing the hypothesis and the specific design features of the method, although these are also considered when the hypothesis is constructed. *Research methods* are the techniques, or 'tools', psychologists use to collect, analyse and interpret data. There is a variety of research methods from which psychologists can choose. These include *experiments*, *observational studies*, *case studies* and *surveys* using questionnaires and interviews. In some studies, it is appropriate to use a combination of research methods. The design of the research method to be used depends on the specific topic and hypothesis of research interest. In designing the specific features or procedures of the research method, the researcher must make decisions about the type of data to be collected, how the data will be collected, which participants will be studied, how many participants there will be, how they will be selected and how they will be allocated to different groups that may be used in the study.

Participants are the people who take part in the research. The responses of the participants provide the data and the results for the research. For the memory improvement study, the researcher may decide to conduct an experiment using a number of Year 6 students from a range of different primary schools in the Melbourne metropolitan area as participants in the study. Since children will be used in the study, the researcher will be required to follow appropriate ethical standards and practices for conducting research with children and obtain informed written consent from the parent(s) or guardian(s) of the children selected as participants for the study. If the researcher used an experimental research design called *independent-groups*, one-third of the participants would be taught the narrative chaining technique, then they would use it to learn new information (e.g. a shopping list); one-third would be taught to use the method of loci; and the other third would be used for comparison purposes and would therefore not be taught or use narrative chaining or the method of loci. The two groups who use a technique for improving memory would be called *experimental groups*, and the comparison group would be called the *control group*.

Step 4 Collection of the data

The fourth step involves actually collecting the required data in order to determine the results. Based on their plans and predetermined procedures, researchers organise the participants to be involved in the research and then conduct their study in an objective way. **Objectivity** involves taking steps to prevent personal factors from influencing any aspect of the research (or its reporting). Objectivity requires that data are collected and recorded free of bias, prejudice and other personal factors that may distort the data obtained. For example, an objective description of an event should simply describe what happened. The description might offer suggestions or beliefs about the motives or emotions of the people involved, but it should be made clear that these are not objective observations, but rather are personal interpretations.

Psychologists may use one or more data collection techniques to obtain their information.

These include *observation*, *self-reports* such as questionnaires and one-to-one or group interviews, *standardised tests* such as intelligence and personality tests and *physiological* ('bodily') *recordings* such as scans and print-outs from brain imaging and recording technologies. The data collection technique(s) used depends on the research topic and the hypothesis under investigation. In the memory study, if an experiment was conducted, the data collection technique would be referred to as 'observation', whereas for a survey, the data collection technique would more commonly be referred to as a questionnaire and/or an interview. However, survey questions may also be described as observations. Generally, all psychological research methods involve observation of responses. For example, experimenters observe the responses of their participants, interviewers observe the spoken responses of their participants and researchers conducting a survey requiring participants to give written answers for a questionnaire observe the written responses of their participants.

Step 5 Analysis of the data

The data collected by the researcher are initially referred to as *raw data* because they are not processed (that is, coded or summarised in a meaningful way). Once collected, the next step in psychological research is to objectively summarise, organise and represent the raw data in a meaningful way. This usually involves breaking down a large set of numbers into smaller sets (e.g. raw data summarised as percentages in a table or graph), or even down to a single number or two (e.g. a mean or standard deviation). The researcher is then better able to consider the data when determining whether the hypothesis is supported or rejected based on the results obtained.

Step 6 Interpretation of the data

Once the data have been analysed, they need to be interpreted and explained. This includes drawing a conclusion(s) from the results obtained in the research study. A *conclusion* is a judgment about what the results of an investigation mean. Conclusions relate directly to the hypothesis established prior to the research. Statistical testing involving mathematical procedures is used by the researcher to help make judgments, or decisions, about what the results mean. These procedures allow the researcher to know what conclusions can legitimately be drawn from the results and what generalisations (wider applications) can legitimately be made. Statistical tests are also used to enable the researcher to determine the *statistical significance* of their results; that is, how likely it is that the results obtained for the study could have occurred by chance.

If, following statistical testing, the results for the memory study were found to clearly indicate that narrative chaining was a more effective technique than the method of loci, then the researcher would interpret the results as providing support for the hypothesis. They would conclude that using narrative chaining is a more effective strategy for improving memory of new information than is using the method of loci. However, the results of this study might also indicate that the method of loci is also an effective strategy for improving memory (when compared with using no strategy). If so, the researcher would make this conclusion as well. When drawing conclusions, the researcher would base their judgments strictly on what the results show. They would also be aware of and comment on the limitations of their study; for example, variables (factors or events) that may have influenced their results in an unwanted way, that the results may only apply to specific kinds of information (e.g. grocery lists) and that the mnemonic devices may be more or less suitable for other age, social or cultural groups.

Step 7 Reporting of the research findings

The final step of psychological research involves objectively reporting the research findings to others who may be interested in the results. Typically, researchers prepare a report that is presented to other psychologists at a conference and/or submitted to a journal for publication. A *journal* is a publication that contains reports of scientific research. The reports prepared by psychologists follow a strict format and standards, as described on pages 85–9. As well as providing a summary of the research, a complete formal report describes, in detail, background information about the research and its relevance, how the research study was conducted, the findings of the study, how the findings can be interpreted and applied, any relevant problems encountered in conducting the study that may have affected the findings and a list of references used in preparing and writing the report.

Reporting research findings is a very important part of the scientific research process. It is the way other researchers find out about research that has been conducted and the way scientific progress is achieved. It also enables the general public to benefit from the findings of research. Reporting research places the study and its procedures and data under the scrutiny of other psychologists, researchers and even the general public; for example, to check the accuracy of the results and to consider alternative conclusions that may also be valid. Importantly, reporting research in an appropriate way enables *replication* by other researchers; that is, it enables them to repeat the study in order to test the accuracy of the results or to test the relevance of the study or results to other groups or situations.

Step 1 Identification of the research problem	Is narrative chaining a more effective technique for improving memory than the method of loci?
Step 2 Construction of research hypothesis	Year 6 students who use narrative chaining to learn new information will have a better memory of that information (as measured by a test of recall) than Year 6 students who learn new information using the method of loci (as measured by the same test of recall).
Step 3 Design of the method	Determine how the hypothesis is best tested. Consider ethical issues. Decide who the research participants will be, how many will be used and how they will be selected. Develop instructions and materials to teach the mnemonic techniques and develop all test materials, as well as instructions and materials for the control (comparison) group. Develop a consent form (including briefing statement) for participants.
Step 4 Collection of the data	Data are collected from 18 Year 6 students, six of whom are in one experimental group (narrative chaining), six in another experimental group (method of loci) and six in the control group (no mnemonic technique). There were three females and three males in each group to ensure the variable of sex differences was controlled and did not affect the results in an unwanted way.
Step 5 Analysis of the data	The mean score for the narrative chaining group is higher than the mean score for the method of loci group, but the method of loci group achieved a higher mean score than the control group.
Step 6 Interpretation of the data	The results appear to support the hypothesis. Narrative chaining is a more effective technique for improving the memory of Year 6 students than the method of loci. However, using the method of loci is better than not using any technique. Conclusions are very tentative ('cautiously' stated) because the experiment may not have been strictly controlled and a test of statistical significance has not been used. The results may apply only to specific types of memory activities or groups.
Step 7 Reporting of the research findings	A written report using the appropriate reporting conventions is prepared and submitted to the VCE Psychology teacher.

Figure 1.6 Flow chart of steps in psychological research. The flow chart summarises the memory study as if it were completed for VCE Psychology.

Box 1.4

Planning and carrying out your own research investigation

In Unit 3 you are required to report on a research investigation conducted on a topic relevant to Outcome 1 for Area of study 1 (Mind, brain and body). In Unit 4, you may also be required to report on a research investigation conducted on a topic relevant to Outcome 2 for Area of study 2. The report(s) are assessed as part of your SACs for the unit(s).

The following guidelines for undertaking your research investigation are based on and summarise the 'Steps in psychological research' described on pages 11–14 and will help ensure you plan and conduct your research appropriately. The guidelines are also relevant to practical activities you may be required to undertake in your study of VCE Psychology.

Step 1 Identify the research topic

Your teacher may give you a research topic or allow you to choose your own. (If you are required to investigate a specific topic, some of the steps may not be relevant.)

Step 2 Read relevant literature

Review and become familiar with the area of study and specific topic you intend to investigate. Refer to the VCE Psychology Study Design, the relevant chapter(s) in this textbook, other psychology textbooks, your class notes or even journal articles from a library or the internet. This will assist you to refine your ideas. It is important that you focus on a *specific* topic (such as mnemonic devices), rather than a general topic such as (memory).

Step 3 Draft a research proposal

Draw up an initial plan for carrying out your research investigation. Consider such matters as constructing a research hypothesis (with 'operationalised' variables for experimental research) and explaining how it could be tested (the research method and its specific design), and outlining relevant ethical considerations, availability of and access to participants, time, equipment, data that will be obtained and how the data will be summarised and interpreted. Submit your proposal to your teacher. Regardless of how careful you are, your teacher can find errors in the research design and oversights in ethical considerations that you, the original designer, being so close to the research, might not notice. Furthermore, according to the VCE Psychology Study Design (p. 9) your teacher is responsible for ensuring that your research is conducted ethically.

Step 4 Refine the research design

Correct any problems with your initial proposal. Ensure your hypothesis is clearly stated and testable using your proposed research design. Your choice of sample and control of variables are important considerations. The sample size should be manageable. Prepare a revised research proposal.

Step 5 Obtain approval to conduct the research

Submit your research proposal to obtain your teacher's approval to conduct the research.

Step 6 Organise materials and arrangements for the research

Schedule and confirm availability of participants, the research setting or venue, equipment, materials and any other relevant resources.

Step 7 Collect the data

Undertake the research to test your hypothesis. Ensure that you collect the data objectively and follow all relevant ethical requirements.

Step 8 Present the results

Summarise the raw data, organise them and present them in an appropriate form using relevant statistical measures such as percentages and means. Data are usually presented in tables and figures such as graphs and charts.

Step 9 Analyse the results

Evaluate and interpret the summarised data in relation to the operational hypothesis. Although you are not required to use a **test of significance** or calculate a *p* value, you should consider the meaningfulness of the results.

Step 10 Draw a conclusion(s)

Having interpreted the data, state the major finding(s) of the investigation. You should make a statement about whether the results support or do not support your hypothesis, then review your design, and comment on any limitations of the research investigation (including potential influences of unwanted extraneous variables), ways in which the investigation might be improved, and the possible wider application (generalisation) of the results.

Step 11 Present a report

Finally, you should prepare a report using appropriate reporting conventions. Your teacher will give you advice on which section(s) to include in your report and the degree of detail required. Keep in mind that your report will be assessed. Ensure that your report meets all the assessment criteria to be used by your teacher.

Research methods

Psychologists can choose from a wide variety of research methods to scientifically collect data in order to test hypotheses and answer questions on topics of interest. A **research method** is a particular way of conducting a research study to collect accurate and reliable information about behaviour and mental processes. For example, an experiment and a survey are different research methods. Each method has its specific purposes, procedures, advantages and limitations. The choice of research method depends on what is most appropriate for the specific topic of research interest. This is not unlike the choice made by a carpenter of which tool to use. Whether a hammer or a saw is selected will depend on the work that needs to be done. Each tool will have a specific use and way of being used. Similarly, each research method has a particular logic underlying its use and how it is used.

Figure 1.7 A carpenter chooses tools depending on the work to be done, just as the researcher chooses the most appropriate research method to conduct an investigation on their topic of interest.

Experimental research

One of the most scientifically rigorous research methods used in psychology, as in other sciences, is the experimental method. An **experiment** is used to test a cause–effect relationship between variables under controlled conditions. For example, an experiment would be used to find out if the variable of anxiety (a possible cause) has an effect on the variable of exam performance, if the variable of playing music while studying (a possible cause) has an effect on the variable of learning, or if the variable of amount of sleep (a possible cause) has an effect on the variable of memory. In any of these examples, a researcher could conduct an experiment to find out if there is a cause–effect relationship between the different variables. In conducting an experiment, the researcher would approach the research study in a systematic way, manipulating and measuring the variables of interest, while controlling other variables that might influence the results. Generally, four different types of variables can be identified in experimental research. These are called *independent variables*, *dependent variables*, *extraneous variables* and *confounding variables*.

Independent and dependent variables

A **variable** is any factor that can change ('vary') in amount or type over time. Sexual desire, alcoholic content, stress, happiness, sociability, amount of sleep and degree of masculinity or femininity are examples of variables. An individual's biological sex, blood type or genetic make-up are all fixed factors and do not vary. However, in research these are considered to be variables even though they are fixed and unchanging within a person (or animal).

Every experiment includes at least one independent variable and one dependent variable. The **independent variable (IV)** is the variable that is systematically manipulated, changed or varied in some way by the researcher in order to assess its effect on the participants' responses. The way in which it will be manipulated (e.g. in level or value) is planned and determined before the experiment begins. It is called an independent variable because the researcher can *independently vary* it in some way.

The **dependent variable (DV)** shows any effects of the independent variable; that is, it is the aspect of a participant's behaviour or experience that is observed or measured and is expected to change as a result of the manipulation of the independent variable. It is called a dependent variable because whether or not it will change *and* the way it will change *depend* on the effects of the independent variable. In the examples given previously, anxiety would be the IV and exam performance the DV; playing music while studying would be the IV and learning the DV; and amount of sleep would be the IV and memory the DV. In terms of a cause–effect relationship, the independent variable is viewed as the possible *cause*, and changes in the dependent variable are the possible *effect*.

The simplest experiment uses one independent variable with two values or levels (an experimental condition and a control condition) and one dependent variable. In the **experimental condition**, the independent variable is present, and in the **control condition** the independent variable is absent (or the participants in the experimental condition are treated differently to those in the control condition). For example, consider an experiment to test whether displaying posters of rock stars wearing a particular brand of jeans increases sales of that brand of jeans. The experimental group is exposed to a condition in which there are posters showing rock stars wearing the jeans displayed prominently in a jeans store, while the control group is not. The dependent variable might be the number of pairs of that brand of jeans sold (see table 1.1). The control condition provides a standard of comparison for the experimental condition in which the independent variable is present. Without a control condition, it would not be possible to determine the influence of an independent variable; for example, whether the posters of rock stars wearing the jeans affected the number of pairs of jeans purchased.

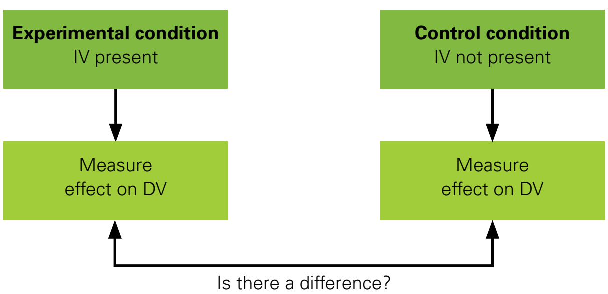


Figure 1.8 A simple experiment

Table 1.1 A simple experimental design

Group	Independent variable (rock-star posters)	Dependent variable (number of pairs of jeans purchased)
Experimental group	Exposure to posters with rock stars wearing jeans	Number purchased
Control group	Non-exposure to posters with rock stars wearing jeans	Number purchased

If a significantly greater number of these jeans are purchased by participants in the experimental group, the experimenter may assume that the difference between the two groups was caused by the exposure of the experimental group to the posters of rock stars (IV). However, in order to make this assumption, the experimenter must be confident that no variable other than the independent variable being tested had an excessive influence on the purchase of jeans.

Learning Activity 1.1

Review questions

1. What are two features that best distinguish an experiment from other research methods?
2. Write a definition of each of the following terms as they apply to an experiment:
   - variable
   - independent variable
   - dependent variable.
3. What do researchers expect to happen to dependent variables when they manipulate independent variables?
4. Identify the IV and DV in each of the following:
   a. Receiving a reward for studying will increase the amount of time students engage in studying.
   b. People who are in love perceive each other more positively than other people perceive them.
   c. Recall of information presented early in a list is better than recall of information presented later in a list.
   d. People react quicker to sounds than to visual stimuli.
   e. Using adult language when talking to infants improves their vocabulary.
   f. People change their pitch of voice when lying.
   g. People who suffer from depression recall more negative experiences than positive experiences.
   h. Daydreaming occurs more frequently during simple tasks than during complex tasks.
   i. Workers on an assembly line are more productive when working alone than in a small group.

Learning Activity 1.2

Identifying variables in an experiment

A researcher noticed that some of her laboratory rats stood on their hind legs for a moment whenever their food was brought into the laboratory. She decided to test whether she could teach the rats to stand on their hind legs when she rang a bell.

First she measured the exact amount of time the rats spent standing when the food was brought in. Then she rang a bell just before each meal. The rats eventually started to stand on their hind legs when they heard the bell.

1. What two IVs are being manipulated in the experiment?
2. What is the DV in this experiment and how is it measured?
3. Why did the researcher measure the rats' movements before introducing the bell-ringing?

Source: adapted from Davenport, G.C. (1988). *An introduction to child development*. London: Unwin Hyman, pp. 143–144.

Construction of the research hypothesis

In research, a **hypothesis** is a tentative and testable prediction of the relationship between two or more events or characteristics. It is an educated guess about what will happen in the research. A hypothesis can be described as an educated guess because it is thoughtful (involves logical reasoning) and based on theory and/or previous research findings. Any hypothesis must be constructed and worded in such a way that the results obtained from the research will either support or not support the prediction.

The simplest hypothesis for an experiment would state that one event or characteristic (i.e. one variable) influences, causes or contributes to a second event or characteristic (i.e. another variable). Examples of simple hypotheses are 'exercise relieves depression', 'reading novels promotes language development' and 'students perform better on exams when they study on a regular basis'.

The hypothesis used in research—the **research hypothesis**—is rarely expressed using such general terms as 'exercise' and 'depression'. In experimental research, the research hypothesis states the causal relationship between the independent and dependent variables to be tested; that is, that the IV(s) will cause the DV(s) to change in a particular way. Furthermore, the variables to be tested are defined and stated in terms of how they will be observed, manipulated and measured. For example, 'exercise', which is the IV to be manipulated, might be defined as vigorously walking at a particular pace for a specified period of time on an automated treadmill, and 'depression', which is the DV to be measured, might be defined as the number of negative words used in writing a creative story, as it has been found through previous research studies to be related to the level of depression. In the examples, exercise and depression are both defined and stated in terms of the procedures ('operations') that will be used to manipulate and measure them in the experiment.

Figure 1.9 An experimental research hypothesis precisely defines the variables to be manipulated and measured. For example, *vigorous exercise* might be defined as walking at 7 km/h for 30 minutes on an automated treadmill.

Because a research hypothesis for an experiment operationalises the IV and DV, it is sometimes called an operational hypothesis. An **operational hypothesis** is a research hypothesis that states how the variables being studied will be observed, manipulated and measured. In addition, an operational hypothesis outlines the population (i.e. the larger group of research interest) from which the sample (i.e. actual research participants) has been selected. For example, in an experiment on exercise and depression, people (e.g. adult males and females) clinically diagnosed as having severe depression could be randomly selected as participants and then randomly allocated to either the experimental or control condition (or group). Those in the experimental condition would be required to engage in 30 minutes of vigorous walking and those in the control condition would not engage in any vigorous walking. The operational hypothesis for this experiment would be expressed using clearly stated and precise terms such as 'clinically depressed adult males and females who engage in a regular five-day schedule of vigorous walking at 7 kilometres per hour for 30 minutes per day will use fewer negative words when writing a creative story than will clinically depressed people who do not engage in vigorous walking over the five days'.

A hypothesis used for experimental research usually has the following characteristics:

- the IV is specified in operationalised terms (e.g. how it will be manipulated)
- the DV is specified in operationalised terms (e.g. how it will be measured)
- the population from which the sample will be drawn is stated
- it is testable (e.g. the variables can be reliably observed, manipulated and measured)
- it is an educated guess (e.g. based on logical reasoning, theory or previous research findings)
- it is a precisely worded written statement (rather than a general statement or a question)
- it is expressed clearly (rather than vaguely).

In addition, it is often written as a single sentence, although it is possible to list a number of hypotheses within a single sentence.

After constructing the research hypothesis, the specific features of the study can be designed. The study may then be conducted and the hypothesis tested. Because psychologists cannot know all the variables that affect a person (or animal) at any given time, they can never be certain about the accuracy of predictions. In fact, many researchers would consider it pointless to conduct a study when the outcome is certain.

Scientific predictions are more accurate about people in general than about a specific person. For example, a motor vehicle insurance company can more accurately predict the percentage of people in a particular age group who are likely to be involved in road accidents this year than it can predict whether any particular individual in that age group will have an accident. Likewise, although a psychologist might be correct in predicting that people who work in highly stressful jobs will be more *likely* to suffer heart attacks, they cannot predict with certainty whether a particular person in a highly stressful job will suffer a heart attack. This situation is no different in other sciences, which can only make predictions with varying degrees of probability of being correct. For example, your doctor may prescribe an antibiotic that, based on medical research, is *usually* effective in treating pneumonia. Your doctor, however, cannot guarantee that it will cure *your* pneumonia. Similarly, seismologists know that cities lying along geological faults are more likely to experience earthquakes, but they cannot accurately predict the day, or even the year, when one of these cities will experience its next major earthquake (Sdorow, 1995).

Figure 1.10 Do tattoos make a person more or less attractive? The answer depends on how you operationalise 'attractive'.

Box 1.5
Operational definitions

In psychology, as in any other science, definitions (and any other descriptions) must be clear and precise. Consider the statement 'the research is about crime'. Crime could refer to jaywalking, parking in front of a fire hydrant, shoplifting, assaulting someone, committing armed robbery, smuggling protected Australian birds out of the country, and so on. Like many of the words that we use in everyday conversation, *crime* is a term that covers a broad range of behaviours and is therefore too inexact to use for research purposes. Similarly, a term such as *generous*, while appropriate to use in everyday conversation, is too imprecise for research purposes because generosity can be demonstrated in many different ways, such as donating money to a charity, volunteering to coach a junior sports team, spending time with a friend facing illness or difficult times, and so on.

Researchers overcome this problem by defining their subject matter in terms of the way they observe or measure it. In other words, psychologists define *what* they are measuring by describing precisely *how* they are measuring it. The resulting definitions are called operational definitions. An **operational definition** defines an observable event in terms of the procedures (or 'operations') used to measure that event.

Consider, for example, a researcher who is interested in the conditions under which a rat turns left rather than right in a maze. It may seem like a relatively simple matter to determine the direction that a rat turns in a maze. But what exactly is a *turn*? What will the researcher *observe*? How will the researcher *measure* the turn of a rat in a maze? Will sticking its nose around the corner be considered a turn? What if it gets most of its body around the corner and then scoots back? Does the rat's tail have to make it all the way around? As basic as it may seem, the researcher would have to operationally define a *turn in a maze* by specifying exactly how it will be measured. For the purposes of this study, the operational definition of a *turn* might be 'when a rat's tail makes it all the way around a corner'. And, for the examples of *crime* and *generous* referred to previously, *crime* might be operationally defined as 'any act listed as a felony by Australian law', and *generous* might be operationally defined as 'donating more than 5% of one's annual salary to charity'.

Figure 1.11 A researcher will operationally define a *turn in a maze* by specifying exactly how it will be measured.

Operational definitions are particularly useful when mental processes are considered. For example, terms such as *memory*, *learning*, *intelligence*, *anger*, *happiness* and *love* are too general and can have multiple meanings. However, by using operational definitions, the terms can be clearly spelt out in ways that are testable and measurable. *Memory* might be operationally defined as a score on a test of free recall, *learning* in terms of the reduction in the number of errors when performing an unfamiliar task, *intelligence* in terms of a certain score on a standardised intelligence test, *anger* in terms of measurable changes in some physiological processes such as blood pressure and heart rate, and *love* in terms of the frequency of expressions of affection such as kissing, touching and cuddling. In all these examples, there are responses that can be observed (seen) and measured (counted).

Learning Activity 1.3

Review questions

1. Define the term research hypothesis.
2. In what key ways does a hypothesis used in experimental research differ from a hypothesis used in non-experimental research?
3. Why is the hypothesis used for experimental research sometimes referred to as an operational hypothesis?
4. List the key characteristics of a hypothesis used for experimental research.
5. Suggest a way that each of the following concepts could be operationalised: forgetting, aggression, crowding, anxiety, relaxation, stress.
6. Write an experimental research hypothesis for each of the following topics:
   a. Anxiety causes forgetting.
   b. Crowding increases aggression.
   c. Relaxation minimises stress.

Learning Activity 1.4

Constructing experimental research hypotheses

Construct an experimental research hypothesis for three of the following questions, ensuring that you operationalise the IV and DV.

- Does the offer of an incentive result in greater motivation to succeed?
- Is driving ability affected by the amount of sleep deprivation an individual experiences?
- What is the effect of rote learning of information on a person's ability to recall that information when needed?
- Is our ability to play well in a sports match impaired if we are too anxious?
- Does being permitted to take a bottle of water into an exam improve performance on that exam?

Box 1.6

Research hypothesis versus theory

A research hypothesis is different from a theory. A **research hypothesis** is a specific, testable prediction about the relationship between two or more variables. In contrast, a **theory** (sometimes called a *model*) is a set of ideas that are proposed to describe and explain a set of observations and the relationships between them. A psychological theory explains how and why certain things occur, usually on the basis of scientific evidence.

Theories vary in scope, complexity and detail. Some theories are essentially a hypothesis that has been restated, whereas other theories explain many interrelated research findings and ideas. Along with explaining existing results, a useful theory generates new hypotheses and guides further research. Many theories of personality, intelligence, sleep, learning, remembering, forgetting, and so on, are the products of psychological research and/or have generated valuable research.

Whatever their scope—from tiny to vast—theories serve a gap-filling function; that is, they state how findings and ideas fit together and what they mean, thereby making science more than the reporting of isolated facts. Psychologists prefer *testable* theories. These are theories that can be confirmed or rejected by further scientific research.

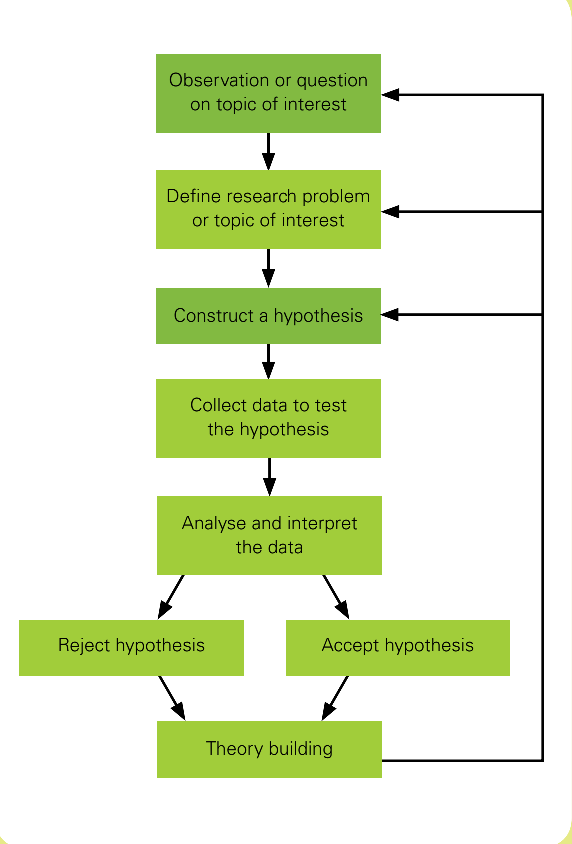


Figure 1.12 Theories are expanded and revised to reflect relevant research findings. New or revised theories lead to new observations or questions that stimulate new research.

Extraneous variables

In an experiment, the researcher predicts that manipulating the IV will cause a change in the DV. If a change in the DV is found, the researcher would like to conclude that the change is due *solely* to the influence of the IV. In order to draw such a conclusion, it must be shown that all other variables that could have influenced what is being measured (the DV) have been controlled, minimised or eliminated. Other, or 'extra', variables in an experiment are called extraneous variables.

An **extraneous variable** is any variable other than the independent variable that can cause a change in the dependent variable and therefore affects the results of the experiment in an unwanted way. Extraneous variables are 'unwanted' because they can make it difficult for the researcher to conclude that any change in the DV was caused solely by the presence of the IV and not some other variable. The researcher tries to control extraneous variables by using procedures that will minimise their influence to an acceptable level. Consequently, the researcher attempts to identify all relevant extraneous variables when designing an experiment. A 'relevant' extraneous variable is one that is believed to have the potential to cause a change in the DV.

Confounding variables

Sometimes the researcher cannot be certain whether the IV or some extraneous variable caused the change in the DV. A **confounding variable** is a variable other than the IV that has had an unwanted affect on the DV, making it impossible to determine which of the variables has produced the change in the DV. It is called a confounding variable because its effects are confounded, confused or 'mixed up' with those of the IV, thereby preventing the researcher from concluding that the IV alone caused the change in the DV. The presence of one or more confounding variables does not necessarily mean that the IV did *not* cause the change in the DV. However, the presence of a confounding variable suggests that there may be one or more alternative explanations for the results obtained in the experiment. The more alternative explanations there are for the results, the less confident the researcher will be that the IV was responsible for the specific outcome.

As an example of the importance of controlling all variables in an experiment, consider what happened when the Pepsi-Cola Company conducted a taste test. Coca-Cola® drinkers were asked to taste each of two unidentified cola drinks and indicate which of the two they preferred. The drinks were Coca-Cola and Pepsi. The brand of cola was the independent variable, and the participants' taste preference was the dependent variable. To prevent the participants from knowing which cola they were tasting, they were given Pepsi in a cup labelled M and Coca-Cola in a cup labelled Q. The results showed that most of the participants preferred Pepsi.

The Pepsi-Cola Company proudly advertised this as evidence that even Coca-Cola drinkers preferred Pepsi cola. But, to test the findings, the Coca-Cola Company repeated the experiment, this time filling both cups with Coca-Cola. The results showed that most of the participants still preferred the cola in the cup labelled M. It seems that the Pepsi taste test had not demonstrated that Coca-Cola drinkers preferred Pepsi. It had demonstrated that Coca-Cola drinkers preferred the letter M to Q. The letters were an uncontrolled variable that had an unwanted effect on the dependent variable (taste preference). Consequently, it remained unclear as to whether the independent variable (the kind of cola) or the unwanted variable (in this case the confounding variable of the letters) had affected the dependent variable (taste preference).

A confounding variable is different from an extraneous variable. A confounding variable produces a measurable change in the IV. This change is consistent with what was predicted in the hypothesis, whereas an extraneous variable may or may not affect the DV. What both types of variables have in common is that they cause problems for the researcher in isolating the real effect of the IV.

An experiment with uncontrolled variables compromises the interpretation of the results. The more alternative explanations there might be for an observed result, the less confidence a researcher will have in their research hypothesis, which states that the independent variable *will* be the cause of a particular result. Because human behaviour is complex and often has multiple causes, good experimental design involves anticipating possible extraneous and confounding variables and developing strategies to minimise their influence or ensuring extraneous variables do not become confounding variables.

Learning Activity 1.5

Review questions

1 Define the meaning of the terms extraneous variable and confounding variable.

2 In what key way are extraneous and confounding variables similar and different?

3 Give two reasons to explain why it is essential to control extraneous and potential confounding variables in research.

4 A researcher is planning an experiment to investigate the rate of forgetting (how much time it takes) and amount of forgetting (how much information) that occurs when new information (e.g. a list of nonsense 'words' such as *qab* and *jir*) is learned.

- **a** Identify the IV(s) and DV(s).
- **b** Identify two extraneous or potential confounding variables that could affect the DV (in addition to the IV) and therefore need to be controlled.
- **c** Suggest a way that each variable referred to in part (b) could be controlled.

5 An experiment was conducted to test whether people make fewer errors in detecting spelling errors in an interesting text than in a boring one. Two groups of randomly selected and allocated participants were used. Group 1 looked for errors in a physics text on string theory (a boring task) and Group 2 looked for errors in the script of a *Twilight* movie (an interesting task). The results showed that Group 1 detected significantly fewer spelling errors than did Group 2.

Identify the IV, DV and a potential confounding variable in the experiment. Explain your choice of confounding variable (answers on page 823).

Identifying extraneous and potential confounding variables

Researchers have described different types of variables that can be identified as extraneous or potential confounding variables in an experiment. These include *individual participant differences*, *demand characteristics*, *placebo effects*, *experimenter effects*, *order effects*, *artificiality* and the *use of non-standardised instructions and procedures*. We consider each of these in turn, and then ways that experimenters attempt to minimise their influence or control them.

Individual participant differences

The differences in personal characteristics and experiences of the individual participants in an experiment are commonly referred to as **individual participant differences** or *participant variables*. These variables that make one individual different from another are expected by the researcher and include age, biological sex, intelligence, personality, memory, educational background, economic background, ethnicity, cultural background, religion, motivation, emotional state, mood, problem-solving ability, self-esteem, social skills, physical health, coordination, prior experience with materials or tasks to which they will be exposed in the experiment, and so on.

Each of these variables, and many other specific participant characteristics and prior experiences, can affect how participants respond in an experiment. For example, mood may affect participants' responses and make them more or less reactive to the experimental procedures. Some participants may be more or less competitive than others, and some may pay more or less attention to instructions or tasks required of them. Thus, the researcher tries to take into account those participant-related variables that have the potential to impact on the DV (in addition to the IV), and therefore possibly distort the results. For example, a researcher conducting an experiment on sex differences in aggressive behaviour after playing a violent computer game will recognise that participant characteristics such as age, personality, mood, prior experience with computers and violent computer games, cultural background and so on can also influence aggressive behaviour. Consequently, the researcher will try to ensure that the influence of these other participant variables is controlled or minimised and will do so *before* the experiment is conducted.

Demand characteristics

Suppose that you are a participant in an experiment being conducted mid-afternoon in a laboratory. The 'laboratory' is a classroom in the psychology department at a university, which looks as if most of the furniture has been rearranged or removed. A researcher wearing a lab coat and holding a clipboard and plate of biscuits walks into the room, places the plate on the table in front of you and says, 'Normal people crave biscuits at this time of day, so eat if you want to'. There is a good chance that you will eat one. Alternatively, suppose that the researcher says, 'Only people who have no self-control eat at this time, but eat if you want to'. There is a good chance that you won't. In any situation, the social and physical surroundings provide cues, or signals, that essentially 'demand' that we behave in a certain way. In research, these cues are called demand characteristics.

A **demand characteristic** is a cue expressed by the researcher or present in some aspect of the research study that communicates the kind of response that is expected from participants and leads them to believe that the research study requires, or 'demands', that they respond in a particular way. Demand characteristics guide or bias a participant's behaviour in some way. Participants rely on demand characteristics to answer such questions as 'What's really going on here?', 'What is this person trying to find out from me?' and 'What am I supposed to do?' In trying to work out what is going on and what they should do, participants may even try to guess the research hypothesis. However, participants don't necessarily respond to demand characteristics intentionally or even consciously. Despite this, demand characteristics typically result in reactions that are not valid or reliable responses to the variables under investigation (Heiman, 2002).

Consider a research study that highlights the influence of demand characteristics. American psychologists Strack, Martin and Stepper (1988) tested a hypothesis that the facial muscles used for smiling provide feedback to the brain that actually improves mood. In other words, being happy makes you smile, but then smiling makes you even happier. To test the hypothesis, they measured the dependent variable of mood after participants had held a pen in their mouths, either using their teeth (which mimics smiling) or using their puckered lips (which does not mimic smiling). Imagine that you are in this experiment, sitting in a room with a pen sticking out of your mouth, with a psychologist watching you. What would you be thinking and feeling, and how would that influence what you said and did? Would you really react naturally? If your answer is 'no', it is because of the experiment's demand characteristics (Heiman, 2002).

American social psychologist Martin Orne (1962) was one of the first researchers to scientifically study demand characteristics and describe the concept as an extraneous variable that can influence the results of a research study, particularly in experimental research. Orne and his research assistants developed a set of tasks that he believed most people would refuse to do, or would do only for a short period of time. According to Orne, 'the tasks were intended to be psychologically noxious, meaningless, or boring, rather than painful or fatiguing'. For example, one task involved additions of rows of random numbers on a sheet of paper. In order to complete just one sheet, participants were required to perform 224 different additions. A stack of about 2000 sheets was presented to each participant, which was clearly an impossible task to complete. After the instructions were given, the participants' watches were taken away and they were told to continue working until they were told to stop. 'Five and one-half hours later, the experimenter gave up!', amazed that the participants had conscientiously stuck to the task without question (Orne, 1962). In a variation of the task, which was designed to be more frustrating, participants were asked to do the additions on each sheet, then tear up their answer sheet into at least 32 pieces before continuing with the next one. Again, participants tended to continue for several hours at this completely meaningless task. All persisted without question, complaint or hostility, simply because they were 'in an experiment'.

Orne argued that one reason participants willingly do things in a research study that they would not normally do is because of *social desirability*; that is, because of their desire to provide socially acceptable responses. Essentially, participants adjust their responses so that they won't appear strange or abnormal. Participants tend to do their best to be 'good participants' so as to not 'upset' the experimenter and consequently be viewed in a negative way.

Box 1.7
Participants' roles in experiments

Malim and Birch (1998) have reported four distinct roles that participants adopt in experiments:

- *The 'faithful' participant* tries to react to the experimental conditions as naturally as possible, either deliberately or out of disinterest.
- *The cooperative participant* tries to work out the hypothesis being tested in order to help support it.
- *The negativistic participant* tries to work out the hypothesis and what the researcher hopes they will do so that they can do the opposite or give obviously 'silly' replies.
- *The apprehensive participant* believes that the researcher is out to discover some hidden truth about them, and makes every effort to avoid a negative evaluation of themself.

Box 1.8
The Hawthorne effect

In a series of well-known experiments over a period of five years, Roethlisberger and Dickson (1939) tested different ways of increasing productivity among employees at the Western Electric Company's Hawthorne plant in Chicago, USA.

At various times the employees were subjected to different work conditions such as shorter working periods, longer working periods, long rest breaks, short rest breaks, better lighting conditions, poorer lighting conditions, and work incentives such as bonus payments. Under most of these conditions, it appeared that productivity increased. This observation led to a conclusion known in psychology as the *Hawthorne effect*—that if participants are aware that they are members of an experimental group, performance may improve simply because of that fact (rather than because of the independent variable—or experimental treatment—to which they are exposed).

Some psychologists believe that the Hawthorne effect is best described as the *Hawthorne defect*. This is because follow-up research suggests that

Figure 1.13 These workers took part in one of the Hawthorne experiments.

many of the original Hawthorne experiments did not actually produce the increased productivity reported by the researchers. Reports of the Hawthorne study concentrated on only one of the experiments in which there was a big improvement in productivity. Nonetheless, it is possible that participants' knowledge of being in an experiment may affect the results in an unwanted way, and researchers make every effort to control this unwanted influence.

Learning Activity 1.6

Review questions

1. a. In what way can individual participant differences be a source of extraneous or potential confounding variables? Explain with reference to an example not used in the text.
   b. A researcher is planning to conduct an experiment to test the influence of amount of time spent studying on exam performance. Identify three potential confounding variables in this experiment, other than demand characteristics, and explain your choice of each variable.
2. a. Explain the meaning of the term demand characteristic with reference to an example.
   b. Why do demand characteristics need to be controlled in research?
   c. Consider Figure 1.14. How can the behaviour of people in demonstrations of stage hypnosis be explained by demand characteristics? Suggest another type of 'stage demonstration' that may depend on demand characteristics.
   d. A researcher delivers different speeches intended to make participants more or less racist. Then, the researcher measures their racist attitudes using a questionnaire titled 'Questionnaire on racist attitudes'.
      i. What demand characteristics are likely and how might they influence participants' responses?
      ii. How could you control or minimise the influence of demand characteristics in this research study?
3. Identify the IV and DV in Orne's 1962 study on demand characteristics.
4. Suggest a way of controlling or minimising the influence of participant-related variables such as individual differences and demand characteristics in experimental research.

Figure 1.14 Under hypnosis on stage, this woman becomes rigid as a board. How can this behaviour be explained by demand characteristics?

Placebo effect

In medicine, the *placebo effect* refers to an improvement in health or wellbeing due to an individual's belief that the treatment given to them will be effective. The placebo effect is evident when a patient recovers from an illness or pain after they have been given a substance or a treatment that has no actual medicinal or therapeutic value, such as a 'sugar pill' or fake injection. This inactive substance or treatment is called a *placebo*. The mere suggestion to the patient that they have received, or will receive, some kind of treatment is often sufficient to minimise or eliminate the symptoms. For example,

"If this doesn't help you don't worry, it's a placebo."

Figure 1.15

some people begin to feel better if they are put on a waiting list for treatment, as compared with how they might feel if they were not on a waiting list.

In an experiment, the **placebo effect** occurs when there is a change in the responses of participants due to their belief that they are receiving some kind of experimental treatment and they respond in accordance with that belief. For example, in a simple experiment to determine the effects of alcohol on driving performance, an experimental group and a control group could be used. Participants in the experimental group would be given an alcoholic drink before a driving test in a simulator and participants in the control group would not drink any alcohol before completing the test. Suppose that the experimental group makes many more driving errors than the control group. Although the researcher would like to conclude that the difference was due to alcohol consumption impairing performance of the experimental group, such a conclusion would not be valid.

The problem is that alcohol consumption may have not been the only variable that adversely affected performance of the experimental group. The act of being given an alcoholic drink by a researcher might have promoted demand characteristics. For example, experimental group participants might have perceived that they were given alcohol because they were expected to act drunkenly, so they did. Consequently, they may have driven as if they were drunk and made more driving errors. Furthermore, because the experimental group received the alcohol and the control group did not, only the experimental group experienced the accompanying demand characteristics. This means that a confounding variable is present—the researcher cannot be certain whether it was the effects of alcohol or demand characteristics that caused the performance difference.

Experimenter effects

Participants are not the only ones who bring expectations to the research setting. Researchers do as well. Their expectations may cause them to unintentionally influence participants' responses.

Researchers must control not only undesirable influences associated with the experimental procedures and the participants, but also undesirable and usually unintentional influences associated with themselves. An **experimenter effect** occurs when there is a change in a participant's response due to the researcher's (experimenter's) expectations, biases or actions, rather than to the effect of the independent variable. An example of an experimenter effect is called experimenter expectancy.

Experimenter expectancy involves cues the researcher provides about the responses participants should give in the experiment. These cues are demand characteristics sourced from the researcher. Research studies have found that specific types of cues from the researcher can produce a self-fulfilling prophecy. A *self-fulfilling prophecy* occurs when the researcher obtains results that they expect to obtain due to cues they provide rather than the IV. The actions of a researcher that might promote a self-fulfilling prophecy include facial expressions (such as smiling at participants in one group but not at those in another), mannerisms (such as shaking hands with participants in one group but not with those in another) or tone of voice (such as speaking in a monotone voice to participants in one group and in a more lively way to those in another).

American psychologists Robert Rosenthal and Lenore Jacobson (1968) demonstrated how experimenter expectancy can promote a self-fulfilling prophecy in a well-known study involving teachers and schoolchildren. They found that primary school teachers' expectations of the performance of their students affected how well the children actually performed. Students whose teachers were led to believe that they were fast learners performed better than students whose teachers were led to believe that they were slow learners. Yet the students hardly differed in their initial learning abilities.

The experimenter effect involves not only the expectations and cues or actions of the researcher that influence participant responses in research settings, but also unintentional biases in the collection and treatment of data. This kind of experimenter effect is commonly referred to as *experimenter bias*. Studies have found that when the person measuring the dependent variable is aware of the purpose or hypothesis of the experiment, it is possible on some occasions for them to do such things as misread data, misperceive a rat's reaction in a maze, misinterpret a participant's verbal response, or give unintentional assistance to participants. This is more likely when the researcher wants a particular pattern of data, a particular verbal response from a participant, or for a rat to take a particular turn in a maze. These are not examples of intentional dishonesty. They are examples of unintentional errors that can be made in collecting and analysing data because of a researcher's close involvement with their study (Gerow, 1992).

Learning Activity 1.7

Review questions

1 **a** Define the term placebo effect with reference to an example not used in the text.
 b Is the placebo effect a demand characteristic? Give a reason for your answer.
 c Explain why the placebo effect is a potential confounding variable.

2 **a** Define the meaning of the term experimenter effect.
 b What is experimenter expectancy and how can it produce
 i a self-fulfilling prophecy?
 ii experimenter bias?
 c Explain why experimenter effects are potential confounding variables.

3 Suggest a way of controlling or minimising the influence of
 a placebo effects
 b experimenter effects.

Order effects

In some experiments, participants are exposed to more than one treatment condition (IV) and they may be required to perform the same type of task twice or even many times under different treatment conditions. For example, in an experiment to determine the effects of alcohol on driving performance, the *same* group of participants may be exposed to one treatment condition (or IV) for which they do not drink any alcohol before a driving test in a simulator (a control condition). After a short break, the participants may then be exposed to another treatment condition (or IV) for which they are given an alcoholic drink before completing the test. The order or sequence in which these conditions are administered can be a problem in this type of experimental design (called a *repeated-measures design*).

An **order effect** occurs when performance, as measured by the DV, is influenced by the specific order in which the conditions, treatments or tasks are presented. Basically, performing one task affects the performance of the next task. Order effects may change or confound the results so that the impact of the IV may appear to be greater or less than it really is. Two types of order effects that illustrate how this can occur are called practice effects and carry-over effects.

Practice effects are the influence on performance (the DV) that arises from practising a task. For example, the participants' performance in the alcohol experiment may be influenced or partly determined by practice. Through practice in the driving simulator, participants may get better at the driving task and perform better on the driving test due to greater familiarity with the simulator and its controls, or by anticipating stimuli designed to cause driving errors that were presented during the first driving test. Participants' responses can also be influenced by fatigue and their performance may get worse as the experiment proceeds due to tiredness. Similarly, their performance may be influenced by boredom due to repeating the same task again, especially if the task takes a long time and is repetitive. Boredom is quite common in experiments in which participants are required to complete multiple trials or tests.

Carry-over effects are the influence that a particular treatment or task has on performance in a subsequent treatment or task that follows it. For example, if alcohol was administered first in the driving simulator task and the task is then repeated without alcohol (in the control condition), a carry-over effect would occur if insufficient time was allowed for the effects of the alcohol in the first condition to wear off. Similarly, if one treatment (such as taking a test in a driving simulator) happens to be very easy, difficult, frustrating or even anxiety-provoking, the feeling may 'carry over', lowering performance during the next treatment (driving in the simulator again) in an unwanted way.

Artificiality

Psychologists often conduct experiments in laboratory settings, usually located at a university, so that the environment and procedures can be controlled and the participants' responses to the IV can be carefully observed. Volunteer participants of any age may be brought into a research laboratory to study virtually any aspect of human thinking, feeling and behaviour. Some laboratories are quite elaborate. For example, a sleep laboratory has a diverse range of technical equipment that enables researchers to monitor a participant's eye movements and brain wave patterns, record the exact time they fall asleep and get dream reports the moment they awaken. Similarly, a laboratory for studying infant–parent social interactions may be set up as a special playroom equipped with hand-picked toys, two-way mirrors, and a hidden camera and microphone so that researchers can record every word that is spoken and analyse every little detail of each participant's behaviour. Thus, in order to make certain observations, psychologists often find it necessary to simulate situations or events in a laboratory. However, the laboratory is an artificial setting. It is a human-made, 'non-natural' setting used for research purposes. This type of environment can produce responses that are distorted or do not adequately resemble how people would 'naturally' think, feel or behave when in the 'field' or real-life settings. For example, can someone sleep normally in a strange bed with metal electrodes pasted to their scalp? Will a parent and child interact in the playroom the way they do at home (Kassin, 1995)?

Laboratory-based research in psychology is often criticised because of its **artificiality**; that is, its lack of realism and differences to real-life settings. The artificiality of the environment in which a study takes place can produce demand characteristics that cause participants to react unnaturally. For example, participants sometimes use such things as random noises, changes in lighting or a broken pencil point as cues to work out what is being studied and how they should respond. More often than not, the conclusions drawn by participants are misleading or wrong (Heiman, 2002). Furthermore, artificiality can limit the generalisability of the results from the laboratory setting to real-life contexts. This means that a study conducted in a laboratory setting may be lacking in external validity.

However, too much emphasis may be placed on the setting in which a study is conducted. Many variables are impossible to study in the field or a real-world context for ethical and practical reasons. For example, Stanley Milgram's controversial studies in the 1960s on obedience to authority were criticised on the basis that they were conducted in a laboratory-based environment at a university. Participants knew they were in an experiment and, due to the artificial nature of

Figure 1.16 Stanley Milgram's controversial studies on obedience to authority were criticised on the basis of their artificiality as they were conducted in a laboratory-based environment. The photo shows an obedient research participant administering a shock.

the environment, may have responded differently to how they would have acted in similar circumstances in real life. For example, they may not have administered electrical shocks at deadly levels, if at all. Milgram recognised the limitation of his university laboratory setting by conducting further studies in a more realistic setting (a shopfront location in the community outside the university). He subsequently obtained a similar overall pattern of results to those observed in the 'artificial' laboratory setting. Such a study would be virtually impossible to conduct in a truly real-life context, and although the study was ethically questionable, it was better to examine the type of obedience involved in a controlled environment.

Use of non-standardised instructions and procedures

The instructions and procedures used by the researcher can also impact on how participants respond, and therefore the results. For example, suppose that the researcher is interested in studying factors influencing the reaction time of helicopter pilots when flying over a hostile war zone at night. The researcher sets up an experiment in which participants perform a task involving detection of the blink of a faint red light in dark room as quickly as possible. Imagine how the results could be affected if 20 individual participants received different instructions on what the experiment is about, what they are supposed to do, whether they can sit or stand, how much time they have to respond, and so on. Furthermore, what if some participants complete the task early in the morning and others late at night (and may therefore be more or less alert than other participants)? Or what if some participants complete the task in a room with 'darker' conditions than another room used for other participants?

Generally, *procedures* involve everything the researcher does in conducting their research study, including selection of participants, instructions for participants in different groups, interaction with participants, use of materials or apparatus, use of rooms or other experimental settings, observation and measurement of variables, data-recording techniques, and so on. Procedures not only involve what the researcher does but also how the relevant research activities are conducted, including their sequence. When the research procedures are **non-standardised**, this means that they are not uniform or the same for all participants (except for exposure to the IV by participants in the experimental group). Even small variations in procedures may affect participants' responses in unforeseen ways. An experiment that uses non-standardised procedures is not strictly controlling all of the procedures, and therefore is a source of extraneous and potentially confounding variables that can influence the DV and therefore the results.

Learning Activity 1.8

Review questions

1. a Explain the meaning of order effect.
   b Distinguish between practice effects and carry-over effects with reference to how these order effects can lead to higher or lower scores on a measure of the DV.
   c Explain why order effects are potential confounding variables.
2. a Explain the meaning of artificiality in relation to experimental research.
   b In what way is artificiality a potential confounding variable?
3. a Explain the meaning of the term non-standardised.
   b Give an example of an instruction to participants and one or more experimental procedures that would be considered to be non-standardised.
   c Explain why non-standardised instructions and procedures are potential confounding variables.

Ways of minimising extraneous and confounding variables

In conducting an experiment, the researcher will approach the task in a systematic way, controlling the variables under investigation in order to observe and measure what happens, and to control or minimise the influence of variables other than those being tested that might influence the results. The extent to which extraneous and potentially confounding variables are anticipated and controlled determines the quality of an experiment and the validity and reliability of the results obtained.

One of the most common sources of extraneous and confounding variables is the participants themselves and the unique combination of personal characteristics they each bring to an experiment. In order to control or minimise the effects of participant-related variables, researchers ensure that the groups of participants in the experiment are as similar as possible in characteristics that are believed to be relevant to the experiment. We consider different ways of how this is achieved through procedures for selecting participants and allocating them to the different conditions of the experiment.

Participant selection and allocation

The people used in an experiment or any other kind of research study are called **participants**. The way participants are selected for a research study and how they are allocated, or assigned, to different groups in the study are very important features of experimental research and in interpreting the results obtained from the study. For example, suppose a psychology lecturer at a university wanted to find out which of two teaching methods is more effective. The lecturer teaches two first-year psychology classes, one that starts at 8 am and one that starts at 4 pm. The lecturer uses one teaching method for the morning class and a different method for the afternoon class. At the end of the semester, the lecturer finds that the final examination scores are higher for the morning class. The researcher concludes that from now on they will use that particular teaching method for all classes. Is this a valid or legitimate conclusion to draw on the basis of the results obtained from the research?

The problem is that the two groups of participants might not have been the same in terms of personal characteristics that may have influenced the results. For example, people who enrol for lectures that start at 8 am may differ in some ways from those who enrol for a 4 pm lecture. Some people prefer to get up early, while others like to sleep late. Perhaps some students have commitments, such as part-time jobs or other activities scheduled late in the afternoon, that prevent them from enrolling in the 4 pm class. For many reasons, the students in the two classes may not be sufficiently alike in personal characteristics that are relevant to the study. Therefore, it cannot be concluded with confidence that the differences in the two groups' examination scores were caused solely by the difference in teaching methods (Carlson & Buskist, 1997).

Participant selection

The process of selecting participants for a research study is called **sampling**. The participants who are selected and used in the research are said to form the sample. A **sample** is a group that is a subset or portion of a larger group chosen to be studied for research purposes.

Sampling is a very important part of the research process. It is usually undertaken with the goal of being able to use the participants in the sample to make inferences about a larger group known as the population. This is not unlike the goal of a medical researcher who analyses a sample of someone's blood to make inferences about all of that person's blood.

The term **population** is used in psychological research to describe the larger group from which a sample is drawn. The sample should mirror, or be representative of, the entire population of interest. In scientific research, the term 'population' does not refer to all the people in a particular country or to the whole human race. It refers to a particular group who has one or more characteristics in common; for example, all VCE students, all VCE students enrolled at a particular school, all females, all females with diagnosed schizophrenia who are patients in a hospital, all left-handed males, all nurses aged 25 to 30 years, all cigarette smokers, all twins, all four-year-old twins, or all four-year-old twins born at a particular hospital.

'Population' can also refer to a measurement of any phenomenon; for example, all EEG (brain wave) recordings for an individual during a certain period of time, the IQs of all students in a particular school, all drug-related deaths reported by the coroner in the previous 12 months, all absences from a workplace in a ten-year period due to a stress-related illness, all the days on which the temperature exceeded 30°C, all the words in the English language, or all of any other specified data.

A sample is always a subgroup of the population. Therefore, it is always smaller than a population. When studying people, psychologists can rarely be certain about any mental process or behaviour that occurs in a population because they can rarely study all members of a population—it's usually too large a group. Consequently, researchers draw a sample from a population appropriate for their hypothesis and attempt to generalise or apply the results obtained for the sample to the population from which the sample is drawn. It is important therefore that the sample accurately reflects, or is representative of, the population it is taken from, although this is not always possible.

There are many different procedures that psychologists can use to select a sample. Four sampling procedures are called *convenience sampling*, *random sampling*, *stratified sampling* and *random-stratified sampling*. Convenience sampling is the simplest method but is less likely to achieve a representative sample than the other procedures.

Convenience sampling

For some research studies it is not convenient, suitable or possible to obtain a representative sample. In such cases, a *convenience sample* (also called an *opportunity sample*) may be used and the researcher may use anyone who is available or present. **Convenience sampling**, or *opportunity sampling*, involves selecting participants who are readily available without any attempt to make the sample representative of a population. For example, a representative sample of illegal drug users or homeless teenagers is not often readily available. Consequently, the researcher may go to locations known to be frequented by the required participants and simply select the first individuals they meet who are in the target population and who are willing and available to participate. Similarly, a researcher conducting a study on drivers who do not obey red traffic lights at a particular intersection at a particular time would be using convenience sampling. Psychology students often use convenience sampling; for example, when selecting participants they have the opportunity to study, such as other students in their school, children at a local primary school, friends, parents or relatives.

In most cases, convenience sampling produces a *biased sample* because only those people available at the time and location of the study will have a chance of being included in the sample. If a researcher used convenience sampling at a local shopping centre, they may select only those shoppers who appear cooperative to be in the sample and ignore those who appear uncooperative. Shoppers left out of the sample might think, feel or behave differently from those who are selected in the sample, yet these thoughts, feelings and behaviours are not represented in the sample. Since a convenience sample is not representative of the target population under investigation, the data obtained can be misleading and the results of the study cannot be legitimately applied (generalised) to the entire population (and therefore have low external validity).

Despite these limitations, convenience sampling is widely used in psychology. It is quick, easy and inexpensive. Convenience sampling can also be of considerable value when conducting research to pilot, or 'test', procedures or to gain a preliminary indication of possible responses before conducting the actual study. Many researchers regard convenience sampling as an adequate sampling procedure when investigating aspects of mental processes or behaviour that are assumed to be similar in all 'normal' individuals, despite individual differences. For example, all 'normal'

Figure 1.17 Convenience sampling involves selecting participants who are readily available without any attempt to make the sample representative of a population.

adults are capable of reflecting on their personal experiences and using language to communicate what they think or feel. Similarly, all normal adults are capable of seeing, hearing and responding reflexively.

Random sampling

When used in relation to sampling and samples, random does not mean 'haphazard'. In fact, it is anything but haphazard. Nor does 'random' mean selecting participants (or allocating them to experimental conditions) according to the whims of the researcher. Using a random procedure for a sample actually involves a very careful, systematic approach or plan.

Random sampling is a sampling procedure that ensures every member of the population of research interest has an equal chance of being selected as a participant for a study (and that the selection of one participant does not influence the selection or non-selection of another). This may be done by tossing a coin or by using a lottery method such as putting everyone's name on a slip of paper, placing the slips in a container, mixing them thoroughly and then choosing some of the slips blindly.

A commonly used method for random sampling when a large number of participants is required is to give each member of the population of interest a number, then to take numbers from a *table of random numbers*, which is simply a list of numbers that have no pattern and are in no particular order. For example, suppose that you are interested in studying some aspect of student behaviour at your school and you want to collect a random sample of 20 students. You would begin by finding an alphabetical list of the students currently enrolled at your school. If there are 1000 students enrolled at the school, each student would be assigned a number, with the first student in the list assigned number 1 and the last student in the list assigned 1000. A table of random numbers (or a computerised random number generator) could then be used to produce 20 numbers that fall between 1 and 1000. The students whose numbers correspond with the numbers selected become the sample. This sampling procedure ensures that every student in the school (the relevant population) has an equal chance of being chosen to be part of the sample. As a result, it is more likely that the sample is representative of the target population and therefore inferences made about the population from the results obtained from the sample are more likely to be accurate. Computerised random number generators achieve the same results in a more efficient way.

Figure 1.18 Selecting a sample of people that fairly represents the population of research interest is a very important feature of psychological research.

If everyone in a target population (population of research interest) does *not* have an equal chance of being selected as a participant, then the sample is called a **biased sample**. Sometimes a researcher may not find it necessary or even desirable to use a random sample that is fairly representative of the population of interest. For example, a researcher interested in the language development of children may intentionally choose to undertake a case study of a child raised in a harsh, deprived environment where there was little or no opportunity to learn language, rather than studying a sample of 'average' children from a 'normal' home environment.

In table 1.2, 100 random numbers were computer generated, with 47 being the first number that was generated, 10 the second number, and so on. With reference to the example in the text, the first student selected in the sample would be the 47th student in the school list, the second student selected would be the 10th in the list, and so on.

Table 1.2 100 random numbers generated by a computer

47	113	958	780	970	553	464	936	767	23
10	220	410	818	167	792	578	197	935	188
963	389	990	846	10	673	537	790	300	577
323	362	597	32	518	232	665	802	298	103
404	860	252	631	401	191	414	624	770	26
559	193	861	383	917	650	972	997	358	878
120	459	448	472	489	823	703	871	400	671
821	617	883	21	62	130	169	274	746	84
284	981	605	372	393	656	16	516	809	610
451	141	799	687	490	628	90	155	533	912

Learning Activity 1.9

Review questions

1 **a** What is the difference between a sample and a population?
b Why is it important that a sample and the population from which it is drawn share common characteristics?

2 **a** What is convenience sampling?
b Why is convenience sampling often described as opportunity sampling?

3 **a** What is random sampling?
b Give an example of an appropriate random sampling procedure.

4 Give an advantage and a limitation of convenience sampling, as compared to random sampling.

5 Consider the newspaper advertisement shown below.
a Is this an example of convenience sampling or random sampling?
b Will advertising for research participants and using a gift voucher or incentive payment result in 'sample bias'? Explain your answer.

6 You want to compare the lifestyles of VCE students in Melbourne and Mildura.
a Define your population.
b How could you obtain a random sample from each of these populations?

7 You want to test short-term memory capacity in preschool children, teenagers and people aged over 65 years.
a Define your population.
b How could you obtain a random sample from each of these populations?

How does long-term cannabis use affect your brain and memory?

The University of Melbourne is conducting a study examining how heavy, long-term cannabis use (daily or almost daily use for 10+ years) affects the brain. There are two parts to the study: a memory testing session and a brain scanning session. Each session takes approx. two hours and participants receive $50 in Coles Myer vouchers for each session. Participants should be betw. 18–35 years old, not using other drugs or alcohol regularly, and NOT have a diagnosed mental illness.

Stratified sampling

In some research studies it is important to ensure that particular groups in a population of interest are represented in their known proportions in that population. For example, if a psychologist wanted to determine the attitudes of Australian voters to asylum seekers, they could reasonably expect that people's attitudes would differ depending on their age, sex, religion and cultural or ethnic background. Consequently, the psychologist would want to ensure that each of these groups was represented in the final sample in the same proportions that they were known to exist in the voting population. This can be achieved by using a stratified sampling procedure.

Stratified sampling involves dividing the population to be sampled into distinct subgroups, or *strata*, then selecting a separate sample from each stratum, in the same proportions as they occur in the target population. Income, age, sex, religion, cultural background, residential area and IQ score are examples of characteristics that may be used as the basis of dividing a population into strata. The stratified sampling procedure is commonly used to study psychological characteristics or attitudes that vary greatly among different subgroups of a population.

"How would you like me to answer that question? As a member of my ethnic group, educational class, income group, or religious category?"

Figure 1.19

Stratified-random sampling

Stratified-random sampling involves identifying all of the people within each stratum of research interest, then randomly selecting samples of proportionate size from within each stratum. For example, suppose you were going to undertake a research study involving volunteer participants from the VCE population at your school or college. You expect that volunteer rates may differ among students doing maths and science courses, performing arts courses and so on. You could first make separate lists of the students in each of these VCE courses at your school or college and then randomly sample from each list. If, for example, 20% of the VCE population is enrolled in a maths and science course and 10% is enrolled in a performing arts course, then the sample would also consist of 20% maths and science students and 10% performing arts students. That is, students from these courses would be represented in the same proportions in the sample as they are in the population. An outcome of this sampling procedure is that the sample can be assumed to be truly representative and unbiased. However, obtaining a stratified-random sample is usually a very time-consuming process and difficult to achieve so the procedure is not often used.

Learning Activity 1.10

Review questions

1. What are random sampling, stratified sampling and stratified-random sampling?
2. In what ways are a random sample and a stratified sample alike? In what ways are they different?
3. Suppose that you are required to determine the sleep patterns (e.g. the amount of sleep) of students at your school or college.
   a. Briefly describe a convenience sampling, random sampling and stratified sampling procedure for selecting research participants.

b Explain which of the three sampling procedures would result in the more representative sample.

c Is any of the three procedures unnecessary for this particular research? Briefly explain your answer.

4 The rating of a TV show is determined by the size of the audience who watches it. The rating is based on data from an electronic recording device attached to a TV set in a viewer's home. The device automatically records which TV show is being watched and for how long. Viewers also indicate who in the household is watching. Suppose you are responsible for determining the TV ratings of the viewing audience in Melbourne (or a regional town) for a one-week period. Briefly describe the sampling procedure you could use to select the participants who will receive a recording device. Explain how your procedure would ensure a representative sample of the viewing population.

5 Explain why each of the following research studies is likely to have sample bias:

a a survey on binge-drinking behaviour in a popular teenager's magazine

b a television or radio call-in survey

c a telephone survey at 6 pm on weeknights

d a survey at a shopping mall on a weekday in March.

6 Suppose that you need a stratified-random sample to conduct a survey on attitudes to ethical guidelines for psychological research. Construct a flow chart that summarises an appropriate procedure for obtaining a stratified-random sample of VCE students enrolled in a secondary school, college, TAFE institute, adult education centre or distance education centre.

Learning Activity 1.11

Obtaining a stratified-random sample from a packet of lollies

Use a large packet of colourful lollies, such as Smarties or M&Ms®, as the population from which a stratified random sample is to be obtained.

Step 1: Count the total number of lollies in the packet (that is, the population).

Step 2: Count the number of lollies in each colour group (that is, each stratum of the population).

Step 3: Calculate the percentage of each colour in the packet using the following formula:

$$\frac{\text{number of lollies in a colour group}}{\text{total number of lollies in the packet}} \times \frac{100}{1}$$

Step 4: Create a stratified-random sample of 20 lollies based on the percentages (that is, proportions) of each lolly colour in the packet.

Participant allocation

After participants have been selected, they have to be allocated, or assigned, to the different groups that may be used in an experiment. The allocation of participants to different groups must be completed as systematically as the selection process. This is necessary to ensure that personal characteristics of participants that may affect the results are evenly distributed across the different groups (and therefore within conditions of the experiment). The psychological experiment typically uses different groups of participants called experimental groups and control groups.

Experimental groups and control groups

In a simple experiment, the participants selected are allocated to one of two groups. One group of participants, called the **experimental group**, is exposed to the experimental condition in which the independent variable under investigation is present. A second group of participants, called the **control group**, is exposed to the control condition in which the independent variable is absent. The control group provides a standard against which the performance of the experimental group can be compared in order to determine whether the independent variable (or treatment) has caused some change in, or affected in some way, the behaviour or event being measured (the dependent variable).

It is important that the experimental group and the control group are as similar as possible in personal characteristics that might cause a change in the dependent variable. It is also necessary to treat the two groups the same, except for exposure of the experimental group to the independent variable. This is because if a large enough change occurs in the experimental group and does not occur in the control group, the researcher can conclude with confidence that the independent variable most likely caused the change and not some other factor.

Some experiments do not have an experimental group and a control group; instead, they have one group of participants who are exposed to *both* the control condition and the experimental condition. For example, to study the influence of rock music on people's concentration while driving, a group of participants could have their driving abilities tested in a simulator while there was no rock music playing (control condition). The same group would later be tested again in the simulator while there was rock music playing (experimental condition). The test results of the same group under the two different conditions would then be compared.

Figure 1.20

Random allocation

It is to be expected that individual participants will have different abilities, personality traits and other characteristics that might affect the outcome of an experiment. One way of minimising differences in the composition of the control and experimental groups is to randomly allocate, or assign, participants to the groups.

In **random allocation**, participants selected for the experiment are as likely to be in one group as the other. This means that every person to be used as a participant in the experiment has an equal chance of being selected for any of the groups to be used. Random allocation can be achieved by simply flipping a coin, drawing names out of a hat, or using some other kind of lottery method in which chance alone will determine the group to which each participant is allocated. With a sufficiently large number of participants, it is reasonable to assume that each group will contain about equal numbers of participants with personal characteristics that can affect the results.

The purpose of random allocation of participants is to obtain equivalent groups before introducing the independent variable to the experimental group(s) so that the effects of the independent variable can be estimated. With random allocation of participants to the experimental and control groups, researchers can more confidently assume that if two groups think, feel or behave differently at the end of the experiment, it is very probably due to the effect of the experiment's independent variable. Consequently, random allocation is a very important means of experimental control.

Random allocation is different from random sampling. Random allocation is used to place

Figure 1.21 Participant selection and allocation

participants in groups used in a research study, whereas random sampling is used to select participants for the research study.

Learning Activity 1.12

Review questions

1. What is the main difference between participant selection and participant allocation?
2. What is random allocation and why is it used in an experiment?
3. How are random allocation and random sampling different?
4. **a** What is an experimental group? A control group?
   b Why is a control group used in an experiment?

Learning Activity 1.13

Practical activity on testing random allocation

The following activities enable you to test whether random allocation actually produces groups that are alike in participant characteristics.

A Collect data on the heights (in centimetres) of about 60 volunteer students, preferably in Year 9 or 10 and preferably all of the same sex. Each student in your Psychology class can help to collect the data.

Record each participant's measurement on a separate card and randomly allocate these cards to three groups. Then, calculate the mean height for each group. The means for groups should be quite close, indicating that random allocation has produced 'equivalent' groups.

Testing random allocation can be extended by using groups of different sizes. For example: 2, 5, 10, 15, 25, 60 students.

This test should indicate that the probability (likelihood) of obtaining groups that are not 'equivalent' actually increases as group size decreases.

B Use random allocation to divide your Psychology class into two groups with about the same number of participants in each group.

Then calculate the means of the two groups for:

- number of sporting events attended last year as a spectator
- number of hours of study (including homework) completed per week
- number of movies seen at a cinema this year
- three other events or personal characteristics suggested by students in the class.

Compare the means of the two groups. Did random allocation ensure equivalence of the two groups? Explain your answer.

Counterbalancing

A counterbalancing procedure is commonly used to control or minimise order effects such as practice and carry-over. **Counterbalancing** involves systematically changing the order of treatments or tasks for participants in a 'balanced' way to 'counter' the biasing influence or unwanted effects on performance of any one order. By counterbalancing, the researcher recognises that an order effect is a potential confounding variable and cannot be controlled or eliminated through other means. Two types of counterbalancing can be used. These are called between-participants and within-participants counterbalancing.

The *between-participants counterbalancing* procedure involves counterbalancing the order in which the groups of participants are exposed to the experimental conditions. Each group of participants receives the treatments in a different order. For example, if there were 20 participants in the alcohol and driving experiment, counterbalancing could require half the participants to undertake the driver test in the no alcohol condition first, followed by the driver test in the alcohol condition. The other half of the participants would undertake the driver test in the alcohol condition, followed by the no alcohol condition. Participants would also be randomly allocated to experience one condition or other first or second. The results for all participants are then combined across the entire experiment to achieve counterbalancing. In this way, whatever order effects impact on performance, as measured by the DV, are controlled.

The *within-participants counterbalancing* procedure requires each participant to be exposed to the same combination of conditions. That is, each participant is exposed to the treatment conditions in one order and then again in the reverse order. For example, in the Pepsi and Coke taste testing study described earlier, participants would rate one cola first followed by the second cola, then the second cola again followed by the first cola. In this way, any order effects are held constant so that their impact is balanced out over the entire experiment.

Table 1.3 Between-participants counterbalancing procedure

Condition A (alcohol)	Condition B (no alcohol)
$P_1 - P_{10}$ (first)	$P_{11} - P_{20}$ (first)
$P_{11} - P_{20}$ (second)	$P_1 - P_{10}$ (second)

or

Condition A (alcohol)	Condition B (no alcohol)
P_1 (first)	P_1 (second)
P_2 (second)	P_2 (first)
P_3 (second)	P_3 (first)
P_4 (second)	P_4 (first)
P_5 (first)	P_5 (second)
P_6 (first)	P_6 (second)
P_7 (second)	P_7 (first)
P_8 (first)	P_8 (second)
P_9 (second)	P_9 (first)
P_{10} (first)	P_{10} (second)

Note: P = participant

Table 1.4 Within-participants counterbalancing procedure

Condition A (Pepsi)	Condition B (Coke)	Condition B (Coke)	Condition A (Pepsi)
P_1	P_1	P_1	P_1
P_2	P_2	P_2	P_2
P_3	P_3	P_3	P_3
P_4	P_4	P_4	P_4
P_5	P_5	P_5	P_5
P_6	P_6	P_6	P_6
P_7	P_7	P_7	P_7
P_8	P_8	P_8	P_8
P_9	P_9	P_9	P_9
P_{10}	P_{10}	P_{10}	P_{10}

Note: P = participant

Single- and double-blind procedures

Participants' expectations and other demand characteristics can influence the results of a study, so it is important that participants do not know whether they are in an experimental or a control group. In this case, the experiment is said to be using a single-blind procedure. It is called a **single-blind procedure** because the participants are not aware of (are 'blind' to) the condition of the experiment to which they have been allocated and therefore the experimental treatment (the IV).

To control possible experimenter effects, researchers may use a procedure in which neither the participant nor the researcher interacting with the participants knows which participants are in the experimental or control conditions. This is called the **double-blind procedure** because the participants *and* the researcher (or research assistant) directly involved with the participants are unaware of (are 'blind' to) the conditions to which the participants have been allocated. Only the researcher removed from the actual research situation knows which participants are in which condition (or 'groups'). The double-blind procedure has obvious value in experiments in which knowledge of the conditions might affect the behaviour of the researcher as well as the participants; for example, when testing the effects of a drug.

Placebos

In an experiment, participants in the experimental group are exposed to the treatment (the IV) and participants in the control group are not. Because only the experimental group receives the treatment, only the participants in this group experience the accompanying demand characteristics. Therefore, there is a potential confounding variable—the experimental group may respond differently to the control group either because of the treatment or because of the demand characteristics.

For example, suppose an experimental group is given an alcoholic drink so that its effects on performance of a task can be observed, whereas a control group receives nothing. Impaired performance observed in the experimental group may be due to the alcohol, or it may have arisen because the act of giving them alcohol suggested that they were expected to act drunkenly, so they did.

Figure 1.22 The inability of many astronauts to sleep well when on space missions led to research designed to test whether they could be helped by taking melatonin, a hormone known to have a role in sleep onset. In one experiment, half the astronauts aboard the space shuttle *Columbia* took a pill containing melatonin, and the other half took a placebo pill that looked the same but did not contain any active ingredient. All astronauts were blind as to which experimental condition they were in; that is, they did not know whether they had taken the melatonin or placebo. Shown above is one of the astronauts wearing sensors that monitored his brain activity, breathing, heart rate and other physiological functions during the sleep study.

In order to control such demand characteristics, control groups can be given a **placebo**, or fake treatment, so that they experience the same demand characteristics of the experimental group. Thus, the control group would be given a drink that smells and tastes like alcohol but is not alcohol. The control group would not be informed that their drink is not alcoholic and they would have no way of distinguishing it from a real alcoholic drink.

Using this procedure, the researcher would communicate to both groups the same demand characteristics for acting drunkenly, so any differences in performance can be assumed to be due to the real alcohol given to the experimental group. Similarly, when testing other drugs, researchers give placebo pills or injections to the control group so that all participants experience the same procedure and form the same expectations. And in studies that require the experimental group to perform, for example, a physically or mentally demanding task prior to making a response, the researcher would have the control group perform a similar placebo task to eliminate differences between the groups in terms of motivation or fatigue (Heiman, 2002).

Standardised instructions and procedures

Another way of controlling specific extraneous variables that may arise in research involves the use of standardised instructions and procedures. The goal is to minimise any differences among participants that might occur within the experiment itself.

The use of **standardised instructions** means that the instructions given to all participants for each condition should be predetermined and identical in terms of what they state and how they are administered ('given'). They should be clear and avoid jargon, and there should be no ambiguities or variations for individual participants. Generally, the researcher should describe the sequence of events, identify the stimuli participants should attend to, and explain how to respond. Questions by participants should be anticipated and the specific answers or type of response to be given by the researcher should be predetermined. To reliably present instructions, researchers usually read from a pre-prepared script (in a 'neutral' voice). The script typically contains all the information about what the researcher says and does during the experiment, beginning with greeting the participants and ending with the debriefing. The purpose of using standardised instructions is to have all participants perform the intended task in the same way, without introducing potential extraneous variables that make the task inconsistent or different for different participants. For example, if the researcher must stop during testing to further explain a task or correct a behaviour, the researcher's actions can become an inconsistency.

It is also essential that all participants are exposed to the same environment and procedures, with the only exception being exposure to the independent variable. Therefore, it is also necessary to use **standardised procedures**; that is, the techniques used for making observations and measuring responses should be identical for all individual participants and all participants should be treated in the same way, as appropriate to the experimental condition to which they have been assigned (e.g. experimental or control group). For example, in using standardised procedures, all participants would interact with the same researcher in the same environment; the experiment would be run at the same time of day for all participants; all participants would have the same amount of time, learn the same amount of information and complete the same activities except for the changes in the experimental manipulation (Stangor, 2004).

How the researcher presents stimuli, obtains responses, and assigns and records scores during the measurement task can be additional sources of inconsistency and therefore extraneous variables. One way of controlling these extraneous variables is through *automation*; that is, using electronic or mechanical devices to present stimuli and to measure and record responses. Electronic timers, data projectors, video and audio recorders, and computers ensure controlled and reliable stimulus presentations. Automating the data collection ensures that the scoring system is consistently and accurately applied and provides for more reliable and sensitive measurement. Automation also eliminates experimenter errors and inconsistencies that could result because (1) the experimenter is so busy directing the study that parts of a behaviour are missed, and (2) the experimenter has expectations about how the study should turn out and thus inadvertently influences participants or records scores accordingly (Heiman, 2002).

The use of standardised instructions and procedures can help control demand characteristics, as all participants will have the same experience. It can also help control experimenter effects, as all the researchers involved will follow the same procedures. Consequently, differences observed between groups can be attributed to the experimental manipulation (the IV) and not these other factors.

Learning Activity 1.14

Review questions

1 Explain what the counterbalancing procedure is and what it attempts to control.

2 **a** A researcher believes that the gender of participants is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

b The researcher will use a number of research assistants to conduct the study and also believes that their gender is a potential confounding variable. Explain how counterbalancing could be used to control this variable.

3 Suggest a randomisation or random allocation procedure that could be used to counterbalance order effects in an experiment.

4 Consider the experiment with school children in which Rosenthal and Jacobson (1968) demonstrated self-fulfilling prophecy (on pages 28–9).

a Briefly explain how a single-blind procedure could have been used to control this effect.

b How would a double-blind procedure be used in this experiment? Would it be necessary? Why?

5 **a** What is a placebo?
b Explain how a placebo can be used to control or minimise the influence of demand characteristics associated with the specific treatment received by participants in experimental and control groups.

6 **a** What are standardised instructions and procedures? Explain with reference to relevant examples.
b Explain how standardised instructions and procedures can be used to control or minimise the influence of demand characteristics and experimenter effects.

Learning Activity 1.15

Evaluating an experiment

Mardi conducts an experiment to find out if colour preference can be influenced by associating a colour with a pleasant experience such as eating. She delivers a supply of red, orange, yellow, green and blue feeding bottles to some mothers of newborn infants and the regular transparent feeding bottles to the mothers of other newborn infants in the sample. The mothers have consented to let their infants be participants in Mardi's experiment.

1. What is the IV in Mardi's experiment?
2. How many experimental groups does Mardi have in her experiment?
3. Which participants make up the control group?
4. What is the DV?
5. How could Mardi randomly allocate the participants to different groups?
6. Identify two extraneous or potential confounding variables that should be controlled and explain why.

Source: adapted from Sugar, J., & Offir, C. (1990). *Student resource manual* (3rd ed.). New York: Harper & Row.

Types of experimental research designs

Various experimental designs can be used to minimise the effects of extraneous variables and potential confounding variables, particularly variables associated with individual differences of participants. Three of these designs are the *repeated-measures design*, the *matched-participants design* and the *independent-groups design*.

Repeated-measures design

One way of controlling individual differences of participants is to design an experiment that uses the *same* participants in the experimental and control conditions. This is what happens in an experiment with a repeated-measures design (also called a *within-participants* or *within-subjects design*).

In the **repeated-measures design**, each participant is involved in both the experimental and control conditions of an experiment so that the effects of individual participant differences balance out exactly. For example, suppose a researcher is interested in investigating the effects of loud music on performance of a problem-solving task. Using the repeated-measures design, a group of participants would be given a problem-solving task to complete while loud music was playing, and the same group would then be tested on a similar, equally difficult problem-solving task but without the loud music playing. In an experiment with this design, each participant would experience both the loud music and no music conditions while solving similar problems. Furthermore, how well problem-solving was performed by all participants would be measured twice, once after each condition of loud music and no music respectively (hence the term 'repeated-measures'). This design would give the researcher strict control over all relevant participant variables that can influence the results, such as individual differences in problem-solving abilities and levels of motivation. Furthermore, any participant differences that may not have been identified by the researcher as potential confounds have also been controlled as the participants in both conditions are identical in every respect.

When using a repeated-measures design, the researcher has to consider order effects that may arise from the experimental design; that is, whether a problem-solving task is performed first or second. Performance on the problem-solving task that is completed second may be better

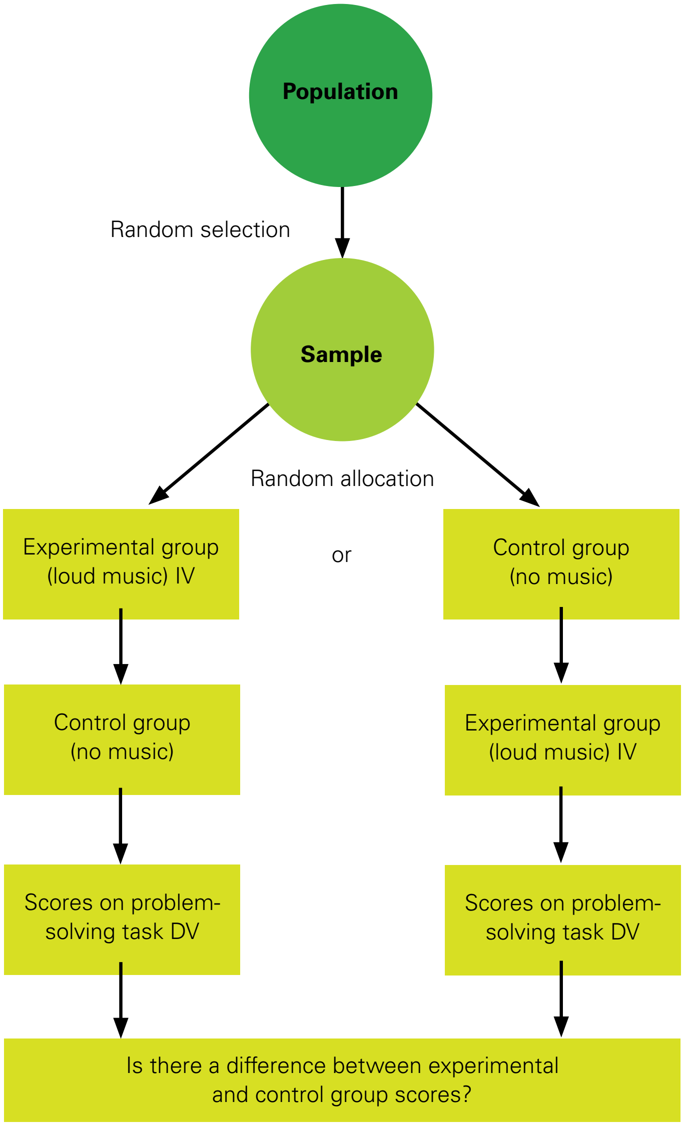


Figure 1.23 Repeated-measures design: in a repeated-measures experiment, the same participants are in both the experimental group and the control group, and are therefore observed under all conditions.

because of the experience gained in completing the first task. For example, participants may perform better when they are in the second condition because they have practised the task or have gained other useful knowledge about the task or the experiment. Alternatively, participants' performance may be impaired by effects such as boredom or fatigue, and they may not perform as well on the second occasion. In either case, the order effect is a potential confounding variable because the researcher cannot be confident about whether the independent variable or order effect caused the change that was measured in the dependent variable.

One way of dealing with order effects such as practice, fatigue and boredom is to increase the time period between the measurement of the dependent variable in each condition (in this case, completion of the problem-solving tasks). For example, participants might be in the experimental group one day then return a week later for the control condition. When this procedure is inappropriate, inconvenient or impractical, the researcher will ensure that the order in which the problem-solving tasks are performed is counterbalanced across the participants.

As shown in table 1.5, *counterbalancing* would involve arranging the order in which the conditions of the repeated-measures experiment are experienced so that each condition occurs equally often in each position. For example, half the participants would follow one order (solving a problem in the experimental condition first, then solving a problem in the control condition), and the other half would follow the reverse order (solving the problem in the control condition first, then solving the problem in the experimental condition). To further ensure control of order effects, the experimenter may ensure that the order in which each participant will be exposed to each condition is determined using a random allocation procedure. Such experimental procedures usually ensure that order effects are balanced out over the entire experiment, but there is no guarantee that this will occur.

The strength of the repeated-measures design is that it eliminates potential confounding variables arising from individual participant differences. The researcher can assume that any difference in performance on the dependent variable in each condition of the experiment should not be due to differences produced by any extraneous variable associated with individual participant differences because each participant, with the same personal characteristics, is in every condition. Another strength of the repeated-measures design is that it

Table 1.5 Repeated-measures design using counterbalancing

Participant	Experimental condition	Control condition
1	first	second
2	second	first
3	first	second
4	second	first
5	second	first
6	first	second

requires a relatively smaller number of participants when compared with other experimental designs because the same participants are in all conditions.

However, the repeated-measures design has several limitations. Although this design keeps individual participant differences constant, it does not necessarily control participant *demand characteristics* that can influence the results. For example, participants may guess what the experiment is about as they compare the two conditions, creating demand characteristics that lead to unnatural responses. Another limitation of the repeated-measures design is that it can produce substantial *participant attrition*, or loss of participants, before the experiment is completed. It is most common when the repeated measurement of the dependent variable requires a considerable amount of time per participant, so that, to reduce fatigue or overload, the researcher spreads out the time period between the different conditions over several days. Then, participants show up for the first session but do not return for the second one. It is also quite common for participants to find the first condition boring and not attend the second simply because they don't want to.

In a repeated-measures experiment, the researcher could counterbalance the order of conditions to control order effects. Half of the participants experience the experimental condition followed by the control condition, and the other half experience the control condition followed by the experimental condition. Participant allocation to different orders would also be randomised.

Matched-participants design

The **matched-participants design**, also called a *matched-subjects* or *matched-groups design*, usually involves selection of pairs of participants who are very similar in one or more personal characteristics that can influence the dependent variable, then allocating each member of the pair to different groups. The use of a matching process in terms of one or more relevant participant variables (such as intelligence, creativity, sex, age) is reflected in the name of the experimental design. Randomly allocating one member of each matched pair to different groups (or conditions) ensures that each group is fairly equivalent in terms of the spread of

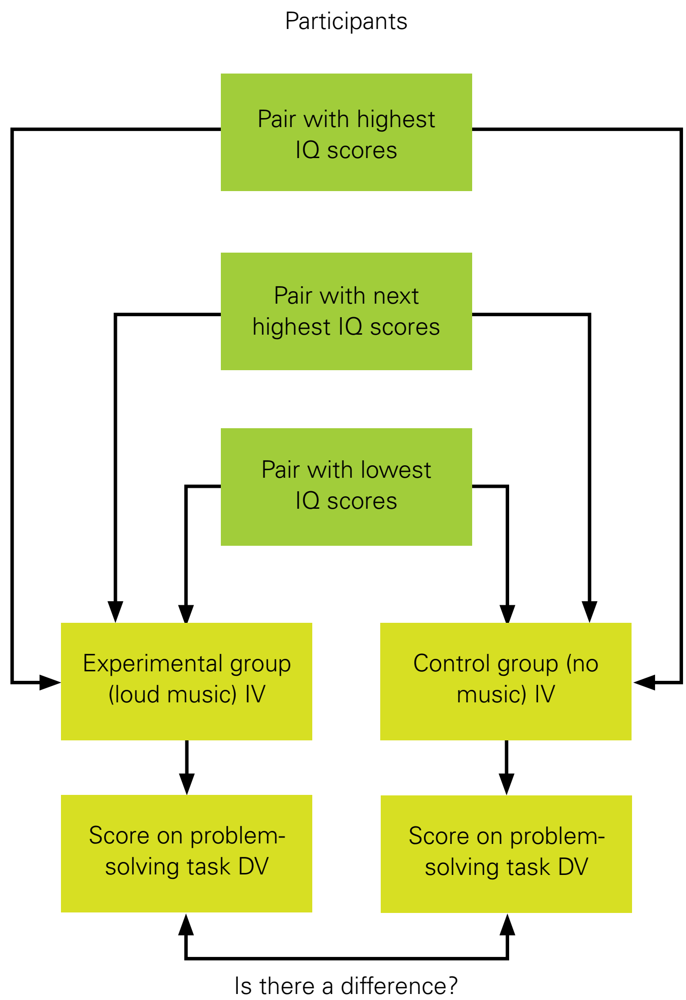


Figure 1.24 Matched-participants design: in the hypothetical experiment, all participants are given an intelligence test after being selected for the experiment.

participant characteristics that can cause a change in the dependent variable.

Sets of identical twins are best for matching participants. They have the same genetic make-up, are identical in age and sex and tend to be very similar (but not identical) in socio-cultural background, mental abilities, temperament and various other personal characteristics (but not all). In an experiment using a matched-participants design, one member of each pair of twins would be allocated to the experimental group and the other member of each pair of twins would be allocated to the control group. In this way, the experimental and control groups would be considered fairly equivalent, thereby minimising potential extraneous variables. However, identical twins are often not available.

In the loud music and problem-solving experiment, the intellectual ability of each participant could be reasonably assumed as being likely to affect their problem-solving ability. Suppose that the experimental group (loud music condition) performed poorly on the problem-solving task, as compared to the control group (no music condition). The researcher would want to be in a position to conclude that this difference in performance was due solely to the independent variable (loud music). If the experimental group had all the participants who were least intellectually able and the control group had all the participants who were most intellectually able, the experimenter would not know whether it was the loud music or the problem-solving ability of participants that caused the poor performance.

In order to avoid this problem, the researcher could administer an intelligence test to each participant after they had been selected for the experiment, but before the experiment began. The pre-testing using an intelligence test would provide an IQ score for each participant. Each participant would then be paired with someone else on the basis of a similar IQ score until all the participants had been matched on intelligence with someone else. The participants would then be allocated to a group (experimental or control condition) on the basis of their IQ scores. For example, in allocating participants to groups in the loud music and problem-solving experiment, the two participants with the highest IQ scores would be randomly allocated to the loud music and no music groups respectively. Then the two participants with the next highest IQ scores would be randomly allocated to the two groups, and so on. In this way, the two groups in the experiment would be *matched* in terms of intellectual ability, thereby controlling the influence of this extraneous variable and potential confounding variable.

The advantage of matching participants is that it ensures that in every condition there is a participant with very similar or identical scores on the variable(s) the researcher seeks to control. This means that these variables are constant across the conditions, thereby eliminating them as potential confounding variables. Participant attrition is less common than with the repeated-measures design and there is not often a need to spread out the time period between the different conditions.

There are, however, limitations to the matched-participants design. One potential problem is the difficulty of knowing which specific participant variables should be matched. Even if the researcher can identify the variable(s) that is likely to most influence performance on the dependent variable, it is often difficult and time-consuming to actually recruit participants who are sufficiently alike in the variable. There are also other practical problems. For example, to find matching participants, the researcher might have to pre-test many individuals and/or settle for a very small number of participants. Pre-testing may create order effects or communicate demand characteristics. And the loss of one participant through attrition means the loss of a whole pair.

It should be kept in mind that the use of the matched-participants design is usually not necessary in experimental research. The use of random allocation is sufficient to control individual differences of participants as it ensures equivalence of the experimental and control groups. Consequently, the matched-participants design is not often used.

Independent-groups design

In the **independent-groups design**, also called a *between-participants* or *between-subjects design*, each participant is randomly allocated to one of two (or more) entirely separate ('independent') groups. The random allocation procedure is used after participants have been selected for the experiment, but before the experiment begins. Depending on the number of participants and groups, the random allocation procedure may involve tossing a coin to decide which participant goes into each group or, in the loud music and problem-solving experiment, the loud music or no music condition (see figure 1.25). Alternatively, participants may be asked to draw a number from a container holding as many different numbers as there are participants. Those who draw odd numbers are then allocated to one group, and those who draw even numbers are allocated to another group.

The simplest independent-groups design uses two groups: typically one group as the experimental group and the other as the control group. Placing all males in one group and all females in the other group would not be a random allocation procedure. Similarly, in a classroom experiment, it would not be a random allocation procedure to assign the people seated in the front half of the room to one group and the people seated in the back half to the other group. There could be a difference in one or more personal characteristics of participants who prefer to sit at the front or back of the classroom.

Using an acceptable random allocation procedure is likely to result in two groups that are well matched on participant characteristics and therefore fairly equivalent. However, this may not necessarily be the case if there are a very small number of participants. Although random allocation does not guarantee that the participants in the different conditions are 'exactly' equivalent before the experiment begins, it does greatly reduce the likelihood of differences.

The independent-groups design is very common in experimental research. It has less control over participant characteristics than do repeated-measures and matched-participants designs, but there are no order effects to control. Participant attrition is also less common than with the repeated-measures design and there is not often a need to spread out the time period between the different conditions.

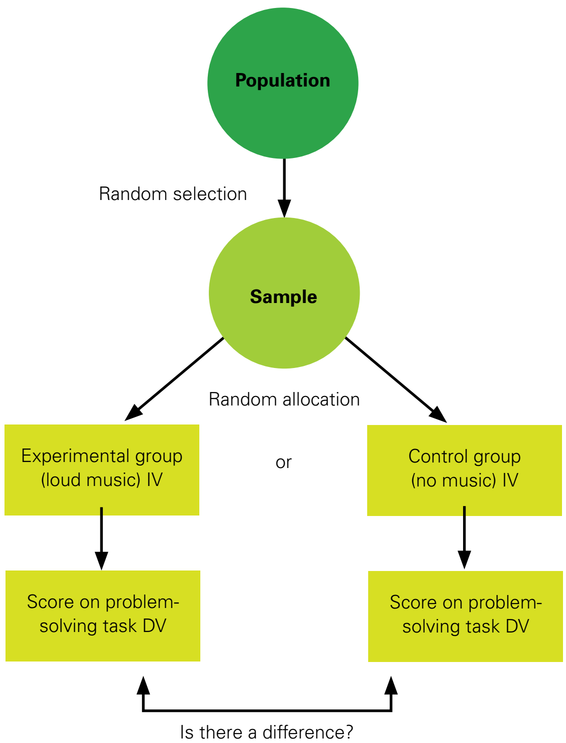


Figure 1.25 Independent-groups design: in an independent-groups experiment, participants are randomly allocated to one of two (or more) separate ('independent') groups to ensure that important participant characteristics that can cause a change in the dependent variable are uniformly distributed across the groups.

Table 1.6 Three experimental designs

Experimental design	Feature
Repeated-measures	Each participant is involved in both the experimental and control groups; that is, all conditions of the experiment.
Matched-participants	Pairs of participants are matched on the basis of an important characteristic(s) that can influence the DV, then one member of each pair is randomly allocated to either the experimental or control group to ensure the groups are equivalent.
Independent-groups	Each participant is randomly allocated to either the experimental or control group and is in one group only.

Box 1.9

Correlational research

In an experiment, the researcher manipulates one or more independent variables in order to establish whether a change in the IV(s) brings about a change in the DV(s). If strict experimental control is maintained, a cause–effect relationship between an independent variable(s) and dependent variable(s) can usually be established. Sometimes, however, the experimental method is impractical or inappropriate to use. For example, suppose a psychologist wanted to find out how a severe emotional trauma in childhood affects school performance. It would be unethical to set up two similar groups of participants and expose one of these groups to the harmful experimental condition of a particular severe emotional trauma. In such cases, the researcher may choose to use existing information in order to assess the relationship, or correlation, between the variables of interest.

Correlational research is used to identify and describe the 'co-relationship' between two variables of interest. No attempt is made to manipulate any variable, such as in an experiment. The researcher simply assesses the degree of relationship between two variables. **Correlation** is a statistical measure that indicates the extent to which two variables are related; for example, the relationship between stress and cancer, between level of anxiety and incidence of bedwetting, or between personality test scores and birth order. Correlation does not indicate that one variable causes another. Rather, it indicates whether a relationship exists, the strength of the relationship and direction of the relationship (e.g. as one variable increases, is the other likely to increase or decrease?).

For any two variables there are three possible relationships between them: positive, negative and zero (no relationship). A *positive correlation* means that two variables vary in the same direction; that is, as one variable increases, the other variable also tends to increase. For example, as a child's height increases, their body weight tends to increase (and as their body weight increases, their height tends to increase). A *negative correlation* means that two variables vary in opposite directions; that is, as one variable increases, the other variable tends to decrease (like a seesaw). For example, as the amount of alcohol in the blood increases, reaction time tends to decrease (and as reaction time increases, amount of alcohol in the blood tends to decrease). It is said that there is a *zero correlation* or little or no relationship between two variables if the way that they vary is totally independent of each other. For example, there is no relationship between height and VCE grades.

A correlation is often described by a number known as a correlation coefficient. A **correlation coefficient** is expressed as a decimal number, which can range from +1.00 to –1.00. This number indicates the strength and the direction of the correlation. The plus or minus sign describes the *direction* of the relationship between the two variables; that is, positive or negative. A correlation coefficient preceded by a plus sign is called a positive correlation. This means that high scores for one variable tend to go with high scores on the other, middle scores with middle scores, and low scores with low. For example, if there is a high positive correlation (e.g. +0.75) between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation should tend to be good problem-solvers (i.e. they would solve many problems in a 20-minute period) and people with slow dilation would tend to be poor problem-solvers (i.e. they would solve fewer problems in a 20-minute period). A correlation coefficient preceded by a minus sign is called a negative correlation. This means that when a score on one variable is high, the score on the other tends to be low, and middle scores tend to go with middle scores. For example, if there is a high negative correlation (e.g. –0.75) between the rate of pupil dilation and problem-solving ability, then people with rapid pupil dilation would tend to be poor problem-solvers and those with slow dilation would tend to be good problem-solvers.

The decimal number of the correlation coefficient describes the *strength* of the relationship between the sets of scores for two variables. A correlation coefficient that is close to +1.00 indicates a high positive correlation (i.e. very strong relationship) between two variables. A correlation coefficient that is close to –1.00 indicates a high negative correlation (i.e. very strong relationship) between two variables. A correlation coefficient that is close to 0.00 indicates little or no relationship between two variables. Correlation coefficients of +1.00 and –1.00 indicate perfect correlations but these very rarely occur.

Correlations show the existence and extent of relationships between variables but they do not necessarily indicate a cause–effect relationship—that one variable causes the other. For example, as the world rotates on its axis, people get older. There is an extremely strong correlation between these two variables but it would be faulty to assume that the earth's rotation causes people to age or that people's aging causes the earth to rotate. Although scientists know that the two variables correlate, they have not been inclined to discover a way of stopping the earth's rotation so that we stop getting older!

There are also many instances when high correlations suggest a logical cause–effect relationship, and sometimes correlations really do represent causal relationships. The amount of ink left in a pen is closely related to the length of time spent using the pen. But a significant correlation doesn't necessarily mean that there is a cause–effect relationship because both variables may be correlated with a third variable. For example, there is high positive correlation between the number of permanent teeth in children and their ability to answer increasingly difficult questions on intelligence tests. It cannot be assumed, however, that having more teeth causes increased mental ability. The correlation is high because a third variable—increasing age—accounts for both new teeth and mental development. Similarly, there is a very high correlation between the number of years spent in schooling and income as an adult. Both of these variables, however, have also been found to correlate not *only* with each other but *also* with a third variable—parents' income. When two variables are correlated, this is not accepted by psychologists as proof of causation in the absence of other empirical evidence. In such cases, researchers will test the possible cause–effect relationship by conducting a carefully controlled experiment.

Learning Activity 1.16

Review questions

1 Make a copy of table 1.6 on page 47. Add two columns, one headed 'Strengths' and the other 'Limitations'. Complete the table including at least two strengths and two limitations for each experimental design.

2 For each of the following extraneous or potential confounding variables, rank the three experimental designs from 1 to 3 to indicate the extent to which the design controls the variable, as compared to the other designs. A ranking of 1 indicates greatest control and a ranking of 3 indicates least control. If appropriate, more than one design may be given the same ranking. Explain your choice of rankings.

- **a** Individual participant differences
- **b** Demand characteristics
- **c** Order effects
- **d** Experimenter effects.

3 A researcher wants to investigate the effects on aggressive behaviour of observing violence on television. The researcher is specifically interested in the effects on young children who watch violent scenes in cartoons during after-school viewing hours.

- **a** Identify the IV(s) and DV.
- **b** Briefly describe an appropriate participant selection procedure and explain why the researcher should use this procedure.

c Briefly describe an appropriate participant allocation procedure and explain why the researcher should use this procedure.

d Identify three participant characteristics that would need to be controlled and explain your choices.

e Briefly describe how the experiment could be conducted using each of the three experimental designs. You may use a diagram such as a flow chart for each design to assist your explanation.

f Identify and explain which of the three designs would be most appropriate and which would be least appropriate for this experiment.

Learning Activity 1.17

Identifying the experimental design

Read the following summaries of experiments and indicate whether a repeated-measures, matched-participants or independent-groups design is used.

Experiment 1

A researcher is interested in the effectiveness of a particular treatment for insomnia. Fifty adult insomnia sufferers are contacted from a newspaper advertisement, and each is given a pill with instructions to take it before going to sleep that night. The pill actually contains milk powder (a placebo). The participants are randomly allocated to receive one of two instructions about the pill: half are told that the pill will make them feel 'sleepy', and the other half are told that the pill will make them feel 'awake and alert'. The next day, all the participants return to meet with the researcher and are asked to indicate how long it took them to fall asleep after taking the pill. The participants who were told the pill would make them feel sleepy reported having fallen asleep significantly faster than the participants who were told the pill would make them feel awake and alert.

Experiment 2

A researcher wants to examine the effects of massed versus distributed practice on the learning of nonsense words such as *qoh*, *nal* and *fub*. The researcher randomly allocates first-year university students studying psychology into one of three groups.

Group 1 is required to learn a list of 20 nonsense words in one 90-minute session on one day. Group 2 learns the same list for 45 minutes per day for two successive days. Group 3 practises the same list for 30 minutes per day for three successive days. The researcher assesses each group's performance with a test of free recall of the nonsense words after each group completes the designated number of sessions. The mean recall of the 20 words for group 1 is 6.2; for group 2, 11.1; and for group 3, 14.9. These mean scores are found to be significantly different from one another, and the researcher concludes that distributed practice is more effective than massed practice.

Experiment 3

A researcher studied how having previously seen an image of an object may influence the ability to name it again when it reappeared later. Participants were first shown pictures of common objects such as a purse, a wristwatch and keys on a computer monitor. The participants then left and returned one week later. At this time, they were shown some of the original pictures they had seen in the first session, some similar but not identical pictures, and some entirely new ones. They were then asked to name the objects as quickly as possible. The researcher found that the original objects were named significantly faster than the new objects, but that the similar objects were named more slowly than the new ones.

Source: adapted from Stangor, C. (1998). *Research methods for the behavioural sciences*. Boston, Massachusetts: Houghton Mifflin.

Learning Activity 1.18

Designing an experiment

Choose a specific topic of interest from Unit 3 and outline an experiment with a repeated-measures design, an experiment with a matched-participants design and an experiment with an independent-groups design that could be conducted on your chosen topic. Present the experimental designs using a flow-chart format (see figures 1.23–1.25) so that the three designs can be compared.

Techniques of qualitative and quantitative data collection

All psychological research involves collection of information. In research, the information that is collected is called **data**. The data may be considered as 'evidence' that will form the results of the study and be the basis of the conclusions that will be made. The type of data collected is determined by the research method used. For example, experiments usually provide data in the form of numbers and a self-report method such as a face-to-face interview often provides data in the form of words. Generally, psychologists distinguish between data in terms of whether it is *qualitative* or *quantitative*.

Qualitative data is information about the 'qualities' or characteristics of what is being studied. They are descriptions, words, meanings, pictures, texts and so on. These data can describe any aspect of a person's mental experiences or behaviour: more specifically, what something is like or how something is experienced. The qualitative data collected could be in the form of written or verbal comments by participants, audio or video recordings, or notes of participants' comments made by the researcher. Anything a person thinks, feels or does can be a source of qualitative data. For example, a researcher may collect and analyse drawings in order to study what the onset of menstruation is like for adolescent girls (Banyard & Grayson, 2000). Alternatively, a researcher may be interested in conducting research on the advantages and limitations of government-funded mental health services provided over the internet and telephone. The researcher may collect data by conducting interviews or holding small-group discussions with individuals who have recently used one or more of these services. Participants may be asked to give examples of when they have used a service and describe their experience without any constraint, other than occasional questions by the researcher to ensure their responses are relevant, have enough detail and have been clearly understood.

Quantitative data is information about 'quantities' or amounts of what is being studied. This type of data is usually expressed in the form of units of measurement or numbers, such as raw scores, percentages, means, p values and so on. For example, the height or age of a participant is considered as quantitative data as both of these characteristics can be expressed in units of measurement (centimetres or years). Similarly, the percentages of participants who respond with 'Agree' or 'Disagree' to survey questions, or the mean time taken to solve a

Figure 1.26 In this small-group setting, the researcher is collecting qualitative data on participants' experiences when using mental health services.

Figure 1.27 This participant is required to name the emotions shown on the computer screen. Are the data collected qualitative or quantitative?

problem in an experiment, are qualitative data. All types of mental experiences and behaviours can be described in quantitative terms; that is, as quantities or numbers. For example, in a survey, a question might ask participants to use a five-point scale to rate the level of stress caused by different events or the effectiveness of different stress-management strategies. There are many different tests used by psychologists to measure various mental processes and behaviours and most of these also provide quantitative data. There are tests to measure intelligence, personality traits and all kinds of aptitudes, interests and abilities. Answers are often totalled to yield a score that can be interpreted and applied to the person or group who did the test. Similarly, data collected by devices used to record the electrical activity of the brain when awake or asleep are measurements and numerical values that are best described as quantitative data.

Although different, quantitative and qualitative data are not mutually exclusive and are not often used separately. Qualitative data are typically expressed in the form of words, but they can be converted into a quantitative form. For example, participants' responses to open-ended interview questions about their thoughts and feelings when they are anxious could be summarised as numbers based on the frequency ('how often') or intensity ('how strong') with which certain feelings are reported.

The majority of studies referred to in this text use quantitative data rather than qualitative data. This reflects the preference for quantitative data in most psychological research. Generally, psychologists tend to prefer quantitative data because the use of numbers increases the precision of results and the ease with which they can be communicated. Quantitative data also enables more precise and detailed analysis through the use of statistical procedures and tests. These are also the reasons why qualitative data are often converted into quantitative data.

Box 1.10

Objective and subjective data

The terms 'objective' and 'subjective' are also used to refer to the way that data are collected, and the way they are described and explained.

Objective data is information based on measurements of a participant's response that can be directly observed and verified by the researcher; for example, data collected through an experiment in which observations and measurements are planned, precise and systematic. Data collected using an assessment device that yields a score, such as an intelligence test or personality inventory, are also considered to be objective data. Mechanical devices can also be used to collect objective data; for example, an instrument that shows internal reactions or underlying physiological activity in measurable form—such as an electroencephalogram (EEG), which records patterns of brain wave activity—provides objective data.

Sometimes researchers want information about thoughts and feelings or information about behaviours that cannot be directly observed in a research study; for example, sexual behaviour or criminal acts. In these cases, researchers tend to use interviews and questionnaires to collect data in the form of self-reports; that is, answers to questions or statements the researcher asks or presents. *Subjective data* are those that are based on self-reports given by participants. Unlike objective data, these data are determined by the research participants and often cannot be verified by the researcher. Consequently, they are often biased. When using subjective data, researchers assume that participants are honest, can accurately recall what they are asked to describe and are able to give detailed accounts of their mental experiences. Although subjective data may be more detailed than those available from more scientifically rigorous methods under controlled conditions, they tend to be difficult to interpret accurately when compared with objective data (which are usually quantitative).

Learning Activity 1.19

Review questions

1 Define and distinguish between qualitative data and quantitative data with reference to an example that is not used in the text.

2 Identify whether the data collected in each of the following research studies are likely to be qualitative or quantitative. Explain your answers.

- **a** A researcher compares the detail in paintings by people with a phobia and people with paranoid schizophrenia.
- **b** A researcher compares the differences in visual perceptual abilities of kittens with and without damage to the visual cortex in the brain.
- **c** A researcher observes how much time male and female adolescents take to get ready for a deb ball.
- **d** A researcher uses diary records kept by people hospitalised with a mood disorder to study their mental experiences.
- **e** A researcher compares how infants who can walk independently respond when left alone with a stranger in a laboratory setting with infants who can crawl but are unable to walk independently.
- **f** A researcher analyses participant scores on a test of recall in a study on long-term memory decline and ageing.

Case studies

Sometimes a researcher will collect data on only a small number of people, perhaps an individual or a small group of two or three. When this is done, the research method used is likely to be a case study. A **case study** is an intensive, in-depth investigation of some behaviour or event of interest in an individual, small group or situation. Clinical psychologists and other mental health professionals routinely use case studies to develop a detailed profile of a client. The case study may involve a combination of data-collection techniques. For example, the client may be interviewed at length. Information may also be collected through interviews of family members, friends, and teachers or co-workers. The client's medical records and school reports may also be considered. Other sources of information can include extensive psychological testing and observations of the person's behaviour. When used in a clinical setting for therapeutic (or 'treatment') purposes, a case study is often referred to as a *case history* or a *clinical observation*.

The case study method is often used when large numbers of participants are not available for study; for example, to study individuals with a relatively rare or unusual disorder, problem or ability. Much of what is known about the role of the brain in mental processes and behaviour has come from case studies of people with brain damage. Intensive study of individuals with brain damage makes it possible for researchers to gain detailed, valuable information about the roles of the brain in consciousness, speech, memory, perception and so on.

One of the earliest and best-known case studies of brain damage is that of Phineas Gage, which was reported by his doctor, John Harlow, in 1848. Gage was a railway construction supervisor who accidentally exploded gunpowder that sent an iron rod through his skull, causing massive damage to his frontal lobes. No-one expected him to live; an undertaker made a coffin for him. Although Gage survived, his temperament (mood), social behaviour and personality changed very noticeably after the accident. The last sentence of his doctor's report reads, 'His mind was radically changed, so decidedly that his friends and acquaintances said that he was "no longer Gage"' (Breedlove, Rosenzweig & Watson, 2009). The Gage case study provided one of the earliest detailed insights into the roles of the upper front area of the brain (frontal lobes) in mental processes and behaviour (see box 4.1, chapter 4).

A more recent case study reported by American psychologists Goldenberg, Mullbacher and Nowak (1995) involved H.S., an adult female patient with Anton's syndrome. People with Anton's syndrome are cortically blind. This means that they are unable to see because of severe damage to their visual cortex, the part of the brain that initially receives and processes incoming visual sensory information. An unusual aspect of Anton's syndrome is that individuals with the disorder do not have any damage to their eyes or visual pathways to the brain. However, they believe that they can still see and have an explanation for why they can't. For example, someone with Anton's syndrome may claim that they can't see because there is insufficient light in the room where they are being examined.

H.S. was of particular interest to the researchers because her visual cortex was entirely destroyed. Despite all the evidence that H.S. was totally blind, she would deny her blindness and describe her sight as only 'unreliable'. She reported that sometimes things around her would appear very clearly, only to disappear a few minutes later. Sometimes she would reach out for an object, such as a cup, only to find that it was not where she expected it to be.

The researchers believed that H.S. might have been mistaking her visual imagery of objects for sight; that is, believing that what she was imagining was what she was actually seeing. They tested their imagery hypothesis by making sounds that related to various objects—for example, the sound of rattling keys or scissors opening and shutting—and then placing the object out of sight. At other times, they let H.S. touch the object and then placed the object out of sight. Each time they did this, the researchers would ask H.S. whether she saw the object. When not allowed to hear or touch the object, H.S. would say that she couldn't see anything, but she would report seeing the object if the object was within her field of vision. The following dialogue, in which R. is the researcher and H.S. is the patient, reveals the test. Although by this time H.S. had recovered some of her vision, she still only had a 5° visual window on the right side. Apart from this, she is functionally blind.

R. [Moves bunch of small keys, producing sound.] *I am holding an object. Do you have any idea what it might be?*

H.S. Could that be a key?

R. [Silently moves the keys beneath the table. The part of the conversation printed in italics takes place while the keys are hidden from view.] *What does it look like?*

H.S. On top there is a big ring, and it has a dark key-bit.

R. Do you see the key well?

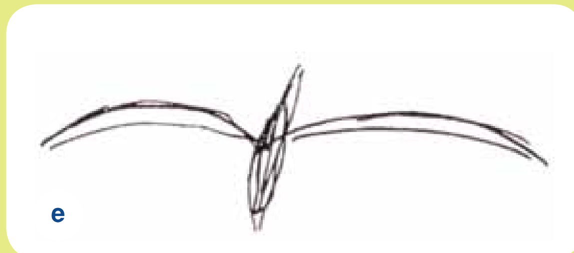
H.S. I am seeing the key.

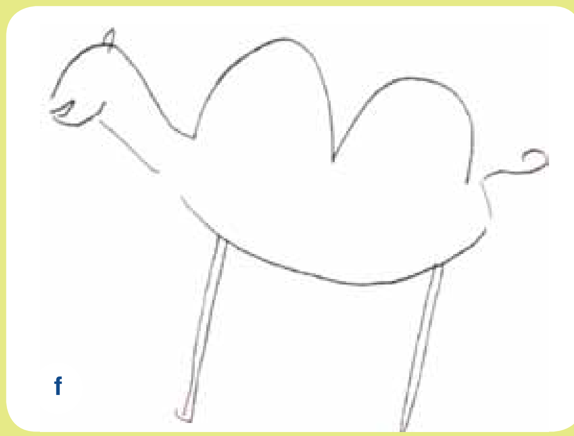
The case study of H.S. provides evidence for a number of different aspects of brain function. For example, the visual cortex is shown to have a crucial role in vision, given that H.S.'s was entirely damaged and she consequently had no vision. Despite believing that she could still see objects, as indicated in her conversation above with the experimenter, H.S. *was* blind—her description of the key was incorrect. However, she had excellent visual imagery, despite having no visual cortex. This suggests that visual imagery and visual perception do not necessarily depend on the same brain structures and processes, and that the relationship between visual imagery and visual perception is not as close as some psychologists have proposed. Furthermore, H.S. recovered some of her vision over time (and recovery may continue). This provides evidence for the *plasticity* of the brain; that is, the capacity of the brain (specifically its neurons) to take over part or all of a function of an area responsible for that function, but which has been damaged (Andrewes, 2001).

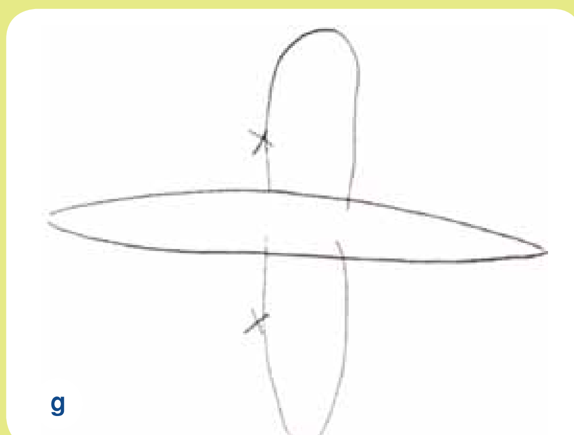
Box 1.11

Case study on Patient L.E.

Patient L.E. was a talented sculptor before brain disease disrupted her ability to form visual images. Her sculpting style then changed from highly realistic (a and b) to much more abstract (c and d). Her capacity for drawing also suffered, as shown by her attempts to draw a bird (e), a camel (f) and an aeroplane (g).







Source: Wilson, B.A. & others (1999). In A. Baddeley, M.W. Eysenck, & M.C. Anderson (2009). *Memory*. New York: Psychology Press.

Advantages and limitations of case studies

Case studies provide a useful way of obtaining detailed and valuable information on mental processes and behaviour, particularly in relation to rare or unusual disorders. There is usually no manipulation or control of variables, as with experimental research. Consequently, case studies can avoid artificiality and provide a 'snapshot' of the actual or real-life experience of one or more individuals at a particular time in a particular situation. Case studies can also provide insights into how others may think, feel or behave under similar circumstances. Furthermore, they can be a valuable *source* of hypotheses for further research. Case studies, however, cannot be replicated to test the reliability of the results in the way that an experiment can. Nor can they be used to test hypotheses unless combined with the results of other case studies of similar participants or used with another research method that is suitable for testing hypotheses.

Case studies also have other limitations. Because of the detailed and comprehensive data usually obtained in a case study, the process of analysing, summarising and reporting these data can be a painstaking and time-consuming process. Furthermore, by their very nature, case studies usually focus on rare or unusual individuals or situations. Because the mental experiences, processes or behaviours of such individuals are 'extraordinary', they may not reflect typical ways of thinking, feeling or behaving. Generalising or applying the results to others in the population, particularly those without the rare disorder or ability, cannot be done with any certainty. This is particularly problematic for case studies involving individuals with brain damage. The damage is rarely limited to specific areas or contained within well-defined anatomical boundaries. Consequently, it is often difficult to be certain as to exactly which area of the brain is responsible for specific problems associated with mental functioning or behaviour. This is complicated by the fact that two people rarely suffer exactly the same brain damage, or have exactly the same pattern of abilities before and after the damage. Another difficulty in understanding brain functions using case studies of brain-damaged patients is the brain's plasticity in being able to adapt to damage and 'reassign' the function of damaged areas to other areas of the brain (depending on the extent of the damage). Thus, the true effect of damage to a specific part is often difficult to ascertain.

Case studies also have the limitation of being more susceptible to biased information from the participant or the researcher. This can influence the accuracy of the information that is obtained and conclusions that may be drawn. For example, case studies usually rely on the individuals under investigation to provide a great deal of the required information. Some participants may not remember clearly what they actually experienced, or they may intentionally change or omit information that they do not wish to reveal for personal reasons. Case studies are usually conducted by one researcher. It is possible that the researcher sees or hears what they expect or hope to see or hear. Furthermore, the researcher is also responsible for deciding what to include in their descriptions and what to leave out. In writing a report on the case, the researcher may select information that supports key points or conclusions they wish to make, and omit other points that may be just as relevant and could have been included by another researcher interpreting the same information.

Learning Activity 1.20

Review questions

1. What is a case study?
2. What type of data can be collected in a case study?
3. Suggest a reason to explain why case studies often involve the use of several data-collection techniques.
4. Are demand characteristics and experimenter effects relevant to case studies? Explain your answers.
5. Describe three advantages and three limitations of case studies when used for research purposes.

Observational studies

In psychology, all research studies involve observation. For example, in an experiment, the researcher observes the responses of participants to the IV; in a case study, the researcher may observe responses of their participants in a diagnostic test and records of brain wave activity in their medical records; and in a survey, the researcher may observe verbal or written responses of their participants to questions. Consequently, the term **observation** refers to any means by which a phenomenon (an observable event) is studied, including the data that represent a phenomenon, such as spoken or written responses, test scores and brain wave recordings. In all research studies, observation occurs in a systematic way and is undertaken according to predetermined procedures. In contrast to the term 'observation', the term *observational study* is used to refer to the specific approach to or way of collecting data (Banyard & Grayson, 2000).

An **observational study** involves collection of data by carefully watching and recording behaviour as it occurs. Psychologists use observational studies to collect data in research when the behaviour under investigation is clearly visible and can be easily recorded. For example, when investigating roles and hierarchies ('pecking orders') in groups, a researcher might ask the members of a friendship group to discuss a controversial issue, then observe and record who starts the discussion, who changes the topic, who speaks, how often and for how long each person speaks, and so on. This study could occur in a controlled laboratory setting or in a field setting, such as a place where the group normally meets and interacts (e.g. the school canteen or an area of the school grounds). Keep in mind, however, that although an observational study involves 'observation' in the way that experimental research uses 'observation', an observational study is *not* an experimental research method.

A commonly used type of observational study is called naturalistic observation. In **naturalistic observation**, a naturally occurring behaviour of interest is viewed by the researcher in an inconspicuous or 'unnoticeable' manner so that their presence does not influence in any way the behaviour being observed. For example, in a study on social behaviour, a researcher might observe children at play in a playgroup situation from behind a one-way mirror so that the children are not aware that they are being observed. From the observational records of each child's interactions, the researcher will make assumptions or inferences about children's social behaviour. Similarly, a researcher studying how paramedics respond to traumatic events might observe paramedics in action by riding along with them on duty. In doing so, the researcher would be as unobtrusive as possible, trying to 'shadow' the paramedics as they respond to various types of trauma, communicating with them only when essential to do so.

Figure 1.28

When researchers try to conceal their presence while making observations, it is often called **non-participant observation**. When observations of behaviour are made in a field setting—that is, the usual or real-world surroundings in which the behaviour occurs—the researcher might conceal their presence by simply blending in with the crowd and observe from the 'sidelines'. For example, a researcher might sit on a nearby seat pretending to be absorbed in a book in order to observe the non-verbal interactions of people being met at an airport.

Sometimes, the behaviour of interest involves private interactions between members of a group that cannot be reliably observed from the sidelines. In such cases, the researcher may engage in participant observation. In an observational study using **participant observation** the researcher is an active member of the group being observed. The researcher will actually participate in the activity being observed and may deliberately try to be mistaken by the participants as being part of the group or situation being observed. In one well-known observational study that used participant observation, the researchers had themselves admitted to several different psychiatric hospitals by imitating the symptoms of a severe mental illness. After they had been admitted, they observed and kept records of how the patients were treated. Their record-keeping behaviour was regarded by the hospital staff as being a symptom of their mental illness (Rosenhan, 1973).

In another observational study, researcher Dian Fossey used both non-participant and participant observation. Fossey, whose work is featured in the movie *Gorillas in the Mist*, lived among gorillas in their remote African highlands habitat. After first using non-participant observation to learn about key aspects of gorilla behaviour, Fossey changed her method to use participant observation and started to behave like a gorilla. The more she learnt about the behaviour of gorillas, the more she was able to act like them. She imitated their feeding and grooming behaviours and even attempted to copy their vocalisations. By waiting for the gorillas to approach her, by avoiding actions that might threaten them, and by imitating their actions, Fossey gradually became accepted by them and was able to collect valuable data about their behaviour.

In most observational studies, researchers use systematic data-collection techniques such as structured checklists with predetermined criteria, such as that shown in figure 1.30, to guide observations and recording of responses. This typically involves operationalising the behaviour of interest and variables that are involved. For example, a researcher observing aggression outside nightclubs in King Street, Melbourne, must define aggression precisely in terms of the variables to be measured and devise a list of the precise behaviours to be observed and recorded. In preparing their observation checklist, the researcher will determine whether, for example, aggression includes shouting or only physical contact, and whether an accidental push or shove is to be recorded along with a deliberate push or shove.

Figure 1.29 Researcher Dian Fossey engaging in participant observation with gorillas

Observations have become more accurate as new technology permits more precise measurement. For example, digital video cameras can be used to record then analyse rapidly changing behaviour. Even a single 'frame' within a long action sequence can be analysed. This technology can be used, for example, in studies of the way subtle changes in facial expressions of mothers and their babies become synchronised and similar over time.

Advantages and limitations of observational studies

The main advantage of observational studies is that, through unobtrusive observation, researchers can watch and record behaviours in their natural real-life settings. When people are observed in this way, they are not influenced by participant reactions that can arise in other types of research study, such as artificiality and demand characteristics.

When studying behaviour in a laboratory setting, a researcher is unable to observe the long-term effects that an organism's natural environment has in shaping complex behaviour patterns. For example, Jane Goodall spent more than 25 years studying patterns of behaviour among chimpanzees in Africa. She believed that if she ended her research after 10 years, as originally scheduled, she would not have drawn correct conclusions: 'We would have been left

Figure 1.30 A sample checklist for an observational study

INITIATION OF AGGRESSIVE ACT, SHOWN BY CHILD AND SEX

	#	1	M	#	2	M	#	3	M	#	4	M	#	5	M	#	6	F	#	7	F	#	8	F
Aggressive act *against* whom (shown by child's assigned number)*	5	6	8				6	7	2	1	3	5	1	6	8	2	2	4				6	3	5
Response:																								
Anger												X		X		X								
Surprise													X			X								X
Hurt, tears		X	X				X	X							X		X					X	X	X
Little or no emotion shown	X								X	X	X													
Help from other children			X				X	X					X									X		
Help from adult supervisor			X					X							X	X								X
Resolution favours:	1	1	8				8	7	3	?	?	5	5	5	8	6	2					8	3	5

* The observer assigned numbers to the children, keyed to clothing; that is, the child in the red sweater was #1, the one in the blue shirt was #2, and so on.

Source: Wiseman, J.P., & Aron, M.S. (1970). *Field projects for sociology students*. Cambridge, Massachusetts: Schenkman, p. 21.

with the impression that chimpanzees were far more peaceable than humans. Because we were able to continue beyond the first decade, we could document the division of a social group and observe the violent aggression that broke out between newly separated factions. We discovered that in certain circumstances the chimpanzees may kill and even cannibalise individuals of their own kind' (Goodall, 1986). Thus, naturalistic observation often enables researchers to gain more accurate information about the typical behaviours of organisms both immediately and over time than do other research methods.

Another advantage of observational studies is that some types of human behaviour can only be studied as they naturally occur because it would be inappropriate or impractical to study them in a laboratory situation. For example, it would be unethical to severely deprive children in their early life in order to observe the effect of deprivation on behaviour in the future (Zimbardo, 1992). Similarly, some behaviours cannot be realistically reproduced in a laboratory. A researcher cannot, for example, expect to obtain valid information about how people usually behave when they are in love by bringing a pair of participants into a laboratory situation and asking them to 'be in love' so that observations can be made. However, since the observer doesn't directly influence the behaviour being observed in an unobtrusive observational study, it sometimes requires a lot of patience to wait for the behaviour of interest to occur.

A practical advantage of observation in a field setting is that it does not require the cooperation of participants being observed. However, this raises the ethical issue of not obtaining informed consent, particularly with participant observation. When participant observation is used without informed consent, a person's expectation of privacy can be violated. This issue has to be weighed up against the fact that the participants are not informed that they will be observed in some special way so that their observed behaviour is likely to be more true to life.

Another limitation of an observational study is that it can be difficult to determine the *causes* of observed behaviour, because there are many factors that may influence the observed behaviour in a natural environment. For example, a researcher could not determine *why* chimpanzees become aggressive towards one another when their social group breaks into factions, or subgroups. The aggressive behaviour may be influenced by factors that the researcher has no control over such as habitat, food supply, climate, availability of partners, or a combination of these.

A major problem relevant to any observation procedure is observer bias. It is possible, for example, that researchers sometimes unconsciously distort what they see so that it resembles what they hope to see. For example, after observing an animal that has been deprived of food for a long time, the observer may assume that the animal was looking for food when the behaviour actually observed was simply increased activity.

Figure 1.31 Using two or more observers to collect the same data in an observational study is a procedure that can control or minimise the influence of observer bias on the results.

Researchers must be trained to observe and record accurately in order to minimise the influence of their personal biases. Furthermore, when recording participant responses or making detailed notes as part of the observation process, the researcher may neglect to record certain behaviours that they either judge to be irrelevant or do not actually see. To overcome these limitations, researchers often use two or more observers for data collection and check for inter-rater ('inter-observer') reliability. This procedure usually results in a more complete and accurate set of data than one observer could obtain alone.

Learning Activity 1.21

Review questions

1. How is observation defined in psychology? Explain with reference to examples.
2. What is an observational study?
3. What type of data can be collected in an observational study?
4. What are the key features of naturalistic observation?
5. Distinguish between participant and non-participant observation with reference to examples not used in the text.
6. Give an example of an observational study in which artificiality and demand characteristics may be potential extraneous or confounding variables.
7. Describe three advantages and three limitations of observational studies.

Self-reports

For some topics or problems of research interest, it is best to ask people about their thoughts, feelings or behaviour. For example, a researcher may be interested in studying a topic such as mental experiences when daydreaming, thought processes when problem-solving, strategies used to recall specific types of information, attitudes that are held towards indigenous Australians, feelings that accompany stress, why people gamble or why people with a spider phobia react as they do when they see a spider. To ask people how they think, feel or behave when conducting scientific research involves using a technique that will prompt self-reports by participants. A **self-report** is the participant's (or respondent's), written or spoken responses to questions, statements or instructions presented by the researcher. For example, self-reports may be participant's responses to statements in a 7-point rating scale measuring anxiety or a participant's diary records kept in response to a researcher's specific request. Questionnaires and interviews are two of the most commonly used self-report data-collection techniques.

Both questionnaires and interviews often comprise questions but they are usually distinguished in terms of how the questions are asked and answered. For example, a questionnaire usually involves asking and answering questions in writing, whereas an interview usually involves asking and answering questions orally. However, this is not a fixed rule. Sometimes, a researcher may prefer to orally ask the questions in their questionnaire. Although questionnaires and interviews can be used exclusively or in combination to collect self-reports, they are also commonly used for other research studies, such as experiments, case studies and observational studies.

When using a questionnaire or interview to collect self-report data, the researcher may choose to use free-response and/or fixed-response questions. The choice of question type determines whether qualitative or quantitative data are collected. *Free-response* (or *open-ended*) *questions* require participants to describe their thoughts, feelings or behaviour 'freely' in their own words, thereby providing qualitative data. For example, the researcher might ask a question such as 'What are you thinking?', 'How did you go about learning and remembering the information?' or 'How can people with a gambling problem be encouraged to seek support?' These kinds of open-ended questions enable participants to provide detailed responses without being restricted to giving answers that fit into predetermined categories (such as those of fixed-response questions). Because open-ended questions allow for a wide range of responses, the researcher may discover new, relevant variables. Furthermore, free-response questions enable the researcher to ask questions of clarification or follow-up questions as participants give information about the thoughts, feelings or behaviour under investigation. With this, however, comes a limitation. Answers to free-response questions are often difficult to summarise or score—and therefore convert to quantitative data. This makes it harder for researchers to statistically analyse, describe and interpret the data obtained. Scoring or interpreting the responses also requires subjective interpretation by the researcher. Consequently, the scoring and interpreting of responses are susceptible to the biases and expectations of the researcher; that is, experimenter effects.

To avoid or overcome these limitations, researchers often ask fixed-response questions, which are more objective and enable quantitative data to be collected. *Fixed-response* (or *closed*) *questions* typically require participants to select their response from a number of 'fixed' alternative responses; for example, 'Do you support the use of medications to treat people who have a phobia: Yes, No, Undecided?' and 'How much time does it usually take to fall asleep when you go to bed at night: 0–10 minutes, 11–20 minutes, 21–30 minutes, 31–60 minutes, 1–2 hours, More than 2 hours?' Because fixed-response questions provide specific alternatives from which the participant chooses, the researcher can accurately and concisely summarise and describe the responses numerically. For example, a '0–10 minutes' response to the question about time taken to fall asleep can be assigned a score of 1, '11–20 minutes' a score of 2, and so on. Furthermore, the same scores can be reliably assigned to all other participants who give these responses and all responses can be efficiently analysed, described and interpreted using statistical procedures and tests.

Questionnaires

A **questionnaire** is a written set of questions designed to draw out self-report information from people on a topic of research interest. It typically has a structured format and the questions are usually answered by participants in writing, at their own pace and without supervision. Questionnaires are most often used when responses are required from a large number of participants. They are an efficient way of collecting self-reports because a researcher can administer the questionnaire via surface mail,

Figure 1.32 Researchers conducting surveys often use a questionnaire to collect self-report data from a large number of people in a relatively short period of time.

the internet, or at the same time to a group who is located in the one place, such as in a school or workplace. However, it is not uncommon for a questionnaire to be administered over the phone. By guaranteeing anonymity to participants, written questionnaires can be a useful way of collecting self-report data that people may not be willing to disclose publicly, such as ambitions, motivations, fantasies, sexual behaviour, gambling behaviour, socially unacceptable behaviour and illegal behaviour.

A **survey** is an example of a highly structured questionnaire that is used to collect self-report data from a large number of people in a relatively short period of time. Unlike the census, which aims to survey the entire population of Australia, a researcher conducting a survey will collect data from a carefully selected sample that is representative of the population of research interest. Generally, the number of people in a sample will vary according to the topic of research interest, the target population and the availability of participants.

Interviews

An **interview** usually involves questions that are asked by the researcher with the aim of obtaining self-report information on a topic of research interest. Interviews are most often conducted with individuals, in a face-to-face meeting or sometimes by phone. They usually require spoken answers to questions and are rarely used with large samples as data collection would require a considerable amount of time. Unlike questionnaires, which are usually structured, interviews may be either structured, unstructured or semi-structured.

In a *structured interview*, the participant is asked specific, predetermined questions in a controlled manner. The most structured interview is when the interviewer simply reads fixed-response questions to participants and records their answers. The interviewer follows a script and the questions are read in a neutral manner with no comments or cues. This is done to ensure that all participants are treated in the same way and demand characteristics are minimised. A less structured interview may use free-response questions, but the researcher will follow a script to ensure consistency for all participants.

In an *unstructured interview*, the researcher has an overall aim of what data should be collected but the questions asked can vary widely from participant to participant. There is also freedom of discussion and interaction between interviewer and participant. For example, the interviewer may ask additional questions to follow up on a participant's response. A goal of unstructured interviews is to allow people to describe their thoughts, feelings and behaviour in their own way using their own terms. This is different from structured interviews (and questionnaires) for which participants have to use the questioner's terms and concepts to describe how they think, feel or behave. However, this also means that the data collected through unstructured interviews is much more detailed, has far less structure and is therefore more difficult to analyse, summarise and describe for reporting purposes.

Advantages and limitations of self-reports

Self-reports such as questionnaires and interviews are widely regarded as useful techniques for collecting qualitative data and quantitative data on how people think, feel and behave. In particular, structured questionnaires that are used for surveys can be an efficient means of collecting self-report data from a large number of people in a relatively short period of time. By guaranteeing anonymity, structured questionnaires also provide a means of collecting self-report data from large groups on ‘sensitive’ or controversial topics that many people are not willing to disclose publicly, such as in an unstructured interview. However, like other self-reports, they rely on the assumptions that people are actually willing to answer all questions and that they will give accurate answers. As you would be aware, we cannot always reliably recall or communicate information about how we think, feel or behave. Furthermore, it is not uncommon for people to deliberately give false or misleading answers to questions presented in a questionnaire (or an interview) in order to create a favourable impression of themselves. This tends to occur more often with highly personal topics, such as socially unacceptable or illegal behaviour, and socially sensitive issues such as attitudes held towards specific ethnic groups, animal cruelty or even environmental problems. Responses to questions on these kinds of topics may be influenced by *social desirability*; that is, a need to create a favourable or socially acceptable impression of oneself.

Self-report data-collection techniques are best used with people who have well-developed language skills, although interpreters and skilful interviewing can help overcome this potential limitation. When comparing the specific advantages and limitations of questionnaires and interviews, it is important to take account of the *type of data* that will be collected (i.e. qualitative or quantitative), the *type of question* used (i.e. free-response or fixed-response) and extent to which *structure* is used (i.e. highly structured, partially structured or unstructured).

Generally, qualitative data are richer in detail but more difficult to accurately and reliably analyse and interpret. Quantitative data by their very nature enable more precise comparisons between participants and more precise analysis and interpretation, particularly when statistical procedures are used. Free-response questions enable unrestricted responses and therefore a wider range of responses, but the responses are often difficult to summarise and statistically analyse. The interpretation of results is also more susceptible to experimenter effects. Fixed-response questions restrict participant responses to predetermined categories but are more objective. Their collection of quantitative data enables responses to be more concisely summarised, efficiently analysed, interpreted using statistical procedures and tests, and more easily compared.

Structured interviews use predetermined questions in a controlled manner to ensure consistency for all participants and minimise demand characteristics. They are quicker to administer and the responses tend to be easier to summarise, statistically analyse and compare. However, the participant is limited to giving a specific type of answer, there is no flexibility, and, if the respondent raises interesting issues that are not on the interviewer’s list, these will not be followed up. Unstructured interviews allow people to answer in their own way using their own terms, responses are richer and there is flexibility. However, the responses are more difficult to summarise, interpret and compare, and the lack of control makes it difficult to ensure consistency for all participants and minimise experimenter effects and demand characteristics. It is also important to note that all self-reports are subjective data. Unlike objective data, these data are determined by the research participants and often cannot be verified by the researcher.

Learning Activity 1.22

Review questions

1. What are self-reports?
2. What type of data can be collected through self-reports?
3. Distinguish between a questionnaire and an interview.
4. Distinguish between structured and unstructured questionnaires and interviews with reference to an advantage and a limitation of using a structured approach compared with an unstructured approach.
5. Distinguish between free-response and fixed-response questions with reference to an advantage and a limitation of each question type.
6. Describe three advantages and three limitations of self-reports.

Analysing and interpreting data

When data have been collected to test a hypothesis, the researcher must decide whether the results support or do not support the hypothesis. The researcher must also draw a conclusion(s) relating to the hypothesis, and this conclusion(s) must be based on the results obtained. Finally, the results must be explained; that is, reasons must be suggested about why the particular results were obtained and what they mean, including whether they can be applied to other similar situations. Researchers use *statistics* to analyse ('break down') and describe the data they collect. They also use statistics to help interpret ('make sense of') the results obtained from the research.

Statistics are essentially mathematical procedures. Two main types of statistics are used in psychology. **Descriptive statistics** are used for analysing, organising, summarising and describing the results. If you have ever plotted a graph or calculated a percentage, then you have already used descriptive statistics. **Inferential statistics** are used for interpreting and giving meaning to the results. Like descriptive statistics, inferential statistics involve the use of mathematical procedures. However, unlike descriptive statistics, inferential statistics involve judgments about the results.

Units 3 and 4 Psychology focus on the descriptive statistics called measures of central tendency (mean, mode and median) and an inferential statistic called a *p* value. You need to be able to calculate or identify the mean, mode and median for a particular set of scores but you are not required to calculate a *p* value. Instead, you are required to understand what a *p* value is and what it means. In this section, we consider measures of central tendency and *p* values in detail. We also consider additional descriptive statistics that will assist you in reading and understanding the descriptions of psychological research referred to throughout this textbook. They will also assist you in completing SACs, such as data analysis, evaluation of research and writing reports on practical activities and research investigations you conduct as part of your study of VCE Psychology.

Descriptive statistics

A researcher interested in whether memory declines with age might give some previously unseen information to ten 10-year-olds, ten 25-year-olds, ten 40-year-olds, ten 55-year-olds, ten 70-year-olds and ten 85-year-olds. The research participants would be required to learn the information and then complete a memory test so that their memory could be assessed. In all, there would be 60 bits of data (that is, test scores) about the memory of participants in different age groups. How could the researcher make sense of all these different bits of information so that meaningful conclusions about memory and age might be drawn?

The first step would be to use descriptive statistics to analyse, organise, summarise and describe the data so that they could be interpreted. It is difficult to draw conclusions about whether memory declines with age by looking at 60 individual scores. Thus, in order to compare the memory scores of the six different age groups to determine whether there has been a decline in memory with age, the data for each age group could be summarised and presented like that in table 1.7. The table provides some order to the data by organising the scores into age groups, but comparison of scores across the different age groups is still difficult.

Table 1.7 Individual participants' scores on a test of memory

Age (years)	Participants' scores
10	14, 11, 9, 10, 15, 16, 14, 12, 13, 11
25	14, 16, 16, 18, 13, 17, 14, 15, 17, 8
40	17, 15, 12, 16, 19, 10, 18, 14, 13, 18
55	10, 18, 13, 14, 15, 14, 12, 19, 12, 10
70	13, 10, 12, 16, 7, 15, 9, 12, 11, 8
85	6, 14, 12, 10, 11, 9, 16, 10, 8, 13

To better enable the scores from different age groups to be compared, a single number that summarises the data for each age group could be calculated. For example, the researcher could calculate the *mean* score on the memory test for each age group. The mean scores could be used to describe the 'average' performance on the memory test for each age group and would enable the researcher to compare the different age groups, as shown in table 1.8. A graph such as a frequency distribution or histogram could also be prepared to visually represent the results, as shown in figure 1.33. Generally, the specific type of descriptive statistic used depends on the kind of research being done and on the type of data collected. Some descriptive statistics are more suited to particular research and data than others.

Table 1.8 Mean scores for each age group on a test of memory

Age (years)	Mean scores
10	12.5
25	14.8
40	15.2
55	13.7
70	11.3
85	10.9

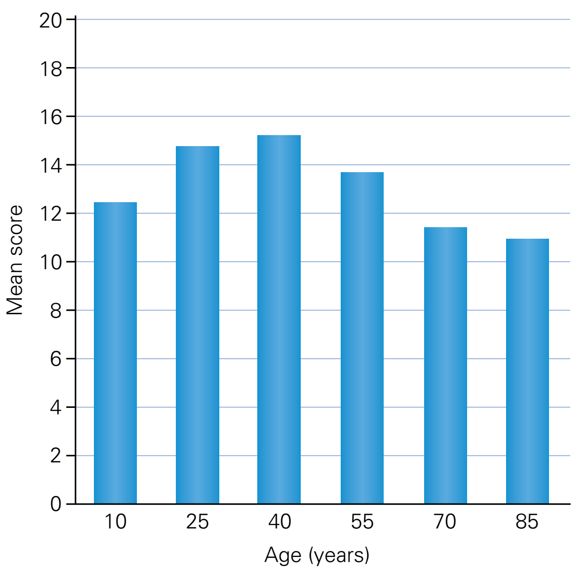


Figure 1.33 Frequency distribution of scores on a memory test

Measures of central tendency

Data are often summarised by determining a single numerical score that can describe the data for the whole group(s). This score, called a **measure of central tendency**, indicates the 'central' or 'average' value in a set of scores. When a measure of central tendency is calculated, it often provides a typical score for a set of scores. The most commonly used measures of central tendency are the mean, median and mode.

Mean

The **mean** is the arithmetical average of all the individual scores (or measures) in a set of scores. It is calculated by adding together all the scores and dividing the total by the number of scores. For example, if ten rats were put into a maze, the length of time (in seconds) it might take each rat to reach the end of the maze could be as listed below:

26, 17, 21, 18, 12, 17, 18, 24, 25, 17

The mean ($\overline{X}$) score for the group is calculated by adding the individual scores together ($\Sigma = 195$), then dividing the total by the number of individual scores ($N = 10$). In this example, the mean is 19.5 seconds. The formula for the mean is shown below.

$$\overline{X} \text{ (mean)} = \frac{\Sigma \text{ (sum or total of all scores)}}{N \text{ (number of scores)}}$$

When scores in a set of data cluster closely around a central score, the mean is a fairly accurate indicator of the typical score; that is, it is representative of the scores. If, however, the scores are widely spread, unevenly distributed or cluster around extreme values, then the mean can be misleading (e.g. a few high values may inflate the mean) and other measures of central tendency should be used instead. Two other measures of central tendency that can be considered are the median and the mode.

Median

Another way of obtaining a score that may represent the central point in a set of scores is to arrange the scores in order of size (e.g. highest to lowest) and select the score that falls in the middle as being typical of the whole set of scores. This middle score is called the median.

The **median** is the middle score (or midpoint) of a set of scores. For example, say the time taken (in seconds) for each rat to complete the maze in rank order (from highest to lowest) is:

26, 24, 21, 18, 18, 17, 17, 17, 15, 13, 12

In this example the median is 17. When there is an even number of scores, the median is the average of the two middle scores. For example, if the two middle scores are 20 and 21, the median would be 20.5.

The median is a particularly useful descriptive statistic if there are limited data, but if there is a large amount of data, determining the median is time-consuming and often impractical.

The median is also a useful statistic when many extreme scores occur in the set of scores, because the median is not affected by extreme scores in the same way as the mean.

Mode

The **mode** is the most frequently occurring score in a set of scores. For example, using the previous set of scores again for the rats in the maze

26, 24, 21, 18, 18, 17, 17, 17, 15, 13, 12

the mode would be 17 because this number appears three times.

The mode is infrequently used because it is often not typical or representative of a complete set of data. For example, if a set of scores was 1, 1, 6, 7, 8, 10, the mode would be 1, which is not a representative score for the complete group. If one of the scores of 1 was changed to 10, the mode would shift completely to the opposite end of the scale. Thus, a single score can alter the mode dramatically, which is in contrast to the median, and to a lesser extent the mean, where individual score changes tend to have less effect.

When to use the mean, median and mode

Generally, where scores in a set of data are fairly evenly distributed about the central value, the mean provides a fairly reliable indicator of a typical score; that is, it is a useful representation of the data.

When extreme scores occur in the set of data, the mean might give a misleading picture of the typical score. In this case, a more representative measure of central tendency is the median.

The mode provides a useful indicator of a 'common', or usual, score because it is the most frequently occurring score. It describes what happens most often in a set of scores; that is, the typical score for that group.

The mean is usually the preferred measure of central tendency for most researchers because it makes use of every individual score and because it can be used in other, more advanced, statistical analyses such as calculating the statistical significance of results.

Tables

A *table* is an orderly arrangement and display of data in columns and rows. The columns and rows are usually identified by names (or 'headers') that assist in making comparisons. A commonly used table in psychology is called a frequency distribution. A *frequency distribution* is a way of organising data to show how often (how frequently) a value or measure (e.g. a score) occurs in a set of data. A frequency distribution can also be presented as a graph.

Table 1.9 is a frequency distribution of scores obtained by males and females in an experiment on memory. It shows all the possible values of what has been measured (organised into groups or *class intervals*) and the number of times each value occurs in the set of data (that is, the number of individuals in each class interval). In a frequency distribution, the scores are often arranged either from the highest to the lowest score or from the lowest to the highest score, so that data are presented in an orderly, logical way.

When there is a large number of scores, it is often useful to organise the scores into class intervals, then total the number of scores for each class interval. The class interval can be any size within the range of scores, but the size of each class interval should be consistent across all scores. Intervals of five or ten units are typically used. If an interval of five is used (as in table 1.9), then

Table 1.9 Frequency distribution of scores by males and females on a test of recall

Scores	Males	Females
20–24	0	0
15–19	1	2
10–14	3	5
5–9	4	2
0–4	2	1
Total	10	10

the difference between one interval and the next is five; that is, 0–4, 5–9, 10–14, and so on.

Note that the labelling of the table (e.g. its title and headers) is just as important as its contents. Some conventions, or standards, for tables used in psychology are:

- All tables should be numbered (e.g. Table 1, Table 2).
- Each table should have an individual title (in journal articles the title is in italics and each word is italicised). The title should be a clear statement that explains what the table is about without being too long.
- Each column should be identified using a descriptive header. The first letter of each header should be capitalised.
- Where appropriate, each row should be identified using a descriptive header. The first letter of each header should be capitalised.
- The reader should be able to quickly work out what the table is about and comparisons of data should be easy to make.

Graphs

A *graph* is used to provide pictorial representations of the results of a study. Graphing or 'plotting' data typically involves the use of two lines (axes) drawn at right angles to one another. The horizontal line is the *x*-axis and the vertical line is the *y*-axis. The point where the axes intersect is called the origin (0,0). Generally, the frequency (e.g. the number of cases or amount of something) is plotted on the *y*-axis. The unit of measurement (e.g. score, time) is plotted along the *x*-axis. Graphs are best used to show trends in the data collected; for example, how often a response is made, or how aspects of behaviour change over time or as a research participant's experience changes.

Various types of graphs can be used to express data in different ways. The type of graph used depends mainly on the type of data collected and on how to best represent the data. As with tables, the labelling of graphs is just as important as the contents. The conventions for presenting graphs in psychology include:

- All graphs should be numbered (e.g. Figure 1, Figure 2).
- Each graph should have an individual title (in journal articles the title is italicised and each word is italicised). The title should be a clear statement that explains what the graph is about without being too long.
- Both the horizontal and vertical axes must be labelled clearly and indicate what is plotted.
- The reader should be able to quickly work out what the graph is about.

We consider some of the graphs commonly used in psychology. These include line graphs, bar charts, histograms, frequency polygons and pie charts.

Line graphs

A *line graph* is commonly used to indicate the relationship between two factors, or two variables, in an experiment; for example, the number of errors made on tests during different trials, or the number of hours of sleep a person has had and their performance on a speed and accuracy test (e.g. matching symbols with numbers). The horizontal, or *x*, axis usually has the independent variable plotted on it, with the numerical value of the data increasing as you go along the axis from left to right.

A line graph that describes the relationship between amount of sleep obtained and test performance would list the amount of sleep in hours on the *x*-axis in intervals; for example, beginning at zero, then one, two, three, four hours and so on. One important feature of a line graph is that the variable plotted on the *x*-axis is continuous; that is, a series of progressively increasing values can be listed.

The vertical, or *y*, axis usually has the dependent variable (e.g. the measure of performance) plotted along it. A line graph that described the data from the experiment on the amount of sleep obtained and test performance would record the test scores (e.g. a total correct score or number of errors) along the *y*-axis in intervals, beginning at zero (see figure 1.34 on page 68).

Various points on a line graph represent the score on one axis that corresponds with a value on the other axis. The intersecting point can represent a corresponding IV/DV score on the two variables by one research participant, or the mean score of a group of participants.

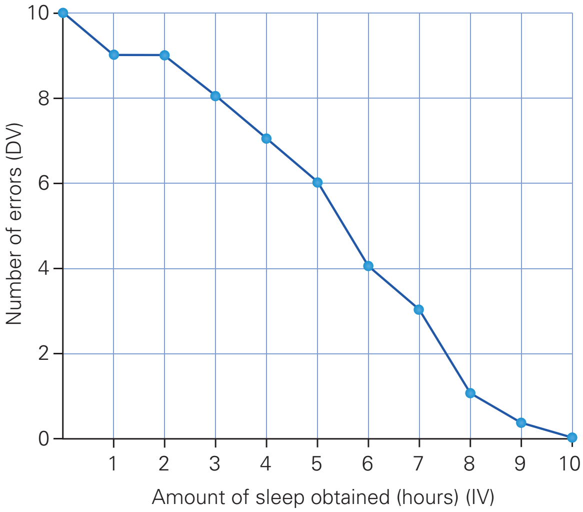


Figure 1.34 A line graph shows the results of an experiment investigating the effect of amount of sleep (IV) on performance on a speed and accuracy test (DV).

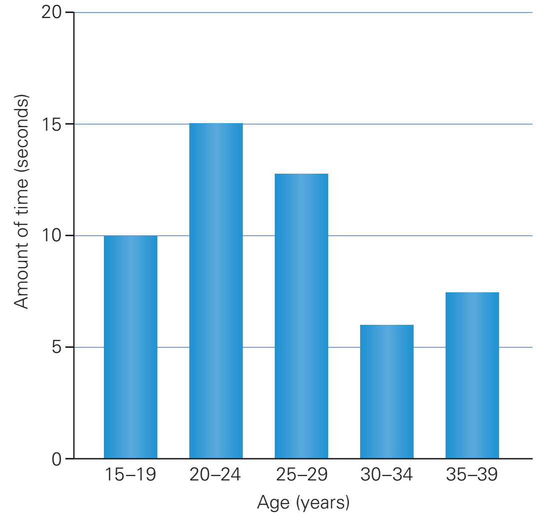


Figure 1.35 An example of a bar graph

Bar charts

A *bar chart*, or *bar graph*, shows how frequently a particular category of data occurs by representing the data using a series of discrete (separate) bars or rectangles next to, but not touching, one another, as shown in figure 1.35. The horizontal (x) axis usually indicates the types of categories and the vertical (y) axis usually indicates the frequency (e.g. how often or how much) with which each category occurs. Bar graphs are commonly used to represent data that have discrete (not continuous) categories, such as age groups and sex.

One important feature of a bar graph is that each of the categories plotted on the x-axis is distinct and that there is no continuation between one category and the next; for example, there would be separate bars for data from each age group. Each bar is the same width and has a small space between it and the next bar.

In addition, the bars can start from either the x-axis (that is, vertically) or from the y-axis (that is, horizontally). Sometimes a bar graph is used to represent values from two categories; for example, scores obtained by age group (e.g. amount of time to solve a problem) and by sex. This is shown in figure 1.36.

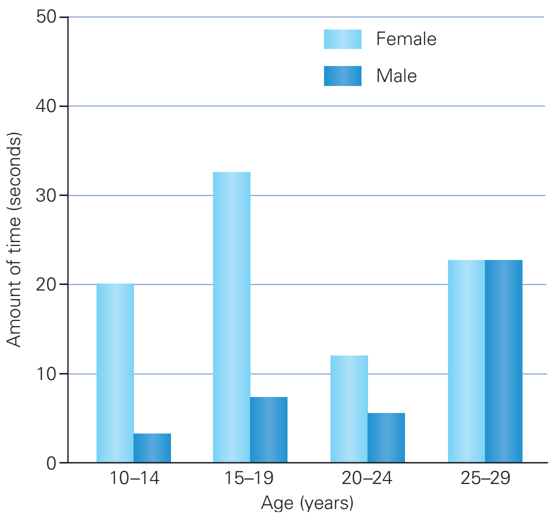


Figure 1.36 Amount of time taken (in seconds) to solve a problem across age groups and sex

Histograms

Histograms are similar in appearance to bar graphs. *Histograms* show the frequency with which a particular score (or set of scores) occurs in a set of data. Like a bar graph, a histogram usually has the types of categories plotted on the horizontal x-axis and the frequency (that is, how often, how much) each category occurs on the vertical y-axis. As shown in figure 1.37, a histogram is slightly different from a bar graph. The bars are drawn so that they touch each other because the data are

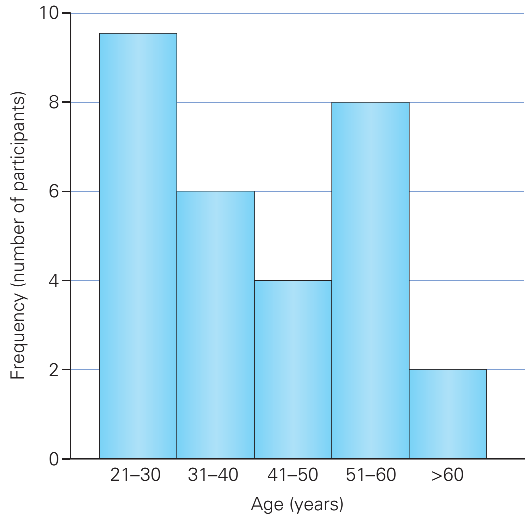


Figure 1.37 An example of a histogram

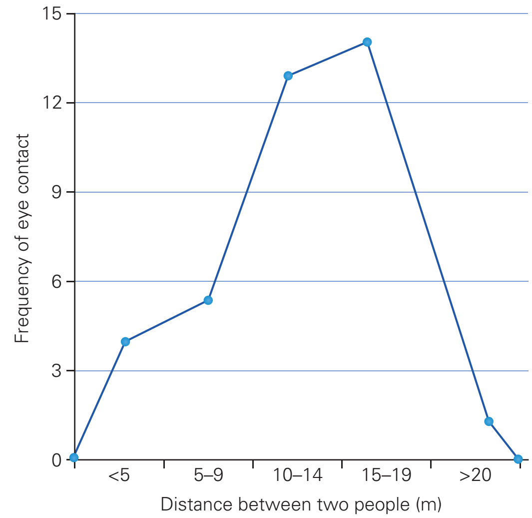


Figure 1.39 An example of a frequency polygon

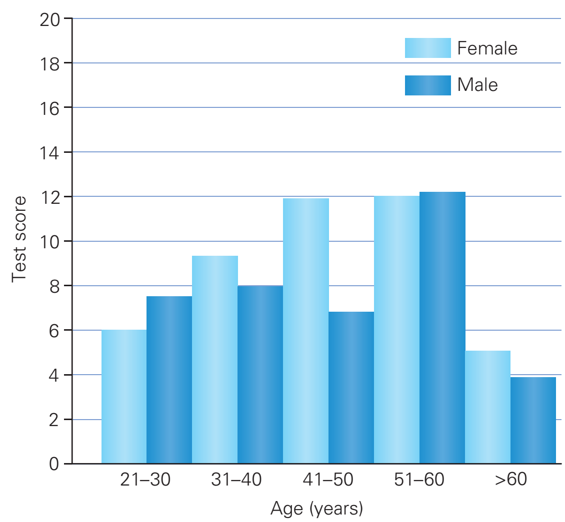


Figure 1.38 Test scores by age group and sex

continuous. Data for two groups of participants can be described on the *same* histogram using a different colour or pattern to identify the responses of different groups. This is shown in figure 1.38.

Frequency polygons

A frequency polygon is another method of graphically representing frequency distributions. A *frequency polygon* is used to graph the frequency of data; however, the presentation of the graph is like a line graph. Using a frequency polygon involves plotting the scores (or groups of scores) for a task on the horizontal *x*-axis against the frequency of the scores (or groups of scores) on the vertical *y*-axis of a graph. Dots are plotted at the intersection of the *x* and *y* axes to indicate individual scores, and a line is drawn to connect the dots and is brought down to 0 on the *x*-axis at either side of the polygon.

In a frequency polygon, if groups of scores are plotted on the *x*-axis, the scores are represented on the graph by the value of the midpoint of the range of scores. For example, if the interval of scores ranges from 0–4, the midpoint is 2. The dot to indicate the score of that range would be placed in line with the score of 2. Frequency polygons graph only the frequency of particular responses (or scores), whereas line graphs can be used to demonstrate a relationship between any two variables being studied.

One advantage of the frequency polygon over the histogram is that more than one set of data can be plotted on the same graph, which makes comparisons easier. For example, suppose a researcher collected data on the effects of sleep deprivation on problem-solving ability across three different age groups (15–20 years, 35–40 years, 55–60 years). These data could be presented on one graph, as shown in figure 1.40. To identify the results of the different groups on one graph, researchers could use different kinds of lines for

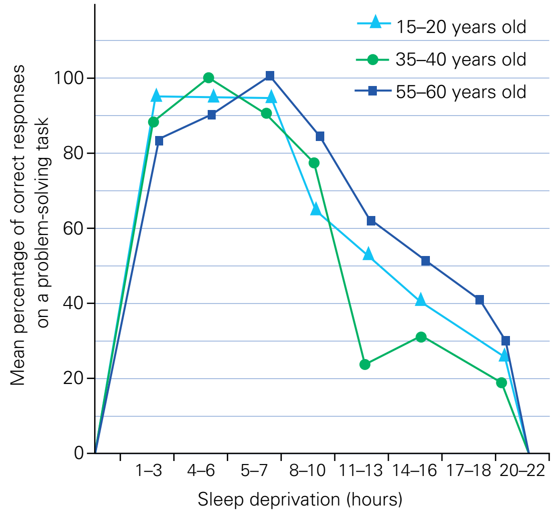


Figure 1.40 Frequency polygon showing a number of sets of data

each set of data (such as a solid line, a broken line and a dotted line), or different coloured lines (such as red, blue and green) or different shapes (such as triangles, circles and squares) to identify the point of intersection between the *x* and *y* axes.

Pie charts

A *pie chart*, or *pie graph*, is a circular diagram that shows the proportions of scores, values or cases (usually as percentages) within a set of data. The differences between the categories in a set of data are represented by different-sized 'slices of pie'. As shown in figures 1.41 and 1.42, a pie graph doesn't use a set of axes to plot data, and the data normally shown are percentages.

A pie graph is best used to compare different parts of the same whole. The circle of a pie graph represents the whole, or 100%. Each portion ('slice of pie') that takes up space within the circle stands for a part of that 100%. In this way, it is possible to see how something is divided into different categories.

A pie graph can be drawn by hand using a compass to construct the circle and a protractor for each portion of the circle. The circle is equivalent to 360° and each portion of the pie chart is calculated as a percentage of 360°, with 1% being equivalent to 3.6°. For example, if 20% needs to be represented in the pie graph, then 20% of 360° is 72° (or 20 × 3.6° = 72°). Within the pie graph, 72°

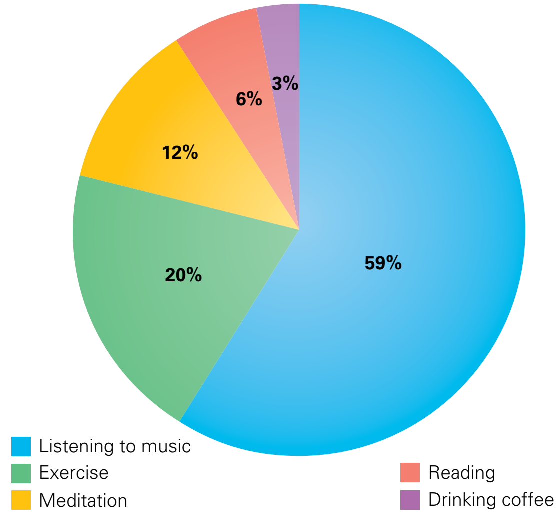


Figure 1.41 An example of a pie graph showing relaxation techniques used by participants when alone

would be a slice equivalent to 20% of the whole area of the pie. In figure 1.41, a key is used to indicate each category ('slice') of the graph and the percentage for each category is clearly shown. A pie graph such as the one in figure 1.42 can be constructed with Excel®, or similar software, to clearly show each category and its respective percentage.

A pie graph is effectively used to show proportions of data, particularly when there is

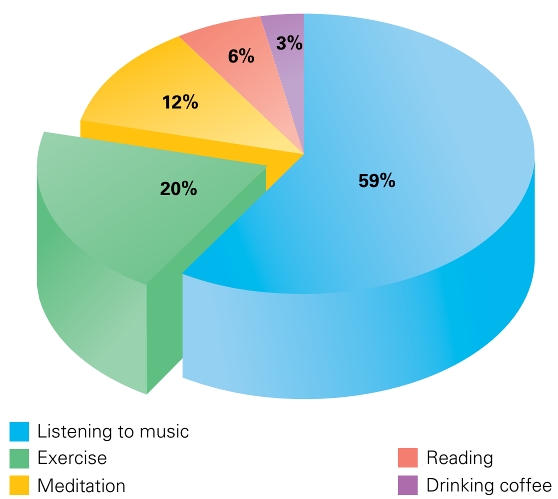


Figure 1.42 An example of a pie graph constructed with Excel software

a relatively small number of categories. However, it is important to be aware that if one (or more) parts of the whole is left out, then it artificially increases the percentage values of the other parts that are represented.

Inferential statistics

Descriptive statistics are useful for analysing, organising, summarising and describing data, but they do not in themselves indicate whether the results are meaningful; for example, whether they support the hypothesis being tested. Inferential statistics, on the other hand, enable the researcher to draw inferences, or conclusions based on evidence, about the results obtained in a study—particularly regarding whether the results would also occur in the population (larger group) from which the sample (smaller group) used in the study was drawn. There are many different inferential statistics that a researcher can choose from, and the choice is mainly determined by the kind of study done, the type of data collected and what the researcher wants to know about the results.

Figure 1.43 These preschoolers were participants in a research investigation on sleep patterns conducted by VCE students. They were part of a sample of eight participants who all attended the same eastern suburbs preschool. Can the results obtained from this sample be generalised to all preschoolers at the centre (i.e. the population)? Can the results be generalised to wider populations, such as all preschoolers in the eastern suburbs? In the Melbourne metropolitan area? In Victoria? Other populations? Inferential statistics can be used to make these types of judgments about results.

Generally, inferential statistics are used for making judgments, or decisions, about what the results collected from research mean. They allow the researcher to know what conclusions can legitimately be drawn from the results and what *generalisations* (wider applications) can legitimately be made. Inferential statistics are also used to enable the researcher to determine the *statistical significance* of their results.

Statistical significance and *p* values

The term **statistical significance** is used to indicate whether the difference in the results obtained for the experimental and control groups in an experiment is a *real* difference (that is, due to the independent variable) and probably not due to *chance* factors alone.

In any experiment there will inevitably be a difference in the mean scores of the groups studied. For example, suppose a researcher wanted to find out if a new study technique called SupaStudy improved performance on a Psychology test. The researcher conducted a simple experiment using two groups of Year 12 Psychology students from the same school. Group A was taught the SupaStudy technique and group B was not. Both groups attended lunchtime sessions three times a week for a month during which they were taught a new topic in Psychology. At the end of the topic, both groups were given the same test. The mean test score for group A was 79% and the mean test score for group B was 73%. On the basis of these results, what legitimate conclusion can the researcher draw about the effect of using SupaStudy on Psychology test performance? Assuming that the researcher controlled all factors that may have affected the results obtained, other than the use or non-use of SupaStudy, can the researcher draw a conclusion that SupaStudy 'works'? There's no doubt that 79% is a higher score than 73%, but the difference does not seem to be very large. Is the difference in the scores large enough to claim that SupaStudy had a real effect, or is the difference in the scores simply due to chance? What is an *acceptable* difference? How big does the difference between the mean scores of the two groups need to be in order to say that the difference is not due to chance?

One way to find out if the results are due to chance is to repeat an experiment several times in exactly the same way with exactly the same participants so as to see if the size of the difference is typical (that is, of about the same size each time the study is done). However, as well as being impractical, it is usually unnecessary. *Tests of statistical significance* can be used to determine the extent to which chance has operated and whether this is at an acceptable level. The tests enable a precise mathematical value to be obtained that will indicate the likelihood, or probability, that if the same experiment were repeated, the results would be similar (or different).

If the likelihood of the difference occurring by chance is extremely low, then it is said that the difference is *statistically significant*. In general, psychologists accept a difference as a true difference that can be said to be due to the independent variable when the probability that it might be due to chance is five or fewer times (≤ 5) in 100 repetitions of the same study. The way of saying this is that the result is significant at the 0.05 level. A significance level of $p \leq 0.06$ (less than or equal to 0.06) would indicate that there was a 6% chance (6 or less in 100) that the difference in mean scores obtained was most likely due to chance, and this would generally be unacceptable. It would therefore be said that the results did not support the hypothesis, and a conclusion would be made that the difference obtained was most likely due to chance alone. The significance level of any difference is called a ***p* value**, with *p* standing for probability. An acceptable *p* value for results is established before the experiment is conducted. In some cases, stricter probability levels than $p \leq 0.05$ are required, such as $p \leq 0.01$ (less than or equal to 1 in 100) and $p \leq 0.001$ (less than or equal to 1 in 1000) (see box 1.12). Such levels are used when the findings of the research are so important that a psychologist wants to be extremely confident in the results; for example, when the research hypothesis being tested involves a radical new treatment for a mental illness or if it contradicts a research finding or theory that is widely accepted.

If research is being undertaken in an area that is likely to be of immense benefit to the community, or if it involves a treatment that carries with it some chance of harm (as in the development of new medications or brain surgery), then replication of the study is still likely to occur.

Box 1.12

Probabilities expressed as decimals, percentages and ratios

Event	Likelihood	Decimal	Percentage	Ratio
When analysing research results	1 in 20 1 in 100	0.05 0.01	5 1	5:100 1:100
That you are alive	certain	1.00	100	100:100
A tossed coin will come up tails	1 in 2	0.5	50	50:100
That you will walk on Mars next week	impossible	0.00	0	0:100

Source: adapted from Malim, T., & Birch, A. (1998). *Introductory psychology*. London: Macmillan.

Learning Activity 1.23

Review questions

1 A researcher conducts an experiment and obtains statistically significant results. What does the term statistically significant mean?

2 Explain the meaning of the term *p* value, with reference to an example.

3 Write the meaning of the following p values as they apply to the findings of an experiment: $p \leq 0.001$, $p \leq 0.01$, $p \leq 0.10$. Make sure that you refer to the probable roles of chance and the independent variable.

4 a Which of the p values stated in question 3 can be interpreted as being *most significant*? Explain your answer.

b Which of the p values stated in question 3 can be interpreted as being *least significant*? Explain your answer.

5 Suppose you conducted a study and obtained results with a p value that is not ≤ 0.05. What would you conclude about the results?

Conclusions and generalisations

When a researcher has formed a view about the meaning of their results, a conclusion needs to be drawn from the results. A **conclusion** is a decision or judgment about what the results obtained from an investigation mean.

One type of conclusion relates to whether the hypothesis is supported or rejected on the basis of the results obtained. This requires careful examination of the results so that an objective, or 'unbiased', judgment can be made. Although the results alone may indicate that the hypothesis is supported, the results may have been influenced in a significant way by variables other than (or in addition to) the independent variable. Therefore, uncontrolled extraneous variables and potential confounding variables also need to be considered when drawing a conclusion, as the researcher must be confident that any change in the dependent variable was due to the independent variable and not any other variable.

The conclusion about the hypothesis is expressed as a statement in a written report that describes the investigation and its findings. In science, a hypothesis may be supported or it may be rejected, but it cannot be 'proven' true. This is because no matter how much support a researcher finds for their hypothesis, there may still be other alternative explanations, some of which are not yet known or even thought of, that could better explain the outcome(s) that has been observed.

Another type of conclusion that can be made is called a generalisation. A **generalisation** is a decision or judgment about how widely the findings of a study can be applied, particularly to other members of the population from which the sample was drawn. Because a study usually tests a sample from the population of interest rather than the whole population, making a generalisation is a process of forming an idea about whether findings obtained from a limited number of cases (that is, the sample) can be extended to apply to an entire class of objects, events or people (that is, the population). In experimental research, generalising the results from the sample to the population is risky if the sample is not representative of the population of interest. Like any other conclusion, a generalisation must also be based on the results obtained and must consider the potential extraneous variables, as well as any other problems with the study.

When drawing conclusions, researchers try to avoid making errors or overstating what the results mean. For example, they attempt to ensure that any influential extraneous variables or potential confounding variables have not been overlooked, that analysis and interpretation of the results enables an accurate finding about whether or not the hypothesis is supported, that the explanation of the findings is reasonable and supported by the results, that any generalisations are reasonable and that limitations of the sample used in the study have been considered.

In many cases, psychologists use university students enrolled in psychology courses as participants in their experiments. Some researchers believe that the results of these experiments cannot be generalised beyond the sample; for example, by applying the results to all students enrolled in a psychology course at a university, to students in other courses, to young adults, or to adults in general. However, other researchers believe that it is reasonable to assume that a relationship between an independent variable and dependent variable observed in one group of people is likely to be seen in other groups, as long as the relationship is a strong one and the sample of participants is not particularly unusual. For example, results from a sample of people with an addictive disorder or an intellectual disability cannot be generalised as easily as data obtained from university students.

The extent to which results can be generalised also depends on the topic studied. Many psychologists believe that researchers who study topics such as sensory processes and biological or physiological factors that underlie behaviour can more easily generalise their results. The phenomena that these researchers study are usually not affected by individual differences. For example, the visual system is basically the same for all people; therefore, differences between individuals in characteristics such as intelligence, beauty, personality, age, weight, political preferences, willingness to volunteer and so on will not affect it. Consequently, it is widely believed that it is reasonable to generalise findings on these topics.

Researchers who study topics such as personality, social behaviour, attitudes, consciousness and learning or memory strategies tend to be less likely to generalise their findings. In these areas, the effect of the independent variable is often influenced by the individual characteristics of the person participating in the experiment. For example, a new technique for learning mathematics may be effective for university students but not for secondary school or primary school students (Wood, 1981).

Figure 1.44 On the basis of a sample of one, can the results be generalised?

Learning Activity 1.24

Review questions

1. What kind of judgment is made about the hypothesis for a study after the results have been obtained and analysed?
2. **a** What is the meaning of the term conclusion?
   b What are the important considerations in drawing conclusions from results obtained in a study?
3. **a** What is the meaning of the term generalisation?
   b What are the important considerations in making generalisations from the findings of a study?
4. Distinguish between the terms conclusion and generalisation as they apply in research studies.

Reliability and validity in research

An important goal of research is to obtain results that are both reliable and valid. This will mean that the results are consistent and accurate.

Reliability

Reliability refers to the consistency, dependability and stability of the results obtained from the study. For example, if you measured your blood alcohol level on a breathalyser and then decided to double-check it, you should expect that the breathalyser will measure your blood level in the same way and that you get the same result. Similarly, if you conducted an experiment on a group of participants and repeated it again with a similar group of participants under the same conditions, you should expect the results to be very similar on each occasion the experiment is conducted.

Because conducting an experiment is a more complicated process than measuring your blood alcohol level, as it involves human participants and the strict control of many variables, it is not likely, or expected, that the results will be identical each time the experiment is conducted. The main reason the results of an identical study are unlikely to be exactly the same when replicated is due to individual participant differences within another sample. Even when a researcher repeats their experiment with the same participants it is unlikely that identical results will be obtained due to participant differences in responses to the IV manipulation and/or DV measurement, even if these are only minor differences. For example, consider the likelihood of your responding exactly the same way as you did in the original experiment if you are a participant in an identically repeated experiment, especially an experiment for which responses are relatively unrestricted. However, researchers believe that if the results of an experiment are to be considered reliable, they should be *similar* each time the experiment is repeated.

Of course, a researcher always sets out to obtain reliable results. Reliability is demonstrated when the overall pattern of results, and therefore the interpretation of the results, remain the same. However, when a researcher repeats their study, it may be found that the results are not replicable. When findings cannot be replicated, poor reliability is demonstrated. This is more likely to occur if the study is not repeated in exactly the same way in which it was first conducted; for example, if there are differences in important personal characteristics of participants or if the conditions under which the study was first conducted are significantly different in some way. Furthermore, if a research finding cannot be reproduced using another valid research method, then the original finding may be regarded as unreliable as it is likely to depend on the research method that was used rather than the IV that was tested.

Reliability also refers to the consistency of the measurement tool used to assess a particular behaviour or characteristic. As many psychological characteristics such as intelligence, motivation, self-esteem and personality traits are usually measured indirectly by psychological tests, these tests must be considered in terms of their internal consistency. **Internal consistency** refers to the interrelatedness of items (or questions) in a psychological test in measuring the same ability or trait. A measure of internal consistency indicates how well the items relate to other items in the test and to the overall total score on the test. A high score on a measure of internal consistency means that the test items all relate to (or assess) the same psychological characteristic. This would indicate that the test has high internal consistency reliability.

Validity

Validity means that the research study has produced results that accurately measure the behaviour or event that it claims to have measured. For example, if you measured your biceps with a cloth tape measure that had been left outside in the open weather for a long time and had stretched and become inaccurate, the result would not be a valid measure of your true bicep size. The inaccurate cloth tape measure, however, is reliable as it will give you the same result each time it is used. In other words, a measure can be reliable even though it is not valid, but a measure cannot be valid unless it is reliable.

As many psychological characteristics cannot be measured directly they must be inferred from other directly measurable (observable) behaviours that are believed to be associated with or 'reflect' the characteristic. For example, the construct of aggression can only be inferred from behaviours such as physical violence, verbal abuse and other aggression-related behaviours. A measurement tool has **construct validity** when there is evidence that the measured behaviours relate to the specific characteristic or behaviour being assessed.

Another type of validity relates to the conclusions the researcher makes about a study. In this case, the results are valid if the conclusion(s) drawn by the researcher is (are) correct. This means that the conclusion is specifically based on those variables that the study was investigating and the data obtained from the study. For example, if a researcher concludes that a new medication they tested in an experiment reduces symptoms of depression, or that participants in a taste-preference study preferred Coca-Cola over Pepsi, the research is valid only if the new medication really works or if the participants really did prefer Coca-Cola.

As with seeking reliability, researchers always attempt to conduct valid research; that is, they attempt to draw accurate conclusions from their data. Yet often, despite a researcher's best intentions, their research is invalid or not as valid as it could have been. This can occur for a number of different reasons. Sometimes a researcher may draw a conclusion from their data that cannot actually be drawn; that is, the data do not actually justify, support or 'back up' the conclusion. Another reason that research and its results may be invalid is because one or more extraneous variables have not been adequately controlled, or have become confounding variables, and have therefore influenced the results in an important way. For example, in an experiment, a confounding variable (an 'unwanted IV') and the IV will both affect the results. When this happens, the researcher will find it difficult to separate the effects of the IV and the confounding variable and therefore cannot be certain whether it was the IV or the confounding variable that caused the change in the DV.

Researchers often distinguish between the internal and external validity of their studies. They consider both internal and external validity in judging the overall validity of a study.

Internal validity refers to the soundness of the design of the research and the procedures used to conduct the study. Researchers need to be confident that the specific method used to conduct a study actually tests the hypothesis and that the hypothesis has been tested in a convincing way. In the case of an experiment, a true cause–effect relationship must be demonstrated if it is to be considered to have internal validity. If an experiment (or any other type of study) has gaps or 'flaws', such as using a sampling procedure that results in an unrepresentative sample when it is important to have a representative sample, then the experiment will be considered as lacking in internal validity.

External validity refers to how well the research findings can be generalised or applied beyond the specific participants and settings used in the study; that is, to people and situations in real life. For example, suppose that a researcher conducted a laboratory experiment on the effects of a stress on behaviour using a relatively small sample of participants. If the experiment has external validity, then the findings can be generalised to apply to situations outside, or 'external' to, the laboratory. To be externally valid the findings must also be able to be replicated in other experiments by other researchers; that is, the findings cannot be a one-off outcome. External validity of any single study may only be established by replication of findings in further studies, especially with different participants and procedures, and in the field or real-life situations.

Figure 1.45 If a researcher concludes that participants in a taste-preference study preferred Coca-Cola over Pepsi, the research is valid only if the participants really did prefer Coca-Cola.

Both validity and reliability are important in any research. Their relationship, however, can sometimes be confusing. Measurements can be reliable without being valid, but they cannot be valid unless they are reliable. Furthermore, for an experiment to be externally valid, it must be internally valid; that is, a true cause–effect relationship has been demonstrated.

Learning Activity 1.25

Review questions

1. Distinguish between validity and reliability in research.
2. Is it essential that the results of an experiment can be replicated in order for the experiment to be considered reliable? Explain your answer.
3. Give an example of when results would not be considered reliable.
4. Explain the meaning of internal consistency with reference to an example.
5. Explain the meaning of construct validity with reference to an example.
6. Under what circumstances can it be said that the conclusions or findings of research are valid?

7 **a** Distinguish between internal and external validity with reference to an example.
b Explain, with reference to an example, whether a study can have internal validity but not external validity.

8 Explain, with reference to an example, why reliability is possible without validity but validity requires reliability.

Learning Activity 1.26

Designing an experiment and interpreting the results

Outline the design of an experiment that could be undertaken to test the following hypothesis: 'If a newborn infant has extra contact with their mother soon after birth, then the bond formed between the mother and infant will be stronger.' You have 12 mothers who are about to give birth and who have volunteered to be participants in your experiment for two years. In designing your experiment, make sure that you address the following.

- What terms need to be operationalised?
- Construct an operational hypothesis for the experiment.
- What groups will be used?
- What are the independent and dependent variables?
- What potential extraneous or confounding variables will it be important to control?
- What type of experimental design will you use? Explain your choice of design.
- If you find an acceptable significant difference in the results for the two groups (say, $p \leq 0.05$), what conclusion would you draw? What generalisation would you make?

Ethical principles and professional conduct in psychological research

Is it appropriate to expose participants to stressful conditions in order to study bodily changes involved in stress responses? Is it appropriate to deprive participants of sleep for a prolonged period of time in order to study the effects of sleep deprivation? Is it appropriate to deceive participants and misinform them of what an experiment is about in order to control the potential influence of demand characteristics on the results? Should it be permissible to conduct research that has no immediate benefits to humankind? Should participants in psychological research be fully informed of the purpose of the research before they agree to participate? Should participants have the right not to have any of their personal details revealed by the researcher? Should participants have the right to withdraw from an experiment at any time, irrespective of their reasons for wanting to do so? Such questions raise important ethical issues that need to be considered by researchers.

The term **ethics** refers to standards that guide individuals to identify good, desirable or acceptable conduct. Essentially, ethical standards help us to make judgments about which behaviours are appropriate ('right') and inappropriate ('wrong'). All societies and cultures have ethical standards that guide the behaviour of members of that society or culture. In addition to the ethical standards of a society or culture, most professions have their own standards of ethical conduct that must be followed. For example, just as it would be considered unethical for a medical doctor to discuss a patient's condition with anyone apart from the patient or people responsible for the patient, so too would it be unethical for a psychologist to reveal information discussed in a counselling session or the results of a psychological test to anyone apart from the client, or the guardians of the client if the client is a child or someone else under a guardian's care.

Ethical standards and considerations also apply to researchers, how they conduct their research and all other aspects of the research. The way human (and non-human) participants in any research study are to be treated is determined by ethical guidelines. These guidelines help to ensure that the wellbeing and rights of research participants are protected during their involvement in a research study and following the study. In addition, the guidelines help to prevent unnecessary research and promote research that is or will be of benefit to the community or humankind.

The Australian Psychological Society (APS) has a *Code of Ethics* (2007), which provides guidelines that must be followed when working with people (and animals) in research situations (and all other areas of professional practice). The *Code of Ethics* has been devised with reference to a national set of ethical guidelines that are intended to cover all research involving human participants, not just psychological research. These guidelines are called the *National Statement on Ethical Conduct in Human Research* (2007).

The National Statement has been co-issued by the National Health and Medical Research Council (NHMRC), the Australian Research Council and the Australian Vice-Chancellors' Committee. The National Statement has been prepared to help ensure that researchers meet the requirements of all Australian government acts of parliament related to research involving people. This means that all researchers are legally required to follow all ethical guidelines specified by the National Statement. However, the purpose of the National Statement is to promote appropriate research values ('what is important') and procedures for ethical reasons rather than legal reasons. This ensures that participants are given the respect and protection that is due to them. It also encourages researchers to undertake research studies that will be of benefit to the community (National Health and Medical Research Council, 2007).

The National Statement and APS *Code of Ethics* for research with human participants cover all aspects of research, particularly the roles and responsibilities of the researcher and the wellbeing and rights of research participants.

Roles and responsibilities of the researcher

Research must be conducted or supervised only by individuals or teams with experience, qualifications and competence appropriate to the research. When planning research, the researcher must take into consideration all of the ethical issues involved. The researcher is responsible for ensuring that the research is conducted in such a manner that the wellbeing of research participants is the main concern and that participants are not placed at risk of injury or harm in any way. Under no circumstances is the researcher allowed to conduct research that causes participants severe distress. If unexpected stress reactions of significance occur, the researcher must immediately alleviate the stress reactions and terminate the investigation. If a research procedure involves participants in high levels of emotional arousal, the researcher must ensure that no psychologically vulnerable person participates. The researcher must be aware that in all scientific research with human participants, there is a need to ensure that any risks of discomfort or harm to participants are balanced by the likely benefit to be gained.

At all times throughout the research, researchers are expected to conduct themselves in a professional manner. They must not behave in a manner that brings disrepute to the psychology profession,

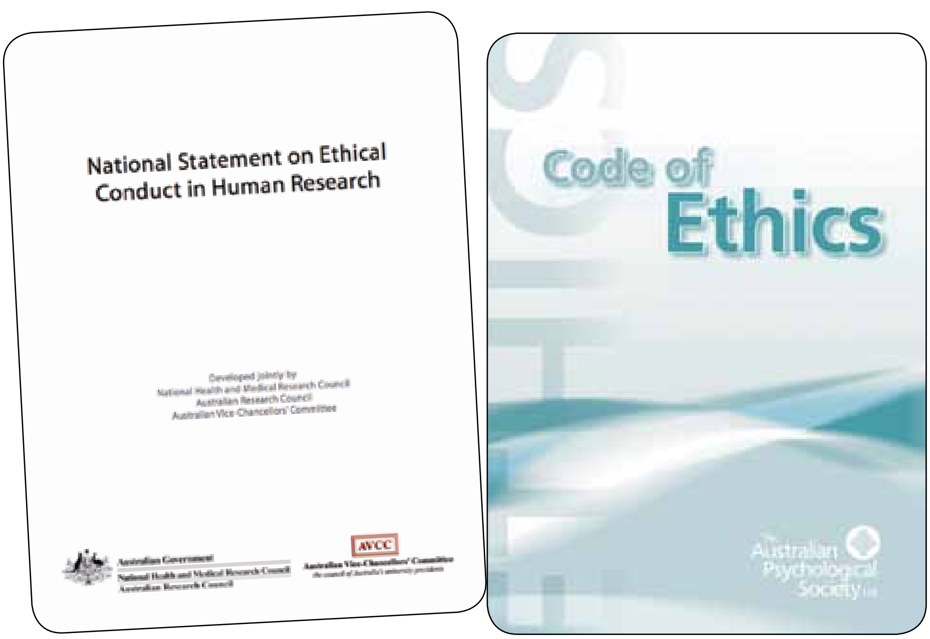


Figure 1.46 All psychologists conducting research with human participants follow the guidelines in the National Statement. The guidelines in the APS *Code of Ethics* are consistent with those in the National Statement.

or to scientific research. For example, they must not use a position of authority to put pressure on people to agree to participate in research. In addition, if psychologists are involved in conducting research with colleagues who are not psychologists, such as biologists or medical practitioners, they have a responsibility to ensure their research colleagues agree to follow all ethical guidelines before conducting the research.

Participants' rights

As well as ensuring that no psychological or physical harm is caused to research participants, a researcher must also respect and ensure the security of participants' human rights as individuals. These rights include confidentiality (privacy), voluntary participation, withdrawal rights, informed consent and access to debriefing.

Figure 1.47 All participants in psychological research irrespective of age, sex, religion, abilities, educational background, cultural background and so on have rights that must be respected. The National Statement emphasises the importance of valuing and respecting human rights when planning, conducting and reporting research.

Confidentiality

Participants have a right to privacy, so any details of their involvement in a study (such as test results or personal information) cannot be revealed in a manner that enables individuals to be identified, unless their written consent is obtained. The confidentiality requirement applies to the access of research data by others, and to the storage and disposal of research data. Wherever possible, the procedures for establishing confidentiality must be explained to participants before the research study is actually conducted.

Voluntary participation

The researcher must try to ensure that participants voluntarily consent to be involved in the study. Participants must not be pressured to take part in a study. The researcher must also ensure that prospective participants do not experience negative consequences if they choose not to be involved in the study.

Withdrawal rights

The researcher must inform participants of the nature of the research and that they are free to participate or decline to participate, or to withdraw from the research. Furthermore, a participant must be permitted to withdraw from a study at any time, without giving a reason, should they wish to do so.

Informed consent procedures

Wherever appropriate, participants must be informed of the nature and purpose of the research. Such informed consent must be appropriately documented; for example, by completion of a consent form that takes account of the participants' level of comprehension and includes information about the purpose, methods, demands, risks, inconveniences, discomforts and possible outcomes of the research, including the likelihood and form of publication of research results. Figure 1.50 on page 81 is an example of a consent form.

For participants who are legally incapable of giving informed consent (e.g. children or people with an intellectual disability), the researcher must provide an appropriate explanation, obtain the participants' consent and/or obtain appropriate consent from those who are legally responsible for the welfare of the potential participants (e.g. a parent or legal guardian).

To help decide whether or not an experiment requires informed written consent of research participants, the researcher must consult with colleagues and ethics committees as appropriate.

Figure 1.48 All participants must be informed about the nature of the research to be undertaken by the researcher, unless deception is essential and justifiable in terms of the potential benefits of the research.

Debriefing

Debriefing involves clarifying participants' understanding of the research study after it has been conducted. This includes correcting any mistaken attitudes or beliefs that participants may have about the research. The researcher must anticipate the possible effects on participants of being involved in the study, and provide information about services available to treat any unnecessary distress that results from their participation.

Once the entire study has been completed, the researcher must provide an opportunity for participants to obtain appropriate information about the study, including its procedures, results and conclusions.

Use of deception

Sometimes, giving participants specific information about a study may influence how they think, feel or behave during the research and affect the accuracy of the results. When it is necessary for scientific reasons to conduct a study without fully informing participants of its true purpose before commencement, the researcher must ensure that participants do not suffer distress from the research procedure. Furthermore, in all cases involving deception, participants must be debriefed at the conclusion of the study.

Role of ethics committees

In universities, where most psychological research is planned and conducted, ethics committees review, or 'assess', research proposals for approval purposes, and then monitor the conduct of the research (if it is approved) to ensure all relevant ethical guidelines are adopted and followed. The National Statement formally refers to these committees as human research ethics committees (HRECs).

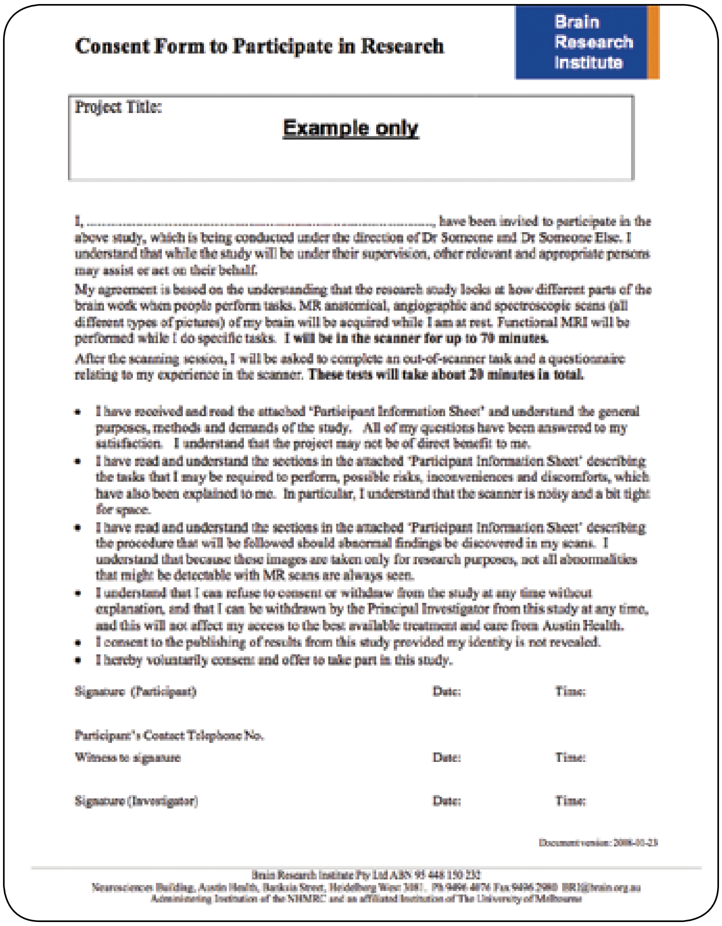
Any HREC is required to have a minimum of eight members, preferably with an equal number of men and women, and with at least one-third of the members from outside the institution for which the HREC is reviewing research. In addition, HREC membership includes at least two people with current research experience that is relevant to the research proposal to be reviewed, a lawyer, someone who performs a pastoral care role in the community (e.g. an Aboriginal elder or a minister of religion), someone professionally qualified in caring for or counselling people (e.g. a nurse or social worker), and two people from the wider community ('lay people' but not scientists, doctors, lawyers or academics such as university lecturers).

Generally, the roles of the HREC include:

- ensuring the research study is designed and conducted in ethically appropriate ways and in full accordance with relevant National Statement guidelines
- ensuring the researcher(s) is adequately experienced and qualified (or the researcher is supervised by a qualified person if there are concerns about the their experience and qualifications)
- monitoring approved research (e.g. through progress reports, random inspections of research sites, interviews with participants)
- handling complaints (e.g. from participants, the wider community)

- ensuring accountability of the researcher (i.e. the researcher understands, accepts and maintains responsibility for all aspects of their research).

Figure 1.49 Human research ethics committees are established to review research proposals for approval purposes, and then monitor the conduct of the research to ensure all relevant ethical guidelines are adopted and followed. Review meetings are usually informal.



Consent Form to Participate in Research

Brain Research Institute

Project Title:

Example only

I, ..., have been invited to participate in the above study, which is being conducted under the direction of Dr Someone and Dr Someone Else. I understand that while the study will be under their supervision, other relevant and appropriate persons may assist or act on their behalf.

My agreement is based on the understanding that the research study looks at how different parts of the brain work when people perform tasks. MR anatomical, angiographic and spectroscopic scans (all different types of pictures) of my brain will be acquired while I am at rest. Functional MRI will be performed while I do specific tasks. **I will be in the scanner for up to 70 minutes.**

After the scanning session, I will be asked to complete an out-of-scanner task and a questionnaire relating to my experience in the scanner. **These tests will take about 20 minutes in total.**

- I have received and read the attached 'Participant Information Sheet' and understand the general purposes, methods and demands of the study. All of my questions have been answered to my satisfaction. I understand that the project may not be of direct benefit to me.
- I have read and understand the sections in the attached 'Participant Information Sheet' describing the tasks that I may be required to perform, possible risks, inconveniences and discomforts, which have also been explained to me. In particular, I understand that the scanner is noisy and a bit tight for space.
- I have read and understand the sections in the attached 'Participant Information Sheet' describing the procedure that will be followed should abnormal findings be discovered in my scans. I understand that because these images are taken only for research purposes, not all abnormalities that might be detectable with MR scans are always seen.
- I understand that I can refuse to consent or withdraw from the study at any time without explanation, and that I can be withdrawn by the Principal Investigator from this study at any time, and this will not affect my access to the best available treatment and care from Austin Health.
- I consent to the publishing of results from this study provided my identity is not revealed.
- I hereby voluntarily consent and offer to take part in this study.

Signature (Participant) Date: Time:

Participant's Contact Telephone No.

Witness to signature Date: Time:

Signature (Investigator) Date: Time:

Document version: 2008-01-23

Brain Research Institute Pty Ltd ABN 95 448 150 232
Neurosciences Building, Austin Health, Banksia Street, Heidelberg West 3081. Ph 9496 4076 Fax 9496 2980 BRI@brain.org.au
Administering Institution of the NHMRC and an affiliated Institution of The University of Melbourne

Source: Brain Research Institute, Austin Health, www.brain.org.au/docs/consent_form.pdf.

Figure 1.50 Example of a consent form used in psychological research. It is used in conjunction with a briefing statement or 'participant information sheet'.

Box 1.13

Ethical considerations in VCE Psychology

The VCE Psychology Study Design provides advice to teachers on student safety and wellbeing, and ethical conduct of experimental investigations in VCE Psychology courses. Following are the relevant extracts from the study design.

Safety and wellbeing

This study may include potentially sensitive topics. Teachers should ensure that students have opportunities to consider topics systematically and objectively, and to become aware of the diversity of views held on such matters. Students should not be asked to disclose personal information about their own or others' health status and behaviours nor should they feel compelled to volunteer this information.

When dealing with sensitive mental health matters, students should be specifically advised that they:

- should not necessarily interpret their own experiences as signs of pathology
- are not in a position to diagnose problems or offer any counselling or therapy.

In addition, students should be given information about sourcing available treatment services within and outside school.

As part of this study teachers and students consider different assessments of intelligence, including standardised psychological tests which are designed to be administered only by trained psychologists.

Teachers must limit access to such tests and ensure that students understand that such tests are valid only if administered by a qualified psychologist.

Ethical conduct of experimental investigations

As part of this study teachers and students will be involved in teaching and learning activities that include experimental investigations using human subjects. Teachers and schools have a legal and moral responsibility to ensure that students follow ethical principles at all times when undertaking such investigations. Teachers should refer to the following documents for detailed advice:

- the *National Statement on Ethical Conduct in Human Research* (2007), issued by the National Health and Medical Research Council (NHMRC) in accordance with the *NHMRC Act 1992* (Cwlth), www.nhmrc.gov.au/publications/synopses/e72syn.htm
- the National Privacy Principles in the *Privacy Amendment (Private Sector) Act 2000* (Cwlth), www.privacy.gov.au/
- the *Code of Ethics* of the Australian Psychological Society (APS), www.psychology.org.au.

Source: Victorian Curriculum and Assessment Authority (2009). *Psychology, Victorian Certificate of Education Study Design*, p. 9.

Use of animals in research

Although psychology is primarily interested in human mental processes and behaviour, about 10% of research involves non-human participants. Within this group, most are mice, rats, hamsters and pigeons. About 5% of the animals used are monkeys and other primates.

The main reasons animals are used in research are:

- Some psychologists are genuinely interested in studying animal behaviour. This field of study is commonly referred to as ethology.
- Some studies cannot be conducted with humans due to the risk of psychological and/or physical harm that may be caused, or because suitable human participants are unavailable.
- Bodily systems and/or behaviours of some animals are similar to those of humans; therefore, using animals can be a starting point for learning more about human behaviour.
- Animals have practical advantages over people for use as research participants. For example, studying the effects of ageing from birth through to old age is not generally practical in humans because most people live for more than 75 years, compared with rats which have a life expectancy of two years. Another advantage is that some animal species breed a lot faster than humans. For example, rats produce a new generation every three months and can be used to study the development of certain behaviours over successive generations within a relatively short period of time. Animals can also be kept for long periods of time in captivity in laboratories and it is easier to observe their behaviour under these conditions.
- The behaviour of animals can usually be controlled to an extent not possible with human participants. For example, a rat can be raised from birth in a cage. The rat can then be used in a learning experiment and the psychologist will have a good idea of what it has already learned before the experiment is conducted.
- When certain experiments require large numbers of participants who have, for example, the same genetic background, animals are more easily obtained than humans.
- Demand characteristics and other participant variables can influence the results research studies; however, animals don't usually have expectations and they are not able to guess the purpose of an experiment.

Many arguments have been presented against the use of animals in psychological research. One argument is that it is not possible to generalise the results of research with animals to humans because the species are not the same, even though there may appear to be similarities, particularly with primates. An issue for researchers is how far they can generalise about human mental experiences and behaviour from the results of animal studies.

If laboratory animals die after prolonged sleep loss, would humans? If a drug causes a brain disorder in animals, should it be banned for human use?

Another argument is that humans should respect animals and protect them from harm rather than use them in research. It is also suggested that humans do not have the right to dominate other species.

Care of laboratory animals must be directly supervised by a person competent to ensure their comfort, health and humane treatment. The care and use of animals in research must follow the NHMRC 2004 *Australian Code of Practice for the Care and Use of Animals for Scientific Purposes*.

According to the NHMRC guidelines, *any* research with animals, including research activities in schools, can be performed only if the research can be justified. Justification involves weighing the predicted scientific or educational value of the research against the potential effects on the wellbeing of the animals.

If an animal is to be subjected to pain, stress or deprivation (e.g. food, social interaction, sensory stimuli), research may only occur if no other alternative is available. If surgery is to occur, the animals must be given the appropriate anaesthesia so they do not experience pain. When an animal's life is to be terminated, it must be done quickly and painlessly.

Learning Activity 1.27

Review questions

1. Construct a table that summarises the ethical guidelines for conducting human research. Use the table to develop an ethics checklist to be used for your practical activities and research investigations in Units 3 and 4. Include definitions of ethics and ethical guidelines for research in your table.
2. Give three advantages and limitations of the use of animals in psychological research.
3. List three key guidelines relevant to the use of animals in research.

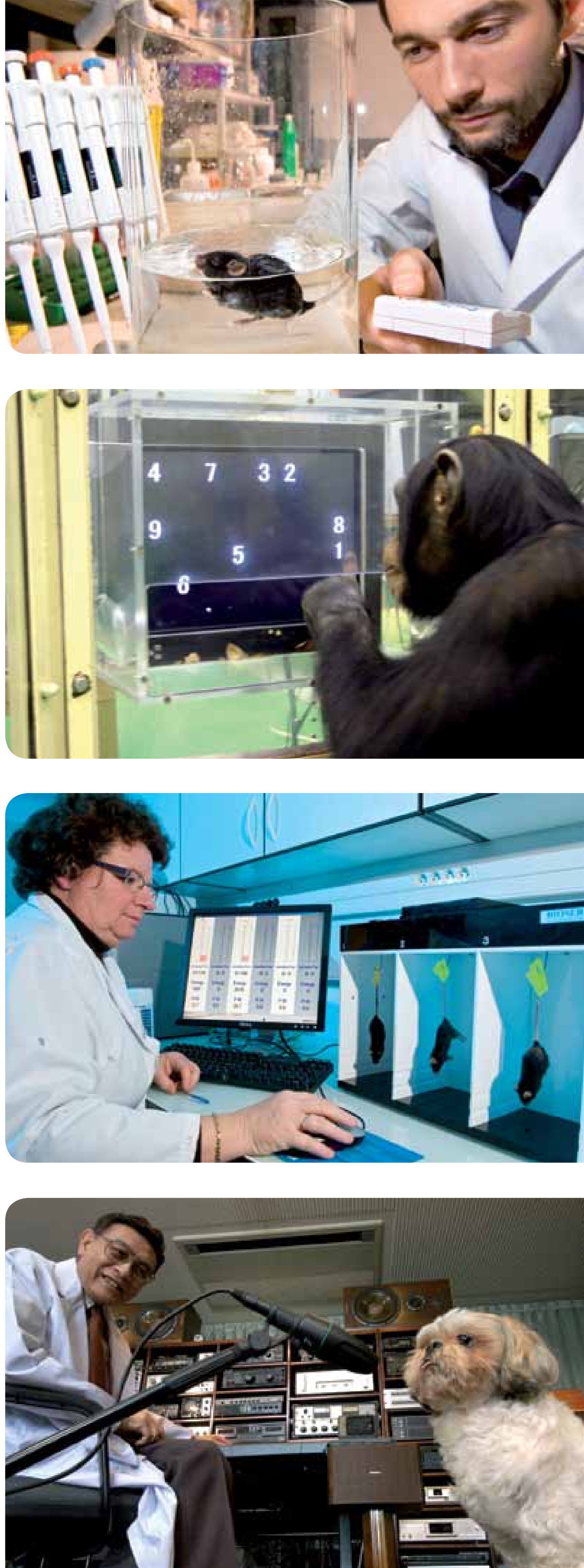


Figure 1.51 Animals are used in a wide variety of psychological research projects. Research with animals is governed by NHMRC ethical guidelines.

Learning Activity 1.28

Identifying ethical issues

Consider the following fictitious examples of research studies that may breach one or more ethical guidelines and identify the ethical issue(s) raised, if any, in each example. If you completed Learning Activity 1.27, you may use your ethics checklist to guide your evaluation of each research study.

Study 1

A psychology lecturer at a university was studying techniques for reducing fear of spiders. He asked a research assistant to telephone students in the first-year psychology course he was teaching to determine their willingness to participate. The researcher was unaware that the assistant told participants that they had to participate.

Study 2

A researcher was interested in factors influencing cheating. She gave participants an exam, then collected and photocopied their answers. The participants were not informed about the photocopying. The answers were returned unmarked and the participants were given the opportunity to cheat while marking their own papers. The answers were collected again and compared with the photocopies.

Study 3

An experiment was conducted to assess driver reaction to a stressful situation. Each participant was asked to drive a car past a construction site. The researcher rigged a human-looking dummy in such a way that it would be propelled in front of the car, making it impossible for the participant to avoid hitting it. The participants reacted as expected. When they learned that the situation was faked, they informed the researcher of their displeasure. Despite their complaints, the researcher continued testing further participants (adapted from Wood, 1981).

Study 4

A VCE Psychology student was required to undertake a research investigation to satisfy the course requirements. The student researcher replicated an experiment on learning that involved classical conditioning of an eye-blink response using two preschool children and two adults as participants. The student researcher thought that the adult participants' knowledge of the conditioning procedure would affect the results in an unwanted way and decided not to seek their informed consent. The student researcher also based their decision on the belief that the conditioning procedure was physiologically and psychologically harmless. The student researcher did, however, obtain informed written consent from both parents of each child.

Study 5

A VCE Psychology student was required to undertake a research investigation on a topic of personal interest to satisfy the course requirements. The student researcher decided to condition a rat to respond by standing on its hind legs whenever it heard a whistle. The student purchased a rat from a pet store, took it home and used what she believed was an accurate interpretation and application of operant conditioning principles to train the rat to make the desired response. This essentially involved blowing the whistle and rewarding the rat with a food pellet when it made a response like that of the target behaviour or smacking it with a plastic ruler if it didn't, but only smacking hard enough to cause discomfort and not pain.

The student's mother noticed what was happening, believed that the rat was distressed by her daughter's procedure and intervened by trying to contact the psychology teacher to express her concerns. As events unfolded, the psychology teacher was absent on a 10-day school excursion and was unaware of his student's choice of research topic and procedures.

Reporting conventions

The final and very important stage in the research process involves writing a report on the research study and its findings. This is done for two main reasons:

- to communicate or share the results with others, particularly other researchers interested in what was studied
- to enable replication of the study to test the validity and reliability of its results.

When reporting research, psychologists provide a detailed description of the study and its findings. The report has two important characteristics:

- there is enough information to enable close examination of all stages of the research (including the results) and, if required, to replicate the research
- reporting conventions are used.

Reporting conventions are well-established and widely recognised standards, or 'rules', about how a report is written and presented. Reporting conventions determine aspects of the report such as writing style, structure of the report, headings, presentation of tables and graphs, and formats for referencing. For example, the writing style, or language used in a psychological research report, is like that of all scientific reports. The language is formal, clear and concise, and is written in the past tense, in the third person and using the passive voice. Appropriate phrases that meet these language standards are: 'An experiment was conducted to test …', 'Each participant was …', 'The results show …', 'It can be concluded that …'. Scientific reports are *not* written using the first person; for example, 'I did …', 'We asked …', 'In my opinion …', 'I believe that …', ' … and then we asked the participants to …'.

Conventions for psychological research reports are based on those described in the *Publication Manual of the American Psychological Association, Fifth Edition* (2001). This manual, commonly called the 'APA manual', is widely recognised and used by psychologists throughout the world to guide their preparation and presentation of research reports. These conventions are also used by psychology students for writing research reports conducted as part of their studies.

The following guidelines for writing a research report and referencing are based on the APA manual.

Research reports

A research report is presented in sections that follow a set order. However, the structure of the report and organisation of the sections may sometimes be modified to suit a particular investigation. Generally, the report is presented in a logical sequence that describes

- what was done
- why it was done
- how it was done
- what was found
- what the findings probably mean.

Although the different sections of the report described below are usually presented in the order shown, they do not have to be prepared in that order. For example, the abstract, which summarises the investigation, appears first in the report but is usually easier to write last.

Title

The title should be brief (usually one sentence) and indicate clearly what the investigation was about. Quite often, researchers use a statement based on the hypothesis for a title.

Abstract

The abstract is a brief summary (about 120 words) of the investigation, usually presented as a single paragraph. It should include a statement of the aim (purpose) of the investigation, the main features of the method (information about the participants and an overview of the procedures used), the results (main findings) and the conclusion(s).

Introduction

The introduction (about 200–250 words) gives the background of the investigation. It often summarises relevant theory and results of other research related to the investigation. The introduction provides background information for the current investigation. If you are unable to find relevant background information, or it is not required by your teacher, then you should explain the rationale ('reasoning') for conducting the investigation.

The introduction is often written in a way that leads the reader to a statement of the aim of the investigation and the hypothesis that was tested. The hypothesis is usually included in the last paragraph of the introduction and should be formally expressed in accordance with all requirements of a research hypothesis.

Method

The method section (about 150–200 words) clearly describes how the investigation was conducted. There should be enough details for the reader to know exactly what was done so that the investigation could be replicated exactly in order to test the results. The method is often divided into three sections: participants (or subjects), materials (or apparatus) and procedure.

- *Participants*: this section includes details on how many participants were used, important characteristics that might have influenced the results (such as age, sex, educational background), the population from which they were drawn, how they were selected and, if in an experiment, how participants were allocated to conditions or groups. Details of the participants are often presented as a table.
- Materials: this section lists equipment and other materials used. A diagram(s) can be used, if appropriate. A description of word lists, questionnaires, observation checklists, test items, data sheets and so on that were used in conducting the research should be listed and examples included in an appendix at the end of the report.
- Procedure: this section gives a detailed description of the steps involved in conducting the investigation. This information should be presented in a logical sequence (e.g. step by step). Information about the roles of the researcher and specific instructions given to participants (where appropriate) should be included. (If you used a procedure described elsewhere, your teacher may permit you to cite the source instead of writing all the information.)

Results

The results section has a summary of the main results. These should be accurate and displayed clearly.

Tables, graphs, charts and other figures are used, depending on the type of data collected. Each of these should be numbered, have a descriptive title and use other conventions as described on pages 66–71. The reader should be able to understand any table or figure without referring to another section of the report.

Only summary data should be presented in the results section. Raw data should be included only in an appendix. Generally, detailed comments on the results (e.g. interpretation) are included in the discussion.

Discussion

In the discussion section (about 200–250 words), the results are interpreted and explained. The section usually starts with a statement about whether the hypothesis is supported or rejected on the basis of the results obtained. The general relevance of the results to the population from which the sample was drawn, and to the theory or other research (referred to in the introduction), should also be described. In drawing conclusions, relevant extraneous and potential confounding variables and their possible impact on the results should be considered and explained. It may also be appropriate to suggest ways of effectively controlling such variables if the research were to be replicated.

References

This section has a list of all sources cited in the report (but no others). Every quotation or summary of information from another source used in the report must be substantiated with a reference. The list of references should be presented in alphabetical order based on the surname of the first named author of a source. The formats for writing references commonly used in psychology are described in box 1.14.

Appendices (if any)

Materials that do not fit into the other sections of the report are placed in the appendices. There should be a different appendix for each set or category of materials. Each appendix should be numbered and have a title; for example, 'Appendix 1 Test items for elaborative rehearsal'. Materials included in an appendix should be referred to in the body of the report; for example, 'Test items for elaborative rehearsal (see appendix 1)'.

Box 1.14

Referencing in psychology

In psychology, the style specified by the American Psychological Association (APA) is used for citing and referencing sources of information. This style is based on what is known as the Harvard or author–date system. Numerous examples of the APA method of referencing, as applied to a variety of sources, can be found in the references list at the back of this textbook. All references used in preparing a research report or an essay must be cited within the body of the report or essay and included in a list of references at the back of the report.

Note that 'et al.' is a short form of 'et alia', which is Latin for 'and others'. In this text we prefer to use '& others' when citing journal articles or texts with four or more authors.

Citations

Whenever a source of information other than your own ideas—that is, another author's work—is used to present evidence, give an example, develop an argument and so on, the source must be cited. This procedure helps the reader differentiate your ideas and work from those of another person(s).

When writing a research report or essay, it is sometimes necessary to cite within a sentence, and at other times at the end of a sentence (or paragraph). Examples of how this is done are:

Within a sentence

One author: In a study by Smith (2005), participants were required …

Two authors: A similar result was reported by Voulos and Jones (2007), who found that …

Three or more authors: Black, White and Grey (2006) studied the effects of …

Three or more authors if cited again: Black et al. (2006) concluded that …

At the end of a sentence

One author: Participants who are rewarded are more likely to repeat the response for which they are rewarded (Canasta, 2001).

Two authors: When individuals are anxious they tend to seek the company of other people (James & Malcovich, 2007).

Three or more authors: This phenomenon is not unique to humans. It has also been observed in primates such as apes and gorillas (Stavros, Wilson & Pink, 2004).

Citing references within sources

Sometimes you need to cite a source that was referred to by another author; for example, when you read about a study or research finding that was summarised and cited in a textbook. In this case, you would cite the source as follows: Watson (as cited in Jackson, 2004) replicated the study using …

Quoting from a source

If you copy (word for word) information from another source (instead of summarising the information using your own words), you should use quotation marks at the start and end of the quotation, use an ellipsis (…) when you omit words, and provide the reference and page number. For example:

Yellow and Schlink (2008) explained the observation in terms of 'the interaction between working memory and long-term memory and … decay of memory traces (p. 18)'.

Reference list

Reference type	Format	Example
Book	1 Author: the surname of an author and their initials. If there is more than one author, the names are cited in the order they appear on the title page of the book. 2 Year of publication: enclosed in brackets, and followed by a full stop. 3 Title of the book: italicised, and followed by a full stop (unless followed by an edition number). 4 Edition: if a second or subsequent edition, 'edition' is abbreviated, enclosed in brackets and followed by a full stop. 5 City of publication: followed by a colon. 6 Name of the publisher: followed by a full stop.	**Book with one author:** Smith, M. (2003). *Memory*. London: Psychology Press. **Book with two or more authors:** Grivas, J., Letch, N., Down, R., & Carter, L. (2010). *Psychology: VCE Units 3 & 4* (4th ed.). Melbourne: Macmillan Education.
Article in a journal	1 Author: the surname of an author and their initials. If there is more than one author, the names are presented in the order they appear in the article. 2 Year of publication: enclosed in brackets, and followed by a full stop. 3 Title of the article: followed by a full stop. 4 Title of the journal: italicised and followed by a comma. 5 Volume number of the journal: italicised and followed by a comma. 6 Page numbers: followed by a full stop.	**One author:** Mandalis, D.S. (1984). Stress and athletic performance. *Australian Journal of Psychology*, *10*, 334–345. **Two or more authors:** Blackmore, A.B., & Chan, I. (2006). Memory decline and aging. *Developmental Psychology, 19*(2), 121–128.
Article in a newspaper or magazine	1 Author: the surname of an author and their initials. If there is more than one author, the names are cited in the order they appear in the article. 2 Date of publication: enclosed in brackets, with the year before the month and the day, followed by a full stop. 3 Title of the article: followed by a full stop. 4 Title of the newspaper or magazine: italicised, followed by a comma. 5 Page numbers: preceded by 'p.' (or 'pp.' for more than one page) and followed by a full stop.	**If you know the author:** Paggio, I. (2010, January 10). Improve your memory. *The Sunday Age*, p. 11. **If you do not know the author:** Computer games promote violence. (*Herald Sun*, 2009, June 4, p. 32.).
Internet site	1 Author: the surname of the author and their initials, or the organisation, followed by a full stop. 2 Date of webpage publication: if available and enclosed in brackets, followed by a full stop. 3 Title of article: if specified. 4 When (month, date, year) information was retrieved; followed by a comma and the word 'from'. 5 Full URL: not followed by a full stop.	Mental Illness Fellowship of Australia. (2010). *Fact Sheet – Alzheimer's Disease*. Retrieved December 1, 2009, from http://www.mifellowshipaustralia.org.pph.htm.

Reference type	Format	Example
Motion picture (movie), TV, DVD, audio	1 Main contributors: the surname, and in brackets, the role of the main contributors, usually the producer, director and/or writer. 2 Year or date released: enclosed in brackets and followed by a full stop. 3 Title: italicised. 4 Media type: identify as a motion picture or other media type, in brackets and followed by a full stop. 5 Origin: give the motion picture's country of origin, where it was primarily made and the name of the production company.	Samir Mamin (Director). (2001). *Old and young* (Motion picture). Australia: Billabong Productions.
Personal communication or interview	1 Interviewee's name 2 Type of communication: in brackets. 3 Date of communication: in brackets and followed by full stop.	J. Smith (interview, 12 September, 2009).

Chapter 1 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Psychology can be defined as the study of mental experiences and behaviour in people and animals.

2 ______ Non-standardised procedures are a source of extraneous and confounding variables.

3 ______ Extraneous variables are only relevant to experimental research.

4 ______ If the results of an experiment are reliable, then the experiment must also be valid.

5 ______ A placebo effect occurs when the specific order in which the DV is presented influences a participant to respond in an unwanted way.

6 ______ Random allocation is a commonly used experimental research procedure to control potential confounding variables associated with participant differences.

7 ______ In research, a control group is used for comparison purposes.

8 ______ With the single-blind procedure, the researcher is unaware of the experimental conditions to which participants have been assigned.

9 ______ A score on a test is quantitative data.

10 ______ A structured questionnaire can be used to collect self-report data.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 1 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 A random sample of VCE students in a school could be achieved by selecting

A students whose VCE candidate number ends with an even number.
B students who walk to school.
C every tenth student walking out of a VCE assembly.
D all students who are enrolled in three or more science studies.

Q2 Operationalising the variables for an experimental research hypothesis would involve

A ensuring the variables operate in a strictly controlled experiment.
B deciding on the importance of all the experimental variables.
C describing the independent and dependent variables in terms of how they will be observed, manipulated and measured.
D providing detailed descriptions of all independent and dependent variables.

Q3 In an experiment, strict control of extraneous and potential confounding variables

A can be achieved only in a laboratory setting.
B enables the researcher to deal with all ethical considerations.
C can be achieved only if random sampling is used.
D eliminates any explanation of the results obtained being due to a variable other than the independent variable.

Q4 An interview usually involves _____, whereas a questionnaire usually involves _____.

A written responses to written questions presented by the researcher; oral responses to orally presented questions
B quantitative data; qualitative data
C qualitative data; quantitative data
D oral responses to orally presented questions; written responses to written questions presented by the researcher

Q5 In an experiment

A the dependent variable is manipulated.
B the independent variable is always introduced into the control condition.
C the dependent variable is held constant.
D the independent variable is manipulated.

Q6 A statistically significant difference in the mean scores of groups in an experiment suggests that

A the role of chance is at an acceptable level.
B the results should be rejected by the researcher.
C chance has played no role.
D the level of probability is high.

Q7 Random allocation and random sampling

A are avoided by researchers as they are haphazard procedures.
B differ in that random allocation is used to place participants in groups and random sampling is used to select participants for a study.
C differ in that random sampling is used to place participants in groups and random allocation is used to select participants for a study.
D are both used to select participants for an experiment.

Q8 In an experiment, the group that receives the treatment is called the _____ group, whereas the group that does not is called the _____ group.

A independent; dependent
B control; experimental
C dependent; independent
D experimental; control

Q9 Which of the following *p* values is the strictest?

A $p \leq 0.001$
B $p \leq 0.01$
C $p \leq 0.10$
D $p \leq 0.05$

Q10 The matched-participants experimental design involves

A allocation of each member of a pair of participants, very similar in a characteristic likely to influence the dependent variable, to different groups (or conditions).
B the allocation of each member of a pair of participants, very similar in a characteristic likely to influence the dependent variable, to the same group (or conditions).
C random selection of participants, then random allocation to different experimental conditions.
D random selection of participants, then random allocation to different experimental conditions, ensuring there is counterbalancing.

Q11 A researcher plans their experiment so that all variables other than the IV that may impact on the DV are spread equally across all experimental conditions.

This procedure is best described as

A an order effect.
B a matched-participants design.
C double-blind.
D counterbalancing.

Q12 A researcher gives vitamin C to one group of research participants and a placebo to another group to measure the effect of vitamin C on the common cold.

The frequency of colds is

A the independent variable.
B the dependent variable.
C an extraneous variable.
D a confounding variable.

Q13 An experiment was conducted to assess the effectiveness of a new technique for learning Greek words. One group used the learning technique and another group did not. Both groups were then given the same test of recall of Greek words. The results showed that the group using the learning technique recalled more Greek words than did the group who did not use the learning technique.

In this experiment, _____ is the independent variable, whereas _____ is the dependent variable.

A number of Greek words correctly recalled; using the learning technique
B using the learning technique; number of Greek words correctly recalled
C number of Greek words learned; number of Greek words correctly recalled
D number of Greek words correctly recalled; number of Greek words learned

Q14 A researcher selects participants by randomly sampling different groups from a target population. The researcher believes that the sex and religious beliefs of participants will be influential on the results, so the researcher ensures these characteristics are proportionally represented in the sample.

This type of sampling procedure is best described as

A biased sampling.
B stratified-random sampling.
C random sampling.
D stratified sampling.

Q15 A statistical test was carried out on the results obtained for the experiment described in question 13. The statistical test showed that the difference in scores between the two groups was significant ($p < 0.05$).

The result for this statistical test indicates that

A the difference between the number of words correctly recalled is due to chance.
B there is a 95% chance that the learning technique works.
C a difference equal to, or greater than, the difference found in this experiment is likely to occur by chance less than 5% of times the experiment is replicated.
D there is a 95% chance that the learning technique does not work.

Q16 Ethical guidelines in psychological research are intended to ensure that

A participants are responsible for the research.
B participants can make comments on the results whenever they want to.
C the rights and wellbeing of the researcher are not compromised in any way.
D the rights and wellbeing of participants are not compromised in any way.

Q17 A researcher intentionally arranged the order in which the conditions of a repeated-measures experiment were experienced. This was done to control order effects that were expected to occur.

This procedure is most commonly referred to as

A biased participant selection.
B counterbalancing.
C unethical.
D biased participant allocation.

Q18 A generalisation of the results obtained from research involves
- **A** determining the statistical significance of the results.
- **B** establishing a cause–effect relationship between the independent and dependent variables.
- **C** applying the findings obtained from a sample to the population.
- **D** drawing a conclusion about whether the results support or do not support the hypothesis.

Q19 Which of the following researcher behaviours would be considered unethical?
- **A** informing participants about the results of the experiment
- **B** preventing a participant from leaving an experiment midway through the experiment
- **C** checking up on the age of a participant when there is doubt that the participant may not be old enough to give informed consent
- **D** publishing the results of the experiment without obtaining informed consent from the participants

Q20 Which of the following is an example of a self-report?
- **A** diary records kept by a person with a spider phobia on how they think and feel whenever they see a spider
- **B** the researcher's raw data collected for their study
- **C** the researcher's formal report on their study
- **D** the findings reported by an ethics committee on the suitability of a researcher's experience and qualifications to undertake a proposed study

Q21 The least number of participants that can be used in an experiment with a repeated-measures design is
- **A** one.
- **B** impossible to determine.
- **C** dependent on the possibility of an order effect.
- **D** dependent on the availability of participants.

Q22 In a repeated-measures experimental design, each participant is exposed to
- **A** all conditions of the experiment.
- **B** the independent variable only.
- **C** the independent variable repeatedly.
- **D** the dependent variable repeatedly.

Q23 Before conducting an experiment, a researcher identified all potential extraneous variables expected to affect the dependent variable, then refined the design of the experiment to minimise or eliminate the influence of such variables.

The researcher did this to help ensure that
- **A** a single-blind procedure could be used before interpreting the results.
- **B** a double-blind procedure could be used before interpreting the results.
- **C** inferential statistics could be used to help interpret the results.
- **D** there would be no confounding variables.

Q24 The best technique for ensuring control over demand characteristics and experimenter effects is the use of
- **A** inferential statistics before the experiment is conducted.
- **B** the double-blind procedure.
- **C** inferential statistics after the experiment is conducted.
- **D** the single-blind procedure.

Q25 In a simple experiment, participants will be either exposed to the independent variable or not exposed to the independent variable.

What type of experimental design will be used?

A single-blind
B matched-participants
C independent-groups
D repeated-measures

The answers to the Chapter 1 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the meaning of convenience sampling.

____

____

1 mark

Question 2

If the results of an experiment are stable and consistent, then they can be considered ______________________________, whereas, if the results are accurate, then they can be considered ______________________________.

2 marks

Question 3

a Distinguish between an extraneous variable and a confounding variable.

____

____

____

____

____

____

2 marks

b Explain how the use of a sugar pill as a placebo in a control group can create a confounding variable in experimental research.

2 marks

Question 4

Explain why random allocation in an experiment with an independent-groups design minimises the likelihood of individual participant differences becoming a confounding variable.

1 mark

Question 5

Describe one advantage and one limitation of a repeated-measures experimental design when compared with a matched-participants design.

2 marks

The answers to the Chapter 1 short-answer questions are available at www.OneStopScience.com.au.

2 States of consciousness

Describing consciousness

Stop for a moment and focus your attention on the thoughts and feelings that are currently inside your head. Are you thinking about the words on this page, something a friend said to you, how hungry you are, what someone else in the room is saying, or something completely different? Now focus your attention on how you feel. Perhaps you feel tired, bored, happy or even curious. Next, switch your attention to the sounds around you. Try to identify the different sounds you can hear. Now change the focus of your attention to what you can see, or the texture of your clothes against your skin. Try to become aware of the rhythm of your breathing, the aromas in your nose, and any aches, itches or pressure you may feel. Before your attention was directed to any of these things, were you actually aware of them or did they just exist without your awareness?

In the course of a day our awareness of various internal states and of information and events in the external world is constantly changing. **Consciousness** is the awareness of objects and events in the external world and of our own existence and mental experiences at any given moment. Our consciousness helps provide us

Figure 2.1 At some times your consciousness is dominated by internal thoughts and feelings; at other times it is dominated by sensations from the external environment.

with a sense of self—a personal identity through which we experience the world. The contents of consciousness can include your perceptions of the world around you—such as what you see, hear, feel or smell; the comments you make to yourself; the memories of events in your life; your beliefs; your plans for activities later in the day; and your attitudes (Baars, 1997).

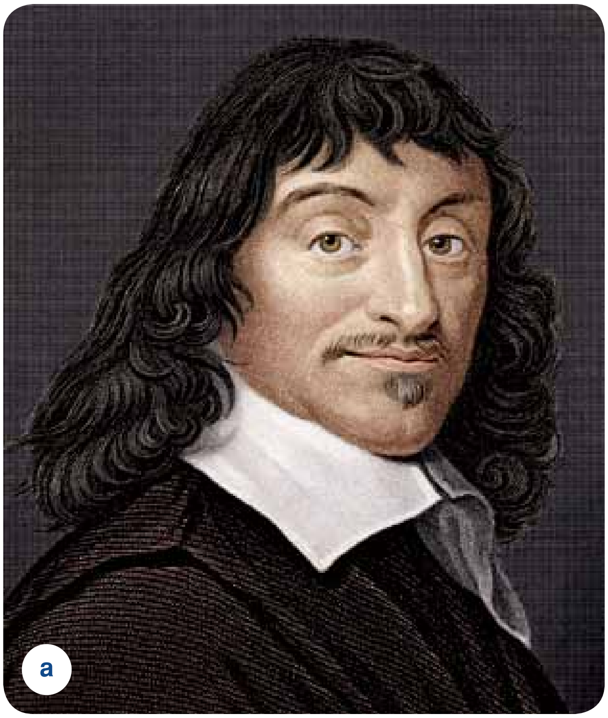
Conscious experience is commonly described as being personal, selective, continuous and changing. It is *personal* because it is your subjective ('personalised') understanding of both your unique internal world and the external environment—it is individual to you. Consciousness is *selective* because you can choose to attend to certain things and ignore others—that is, you can voluntarily shift your attention from the words on this page to a voice in the room or the memory of what you did last Saturday night. Consciousness is *continuous* because there is never a time in the course of a typical day where your consciousness is 'empty'. Consciousness is constantly *changing*, with new information continually coming into awareness, particularly while you are awake. One moment your conscious awareness may be focused on the sound of a person talking to you, and the next moment your consciousness may be filled with thoughts of an argument you had with a friend. There are times when your consciousness is dominated by the internal thoughts and feelings you experience, while at other times sensations from the external environment dominate.

René Descartes—mind and body are separate but interconnected

You would probably agree that consciousness is somewhere inside your head, but precisely where is it located? Is it just under your skull or deep below? Does it reside towards the front in your forehead, in the middle near your temples or at the back? Perhaps like a lot of people you think it is 'floating' around throughout your head? If so, does this mean that it is in your brain or outside your brain? If it is in your brain, is it in all of your brain or a part of your brain? Does your brain need to be active for consciousness to occur? What is the relationship between consciousness and brain activity? Are consciousness and brain activity the same or different? Do they occur independently or are they interdependent? Is consciousness a byproduct of brain activity? Does our brain trigger conscious experience? What comes first: brain activity or conscious experience? Which of the two is in control?

Answers proposed for these questions have created considerable controversy in psychology since the first psychology laboratory was established in 1879 by German doctor Wilhelm Wundt. The same types of questions were also asked by philosophers more than 2000 years ago in Ancient Greece. The questions posed by philosophers centred around a debate that has come to be known as the mind–body problem. Consciousness was often referred to as the 'mind' and has been viewed throughout history as being located in many organs of the body, including the heart and the liver. The mind–body problem essentially involves the question of whether the mind and body are distinct separate entities or whether they are one and the same thing, with the mind simply being the subjective experience of the physical brain. Generally, most of the Greek philosophers believed that the mind and body were separate entities and that the mind could control the body, but the body could not influence the mind. This view was popular for almost 2000 years until the French philosopher René Descartes (pronounced 'day-cart') challenged it in the 17th century.

In his version of a theory called *dualism*, Descartes agreed that the mind and body are two different things. He reasoned that the mind is a non-physical spiritual entity (i.e. a soul), whereas the body is a physical fleshy structure (i.e. matter). However, according to Descartes, the mind and body come into contact through the pineal gland, a tiny structure located deep in the brain. This enables the mind and brain to interact to produce thoughts, sensations, feelings and other conscious experiences. He identified the pineal gland because it is a single structure near the centre of the brain. The rest of the brain is split into right and left halves and made up of lots of layers intricately folded within one another. Consequently, it seemed



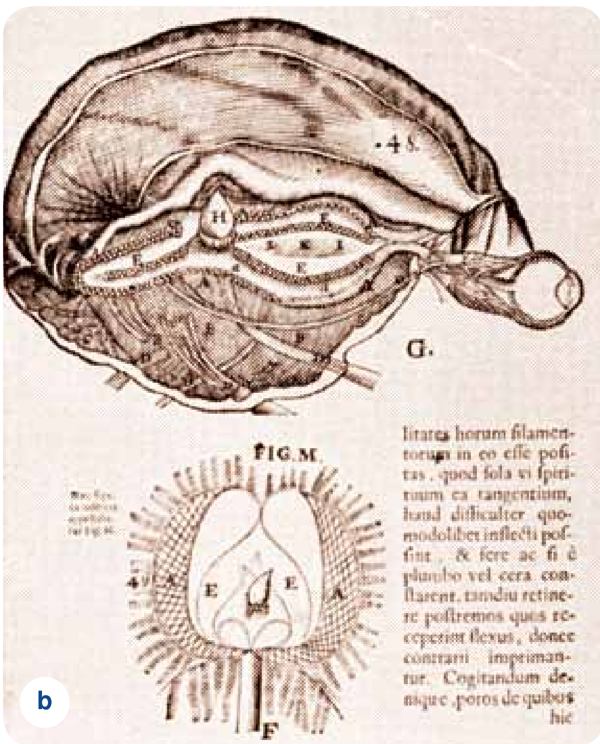


Figure 2.2 (a) French philosopher René Descartes (1596–1650) proposed that the human mind and body are separate but interconnected; (b) Descartes believed that the pineal gland within the brain connected the mind and body, enabling them to interact. This original drawing by Descartes shows the pineal gland right in the middle of the brain (H), well located to serve as the centre of consciousness.

logical that the pineal gland, in being centrally located and isolated from the rest of the brain, could be the centre of consciousness. Descartes also argued that the body could affect the mind and the mind could affect the body. For example, he believed that mental processes such as memory and imagination were the result of bodily functions and that emotions such as love, hate and sadness arose from the body and influenced mental states, which could in turn influence the body.

Descartes viewed consciousness as encompassing everything we are aware of, including our own existence. It exists in the mind (i.e. the soul) but can also exist in the body as it is non-physical and does not take up space. He proposed that our ability to think provided evidence of consciousness, including our knowledge of our own existence. According to Descartes, the proof of this is in our ability to think about or reflect on our own existence. This is exemplified in his statement ‘I think, therefore I am’, which is a translation of the Latin expression *cogito ergo sum*, sometimes also translated as ‘I reflect, therefore I am’.

Descartes’ understanding of the brain and the roles of its various structures was limited and, at times, wrong. For instance, unlike other brain structures, the pineal gland is not even a nerve structure. It is a hormonal gland that is considered to be a part of the endocrine system and therefore could not possibly serve as a centre of human consciousness. However, Descartes brought the mind, brain and body closer together in a way that others had not previously considered possible.

Although there is no universally accepted ‘solution’ to the mind–body problem, it is likely that advances in technologies for studying the brain and consciousness will eventually lead psychologists to a better understanding of the relationship between mind and body, or to the *mind–brain problem* as it is now known. For example, there is considerable research evidence that conscious experience is supported widely throughout the brain in many different structures. One series of research studies has also obtained evidence that suggests that the brain’s activities precede the activities of the conscious mind (see box 2.1).

Box 2.1

What comes first: conscious experience or brain activity?

The mind–body problem, or mind–brain problem as it is now known, has not yet been resolved in a way that is universally agreed to by contemporary psychologists. It is clear, however, that the mind and body are intertwined and that mental processes may be triggered by events in the brain, and that mental processes may, in turn, trigger brain events and therefore influence our behaviour.

Research studies conducted by American psychologist Benjamin Libet in the 1980s indicated how the mind–brain problem could be scientifically tested. These studies also provided evidence that activity in the brain may actually *precede* activity of the conscious mind.

Libet's (1985) procedure involved using an EEG to record the electrical activity in the brains of volunteer participants using sensors placed on their scalps during a decision-making task involving finger movement. As shown in Figure 2.3a, participants observed a dot moving rapidly around the face of a clock. Whenever they consciously decided to move their fingers, they had to state the position of the dot at the precise moment of decision-making. An EMG was used to record the precise moment of finger movement.

Usually, electrical activity is evident in the brain about half a second (535 milliseconds) before any voluntary movement. This is not surprising as brain activity is probably required to initiate a movement. Libet's results, however, showed that electrical activity was evident *before* each participant made a conscious decision to move. As shown in figure 2.3b, the brain became active in less than one-quarter of a second (204 milliseconds) before participants reported that they were consciously trying to move their fingers.

According to American psychologist Daniel Wegner (2002), the feeling that we 'consciously will' actions may be a consequence of brain activity rather than a cause. It makes sense that we first consciously think of an action and then perform it, but Libet's research findings suggest that our brain starts the required activity before either the thinking or the doing, possibly preparing the way for both thought and action. It may appear to us that our mind is leading our brain and body, but the order of these events may be the other way around.

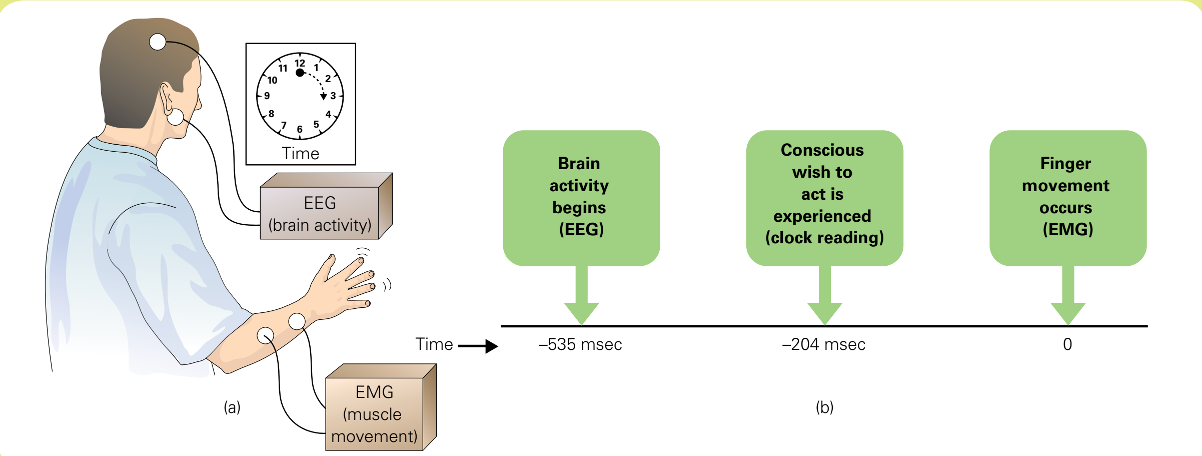


Figure 2.3 (a) Each participant was required to report the exact moment when they consciously made a decision to move their fingers; (b) EEG sensors that detect electrical activity of the brain timed the onset of brain activation and EMG sensors that detect muscular activity timed the onset of finger movement.

Source: Schacter, D.L., Gilbert, D.T., & Wegner, D.M. (2009). *Psychology*. New York: Worth, p. 297.

William James—streams of consciousness

The idea that consciousness is constantly changing, and that there is continual movement of thoughts, feelings, perceptions, images, sensations, and so on, in and out of our conscious minds was first described over 120 years ago by American psychologist William James. James (1890) described the mind as a 'stream of consciousness':

> *Consciousness does not appear to itself chopped up in bits. It is nothing jointed; it flows. A 'river' or a 'stream' are the metaphors by which it is most naturally described. In talking of it let us call it the stream of thought or consciousness, of subjective life.*

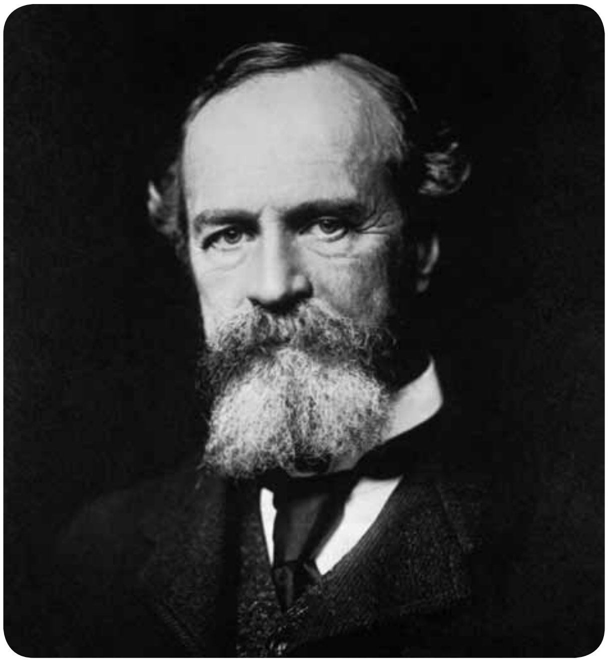


Figure 2.4 William James (1842–1910)

Figure 2.5 An example of what William James called the *stream of consciousness*—a never-ending flow of thoughts, feelings and sensations which often occur in a random way.

James likened our consciousness to a stream because the contents of it are continuously moving and changing just as the water in a stream continuously flows. The never-ending flow of thoughts, feelings, sensations and so on often occurs in a random way as they fleetingly pass through our mind. Sometimes it is called *flowing consciousness* because awareness flows from one feeling or thought to another; for example, it may flow from an emotion to an annoying itch, then onto a memory of a past event. Some images may last for a longer period of time if they capture our attention, while others quickly fade away. According to James, the flow of images is endless and there is never a gap between the end of one image and the start of another.

Learning Activity 2.1

A snapshot of your consciousness

For the next five minutes, write down all the sensations, perceptions, memories, thoughts, images, feelings and so on that flow into your consciousness. Write continuously for the whole time. If you can't think of anything to write, write 'I can't think of anything to write' (because that's what is in your consciousness) until the flow of other things continues. You may find that your hand can't keep up with the ever-changing flow of thoughts and feelings passing through your consciousness.

At the end of the time, count the number of different ideas that entered your consciousness. Compare your result with that of other class members. What is a possible explanation for any differences?

States of consciousness

Our brain is continuously bombarded with information about our internal state and with information from the outside world. But it is our **state of consciousness**, or level of awareness of our internal state and external events, that determines how much of this information we take in and respond to.

Figure 2.6 A continuum of conscious (awareness) and states of consciousness, with total awareness at one extremity and complete lack of awareness at the other. There is no 'precise' location for each state within the continuum.

Consciousness is not an 'all or nothing' phenomenon. There are variations in the extent or degree of awareness we experience at different times. At times, we are highly focused and acutely aware; for example, when we are concentrating on a task such as learning to use a new computer program or lining up to shoot a goal. At other times, we experience a medium level of awareness, such as when we are daydreaming. There are still other times, such as when we are asleep or anaesthetised, where our level of awareness is low and our ability to take in and understand information is considerably reduced.

In the course of a typical day we experience many different states of consciousness and therefore many levels of awareness. There are no distinct boundaries to indicate where one state of consciousness ends and another begins. Psychologists often describe consciousness as ranging along a continuum, or scale, from total awareness (focused attention) to a complete lack of awareness (unconsciousness). This is shown in figure 2.6. At one end of the continuum, when attention is highly focused, concentration on specific thoughts, feelings or sensations dominates our consciousness to such an extent that other incoming information may not be noticed. For example, if you were totally absorbed in working on an assessment task during the first class of the day you might not feel hungry, despite having missed breakfast. At the other end of the continuum, an individual may not experience any thoughts, feelings or sensations at all. For example, someone in an anaesthetised state usually has very little awareness of their thoughts, feelings or sensations.

There are many states of consciousness between either end of the continuum, in which individuals have differing levels of awareness. These variations of consciousness may occur, for example, when people are daydreaming, in a state of shock, fatigued, hypnotised, asleep, in a meditative state or under the influence of alcohol or illegal drugs. While it is sometimes difficult to distinguish between the different states of consciousness and associated levels of awareness, psychologists generally agree that there are two broad categories or types of consciousness: normal waking consciousness and altered states of consciousness.

Although an individual's experience of each type of consciousness is unique at any given moment, there are a number of qualities that distinguish the different states of consciousness. These include level of awareness, the content of consciousness, the use of controlled or automatic processes to perform tasks, perceptual experiences, cognitive abilities, emotional awareness, self-control and the experience of time. There are also certain physiological changes associated with different states of consciousness, such as changes in brain wave patterns, eye movements, heart rate, core body temperature and electrical conductivity in the skin.

Have loved ones reviewed: expert

By Julia Medew, Health reporter

UNRESPONSIVE Australians in vegetative states should be urgently reassessed to ensure they are not conscious and trapped inside their bodies, a medical specialist says.

The director of neurology at St Vincent's Hospital, Mark Cook, yesterday called on families of people diagnosed as vegetative or minimally conscious to get their loved ones re-examined with the latest technology to ensure their diagnosis was correct.

His call followed the extraordinary case of Rom Houben, a Belgian man who was diagnosed as being in a vegetative state 23 years ago, but who doctors now believe was conscious the whole time.

With the use of new technology, Mr Houben's doctors discovered that he had a form of 'locked-in syndrome', in which people are unable to speak or move but can think and reason. He has now been provided with equipment to communicate.

Professor Cook said many Australians with similar conditions could be going through what Mr Houben experienced because they were often sent to nursing homes and then mostly forgotten.

He said there was no policy at present to reassess their level of consciousness, which could have been incorrectly diagnosed in the first place or could have changed over time.

'It depends very much on the practice of particular places, the expertise they have in house, and perhaps whether families feel that more investigations need to be done,' he said.

Although knowledge about the brain had increased exponentially in recent years, Professor Cook said people's level of consciousness after brain injury could still be wrongly diagnosed today because there was no standardised neurobehavioural rating scale used consistently on patients across the country. There are also wide variations in the level of expertise people have access to, depending on where they live.

'I think there is still likely to be quite a few people slipping through the net because of a lack of awareness and a lack of access to diagnostic facilities.'

Professor Cook is trying to contact carers for the estimated 100 Australians living in vegetative and minimally conscious states to scan their brains with a magnetic resonance imaging (MRI) machine while questions and tasks are asked of them.

The research could help families assess their loved one's level of consciousness and lead to new ways to communicate with them.

For more information about the study visit www.neuroeng.unimelb.edu.au/research/consciousness/index.html.

Figure 2.7 Fina Nicolaes was never prepared to accept that her son Rom Houben had been unconscious since a horrific car accident 23 years ago. Doctors, using the latest equipment, have now confirmed her maternal intuition was right.

Source: Medew, J. (2009, November 26). Have loved ones reviewed: expert. *The Age*, p. 3.

Box 2.2

Clinically diagnosing and assessing a coma

A severe blow to the head with a blunt object usually results in immediate loss or impairment of consciousness. The duration and degree of that impairment of consciousness is of major significance in indicating the severity of injury. In the case of mild head injury there may be a clouding of consciousness, whereby the person is confused and disoriented for a period of time, which they subsequently do not clearly remember. In the case of more severe injuries, coma may persist for days, weeks or months. The essential features of a coma are decreased responsiveness to external and internal stimuli. Neuropsychologists clinically define a *coma* as the absence of eye opening, a failure to obey commands, and a failure to give any comprehensible verbal response. Along with measures of physiological responses such as brain wave activity, coma is diagnosed and assessed by measuring the degree of decrease in observable responsiveness to external stimuli.

The assessment device most commonly used for this purpose is the Glasgow Coma Scale, which is shown on page 104. Use of the scale involves regularly monitoring the progress and/or deterioration over time of the injured person's eye opening, and verbal and motor responses. Responses in each of these three categories are ranked and assigned a numerical value, yielding a total score between 3 (a person showing no response) and 15 (a person who is alert and well oriented). A total score of 8 or less is the 'cut off' point that defines a coma in relation to the scale.

In a small percentage of cases, someone with brain damage resulting from a severe blow passes from coma into what is termed a 'persistent vegetative state'. In this state the person typically shows eye opening, with sleep and wake cycles, and sometimes the ability to very briefly 'track' with the eyes. There may be an ability to make some basic limb movements, and a range of primitive reflexes may be evident, such as biting and grasping. However, there is no evidence to suggest that individuals in a vegetative state are responsive to their environment.

Table 2.1 Scores associated with each category of the Glasgow Coma Scale

Scores in the first 24 hours after injury are frequently used to grade severity of injury and to predict outcome. Scores of 3 to 8 have been said to indicate severe injury, 9 to 12 moderate injury, and 13 to 15 mild injury.

Eye opening	
Spontaneous	E4
To speech	3
To pain	2
Nil	
1	
Best motor response	
Obeys	M6
Localises	5
Withdraws	4
Abnormal flexion	3
Extensor response	2
Nil	
1	
Verbal response	
Oriented	V5
Confused conversation	4
Inappropriate words	3
Incomprehensible sounds	2
Nil	
1	
Coma score: (E + M + V) = 3 to 15	

Source: Ponsford, J., Sloan, S., & Snow, P. (1995). *Traumatic brain injury: Rehabilitation for everyday living.* Hove, East Sussex: Psychology Press, p. 36.

Learning Activity 2.2

Recognising different states of consciousness and levels of awareness

People travelling on a plane from Melbourne to Singapore may each experience different states of consciousness. Consider the list of people below and indicate where each person would be on the states of consciousness continuum in figure 2.6.

Person 1: a pilot who is monitoring the cockpit instruments

Person 2: a teacher who is thinking about her holiday and who has just finished her third alcoholic drink

Person 3: a 12-year-old playing a computer game

Person 4: the mother of a two-year-old child who is watching the in-flight movie while simultaneously looking after her child

Person 5: a tertiary student gazing aimlessly out the window

Person 6: an anxious passenger who has taken a sleeping pill and who can be heard snoring.

Learning Activity 2.3

Review questions

1 Define consciousness, with reference to internal and external factors.

2 In what ways is consciousness personal, subjective, continuous and changing?

3 How does Descartes describe consciousness? To what extent is his view different from contemporary psychological descriptions? Explain your answer.

4 How does James describe consciousness? To what extent is his view different from contemporary psychological descriptions? Explain your answer.

5 In what ways are Descartes' and James' descriptions of consciousness similar and different?

6 Explain the term state of consciousness.

7 What changes typically occur as a result of a change in a person's state of consciousness?

8 Could we experience two different states of consciousness simultaneously? Explain your answer.

Learning Activity 2.4

Media response

The newspaper article 'Have loved ones reviewed: expert' on pages 102–3 refers to the case of a comatose man who, for 23 years, was 'written off' as a vegetable: paralysed, brain dead, awake but not aware. After watching a television program on a similar case, his mother contacted a neurologist who agreed to conduct tests on her comatose son and found that he 'had a brain that understood virtually everything. He just could not communicate any response'. Using a keyboard on a computer, and with the help of therapists, the comatose man can now communicate. In his words: 'I was only my consciousness and nothing else … I'll never forget the day they discovered me. It was my second birth.' (Traynor, 2009)

Read the article and answer the following questions.

1 What is 'locked-in syndrome'?

2 Where on the continuum in figure 2.6 would Rom Houben be ranked
   a during the 23 years before being diagnosed with 'locked-in syndrome'?
   b now?

3 For what reasons does Professor Cook believe individual cases such as that of Houben can be misdiagnosed?

4 Do you think that people in a 'vegetative' state, who may have been 'sent to nursing homes and forgotten', should be given periodic reassessments? Explain your answer.

5 What does Houben's case suggest about the relationship between the body, brain and consciousness?

Characteristics of normal waking consciousness

Normal waking consciousness refers to the states of consciousness associated with being awake and aware of our thoughts, memories, feelings and the sensations we are experiencing from the outside world. As described by William James, normal waking consciousness is constantly changing. However, despite this changing experience of consciousness, our perceptions and thoughts continue to be organised and clear, and we remain aware of our personal identity (who we are).

Levels of awareness

As shown in figure 2.6, normal waking consciousness is not one single state, as there are varying levels or 'degrees' of awareness when we are awake. Generally, normal waking consciousness includes all states of consciousness in the upper half of the continuum that involve heightened awareness. In normal waking consciousness we perceive the world as *real* and it has a familiar sense of time and place. This does not mean, however, that all our waking time is spent in the same state of consciousness. We continually shift between different states, and therefore levels of awareness, within normal waking consciousness.

Researchers often use attention as a measure of awareness and as a way of distinguishing between different states of consciousness. **Attention** is a concentration of mental activity that involves focusing on specific stimuli while ignoring other stimuli. Generally, states of consciousness within the range of normal waking consciousness at the top end of the continuum involve more awareness and therefore require more attention than altered states of consciousness that fall at the lower end of the continuum. In normal waking consciousness, our attention can be focused either on *internal* thoughts or feelings (for example, how tired you feel), or on *external* stimuli (e.g. what the person sitting next to you is saying). The focus of attention is like a spotlight that can be moved around. A shift in the focus of your attention, and therefore conscious awareness, can be intentional—such as when you concentrate on listening to arrangements for meeting friends. However, a shift in the focus of attention more often occurs without our being aware of it (La Berge, 1995). For example, when you are focused on a teacher's explanation and the person sitting next to you starts talking to you, the focus of your attention will usually shift to their comments, even if only for a second or two.

Researchers also distinguish between selective attention and divided attention. Selective attention involves selectively attending to certain stimuli while ignoring other stimuli. Selective attention refers to the fact that at any given moment the focus of our awareness is on only a limited range of all that we are capable of experiencing, whether it be an internal event such as the perception of a pain in the foot, or an external event such as watching a car drive past. Research studies in selective attention have shown that people often notice very little of the information that is not attended to (Milliken & others, 1996).

What are the factors that determine whether we will attend to a particular stimulus during normal waking consciousness? It seems that we are more likely to attend to a stimulus if it is important to us, if it changes in some way or if it is novel.

If a stimulus is *personally* important to us, we are more likely to take notice of it. For example, suppose you are at a party where there is loud music playing and you are surrounded by many conversations. Despite being totally involved in one conversation, your attention is likely to be automatically drawn to a different conversation if you hear your name being mentioned. This commonly occurring experience is known as the *cocktail party phenomenon* (Wood & Cowan, 1995). Our attention is also attracted by any *changes* in stimulation or the introduction of a *novel* stimulus; that is, a stimulus that is new or unusual in some way. This may explain why many television and radio advertisers pitch their commercials at a higher or lower volume than the programs they interrupt.

If our attention is selective, does that mean we take in no other information that may be presented to us when our attention is completely focused on one thing? For example, during the first class on Monday morning your attention may be selectively focused on hearing what happened at a weekend party. However, you may still process some of what the teacher is saying or doing with the rest of the class, which is selectively attending to what the teacher is saying. You may be aware that you need to have your book open at a particular section, or that you need to be copying down some questions from the board even if you don't know what the questions actually ask. Thus, even when your

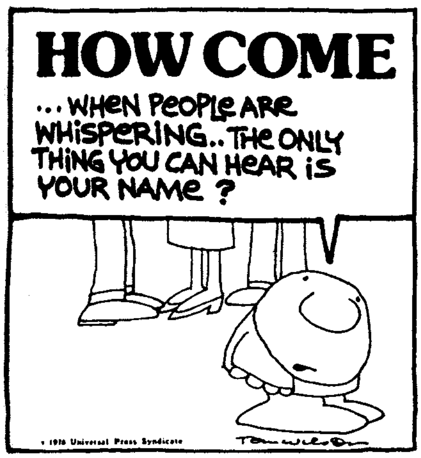


Figure 2.8 The cocktail party phenomenon

attention is focused on one thing, you are still capable of reacting to other stimuli. This suggests that we can process some information outside conscious awareness.

As we begin to move down the consciousness continuum, the level of attention required is not as focused or selective. For example, in normal waking consciousness, people are often able to divide their attention among competing stimuli, such as washing a car while listening to the radio and watching their children playing. Divided attention refers to the ability to distribute our attention and undertake two or more activities simultaneously.

It seems that our ability to divide our attention depends on how much conscious effort is required for the various tasks in which we are engaged (Damos, 1992). Research findings indicate that our perceptual systems can handle some divided attention tasks, as long as the tasks are not complex and therefore do not demand considerable mental effort. In one experiment, Duncan (1993) required participants to make two simultaneous judgments about an object that was visually presented to them on a screen. They were required to both identify the object and determine its location on the screen. Generally, participants were able to complete both tasks with few errors. However, the rate of errors increased significantly when participants were required to make two simultaneous judgments about two different objects, such as the location of each object. It seems that performing a complex task requires selective attention and a higher level of consciousness than a simple or familiar task requires.

Figure 2.9 Using a mobile phone while driving requires divided attention to simultaneously perform two relatively complex tasks and puts the driver at risk.

To test your ability to divide your attention between two tasks, try simultaneously tapping three times on the table with your left hand while at the same time tapping four times on the table with your right hand. Most people are unable to successfully divide their attention between these tasks without considerable practice.

An understanding of the limits of our attention has become an important consideration in the debate about the use of mobile phones while driving. Research findings support the view that using a mobile phone while driving distracts the driver's attention. If the driver's attention is divided between two tasks, one or both of which demand considerable attention, there is a significant increase in the likelihood that the driver will fail to notice a potentially dangerous situation in time to respond and avoid an accident (McKnight & McKnight, 1993).

Box 2.3

Research on selective attention

To test selective attention, American psychologists Ulric Neisser and Robert Becklen (1975) showed research participants two videotapes, one superimposed over the other. One tape showed three people passing a basketball to each other. The other tape showed two people playing a hand-slapping game (see figure 2.10). To minimise the effects of extraneous variables, Neisser and Becklen used an independent-groups experimental research design. In the independent-groups design, each participant is randomly allocated to one of two entirely separate (independent) groups.

The participants in the group that watched the hand-slapping game were required to press a response key whenever the people in the game slapped hands. Those watching the basketball game were required to respond whenever the basketball was thrown. The results showed that participants in both groups were able to selectively attend to the designated stimulus and effectively block any other stimuli that were present. Their 'attention filtering' processes were so successful that of the 24 participants who focused on the basketball game, only one noticed that the hand-slappers had finished their game and were shaking hands. When the experimenter replayed the videotape, the participants reported that they were surprised at what they had missed. These findings suggest that information may enter or be excluded from our consciousness through the process of selective attention.

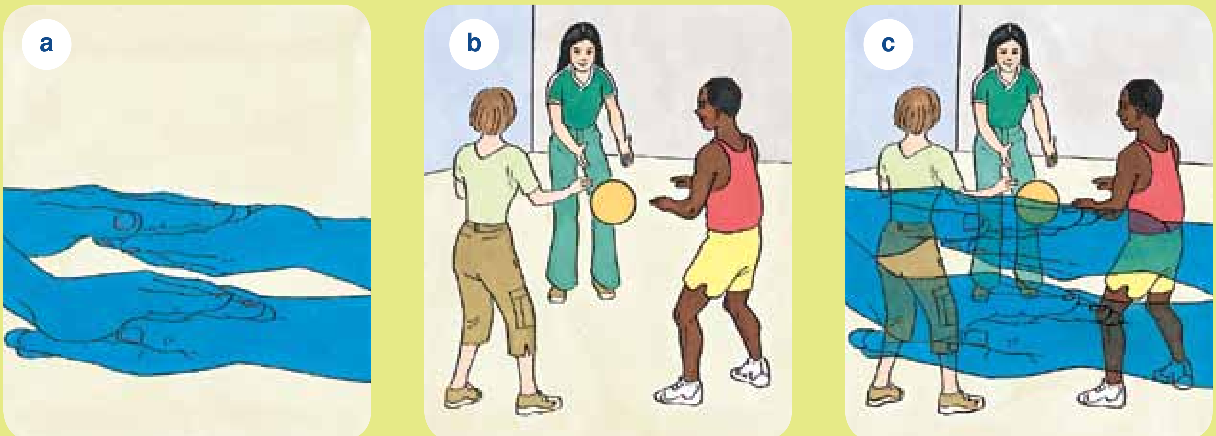


Figure 2.10 Figures (a) and (b) are drawings from scenes in the two videotapes in the Neisser and Becklen experiment. Figure (c) shows the two scenes superimposed, as seen by research participants.

Content limitations

Generally, the *content*—that is, the type of information—held in our normal waking consciousness is more restricted, or limited, than the content of consciousness during an altered state. We are able to exercise some control over what we allow into our normal waking consciousness, for instance, through selective attention. Because a significant amount of information that enters our consciousness is within our conscious control during normal waking consciousness, we can block our awareness of information that makes us feel self-conscious, embarrassed, sad, repulsed, afraid, hurt and so on. However, during altered states of consciousness we generally don't have the same control, therefore the content of our consciousness is not as limited.

The content of normal waking consciousness also tends to be more organised and logical than that in an altered state of consciousness. For example, when we are awake and alert, we are generally able to follow logical steps in solving a problem. By comparison, when we are in an altered state of consciousness, such as when we are dreaming, the content of our consciousness (that is, the images and content of our dreams) is often nonsensical, illogical and disorganised.

Controlled and automatic processes

Towards the top end of the consciousness continuum are the states of consciousness experienced during activities demanding high levels of attention or concentration, such as playing a computer game, solving a maths problem during an exam, or abseiling down a steep rockface. According to Schneider and Shiffrin (1977), activities such as these use controlled processes. When a **controlled process** is used, the processing of information involves conscious, alert awareness and mental effort in which the individual actively focuses their attention on achieving a particular

Figure 2.11 Controlled processes, such as abseiling down a steep rock face, require high levels of concentration.

goal. Controlled processing tends to be *serial*; that is, only one activity requiring controlled processes can usually be performed at a time. Controlled processes are often required when an activity is difficult or unfamiliar. For example, when you first learn to drive a manual car, controlled processes are required. You have to concentrate on controlling the steering wheel while coordinating use of the accelerator, brake, clutch and gears, as well as monitoring events outside the vehicle such as traffic, pedestrians, traffic signs and traffic lights. When you are learning, driving requires your complete focused attention.

As you gain experience, however, driving becomes a more automatic process that does not demand the same level of attention. Generally, experienced drivers have little trouble driving, listening to the radio and maintaining a conversation with a passenger all at the same time. This is because the process of driving, as well as detecting and interpreting important information about traffic and the environment that is needed to drive safely, occurs more automatically and requires less attention for the well-practiced driver than for inexperienced drivers. Any activity that requires low levels of concentration and therefore a lower level of consciousness usually involves automatic processes. According to Schneider and Shiffrin (1977), an **automatic process** requires little conscious awareness and mental effort, minimal attention and does not interfere with the performance of other activities. Automatic processes are used when an activity is easy or familiar. Unlike controlled processing, automatic processing tends to be *parallel*; that is, we can handle two or more activities at the same time.

Automatic processing has been demonstrated by the Stroop effect. In a series of three experiments, psychologist J. Ridley Stroop (1935) found that participants were slower to perform a task and made more errors when they were required to visually process incongruent (conflicting or mismatched) information (see box 2.4). For example, participants found it difficult to name the colour of the ink of a printed word if the actual word was the name of a different colour, such as the word *red* written in purple ink (see table 2.2 on page 111, condition 2). Furthermore, they often stated the *name* of the word by mistake (e.g. red) when they were required to identify the *colour* of the print (e.g. purple).

Stroop used a different group of research participants for each of the three experiments. In addition, a repeated-measures research design was used with each experiment. In an experiment using a repeated-measures design, each participant is involved in both the experimental and control conditions (see page 17). In each experiment, Stroop also ensured control of the order effects of practice and fatigue. To achieve this, Stroop designed the procedure so that the order in which participants experienced the various conditions of the experiments was counterbalanced. Half the participants attempted one experimental condition first, followed by the other experimental condition, while the other half of the participants attempted the two experimental conditions in the reverse order.

The findings of this research have become known as the Stroop effect. The *Stroop effect* is the observation that it takes longer to name the colour of the ink in which a word is printed if the word spells the name of a different colour than it does to identify a block of colour. Psychologists believe that the Stroop effect occurs because when we are presented with a word, our automatic response is to read the word (Macleod, 1997). When we are simultaneously confronted with competing cognitive tasks—that is, to read a word that names

Figure 2.12 When we learn a new task, it is often complex at first and we depend on controlled processes. This enables us to selectively focus our attention on each important aspect of the task. When the task becomes familiar we are often able to use automatic processes, enabling us to divide our attention between a range of other activities or thoughts.

a colour and to identify the colour of the print—our automatic response to read interferes with our attempt to name the colour of the print. Thus, completing the latter task of colour identification requires cognitive effort and attention as well as controlled processes (Lindsay & Jacoby, 1994).

Using variations of the Stroop experiments, psychologists have found that even when there is no incongruence in the task, such as when a familiar word such as 'truck' is printed in different colours, automatic processes still make it difficult not to read the words when people are asked to name the colour of the print (as in table 2.2, condition 4). It seems that when we are simultaneously presented with more than one cognitive task, those tasks involving automatic processing override tasks that involve controlled processing. In fact, some researchers have found that when presented with conflicting stimuli, we cannot prevent automatic processing from dominating—even if we want to.

An interactive online demonstration of the Stroop effect can be found at the Neuroscience for Kids website. Many other variations of interactive online Stroop effect demonstrations can be located by entering 'Stroop effect' into a search engine.

Box 2.4

Stroop's experiments

The Stroop effect is named after American psychologist J. Ridley Stroop (1935), who was the first person to describe this phenomenon. Stroop conducted three experiments using a different sample of university students for each experiment. In the first experiment, Stroop recorded the time taken and the number of errors made by participants when they read a word list of colours printed in black ink (table 2.2, condition 1) and when they read a word list of incongruent (conflicting) colour words. As shown in table 2.2, condition 2, the incongruent list consisted of a list of colour names in which the colour of the print and the name of the word were different; for example, the word 'red' was printed in purple ink. In the first experiment, participants were required to *read the word* 'red'.

In the second experiment, Stroop again recorded the time taken and the number of errors made when participants identified the colour shown on a list of colour blocks (table 2.2, condition 3) and when they *identified the colour* of the print in a list of incongruent words (table 2.2, condition 2).

In the final experiment, the time taken and the number of errors were recorded when participants attempted each of the four different conditions used in the first two experiments, but with one variation. Instead of using colour blocks, Stroop used a symbol (swastika) that was reproduced in the five colours, and the participants were required to *identify the colour* in which each swastika was printed.

In all of Stroop's experiments, participants took significantly longer to identify an incongruent colour (where there were conflicting tasks) than to identify a colour under any other condition. The greatest difference was noted in the second experiment, where participants took 73% longer to identify an incongruent colour than to identify the colour of a colour block.

Stroop's experiment has been replicated many times since 1935, with many variations to the tasks. These experiments have consistently produced similar results (MacDonald & others, 2000).

Table 2.2 Various conditions of the Stroop task

Condition 1: Colour words in black print **Task:** *Read the word*	**Condition 2:** Incongruent colour words **Task:** *State the colour of the ink*
red	red
green	purple
blue	green
purple	brown
brown	blue
green	green
brown	red
red	brown
purple	blue
blue	purple

Condition 3: Blocks of colour **Task:** *State the colour of the block*	**Condition 4:** Familiar words in colour print **Task:** *State the colour of the ink*
	truck
	store
	couch
	table
	shirt
	store
	couch
	truck
	shirt
	table

Learning Activity 2.5

Review questions

1 Define the meaning of normal waking consciousness.

2 In what ways is the content of consciousness more limited in normal waking consciousness than in an altered state of consciousness?

3 a Explain the meaning of controlled and automatic processes in relation to consciousness, with reference to examples not used in the text.

b Describe two important differences between controlled and automatic processes in normal waking consciousness.

c In what ways are controlled processes *serial* and automatic processes *parallel*?

d According to controlled and automatic processing theory, what level of attention and what type of awareness are required to learn a new task?

4 When the Stroop task is given to children who have mastered their colours, but have not mastered their reading, the Stroop effect is not observed. Explain why this occurs with reference to controlled and automatic processing.

Learning Activity 2.6

Controlled and automatic processes in everyday life

Part A

1 Describe a task you have learned that initially involved controlled processes but that you can now perform using automatic processes.

2 What change in level of attention was required to perform the task during the learning process compared with after the learning process?

3 How do you know this behaviour now involves automatic processes rather than controlled processes?

Part B

1 Describe a task that you are currently learning that involves the use of controlled processes.

2 How will you know when your performance on this task is automatically processed?

Learning Activity 2.7

Comparing automatic and controlled processes

Copy and complete the following table, comparing examples of automatic and controlled processes.

Feature	Automatic processes	Controlled processes
Speed at which the processing is performed		
Level of attention required		
Degree of difficulty of the task		
Ability to undertake other tasks simultaneously		
Example		

Learning Activity 2.8

Evaluation of research by Neisser and Becklen (1975)

Evaluate the research on selective attention conducted by Neisser and Becklen (1975) described in box 2.3 on pages 107–8. Your evaluation should include responses to the following:

1. Construct a hypothesis for the experiment.
2. Identify the independent and dependent variables in the experiment.
3. Identify the different conditions of the experiment.
4. Why was an independent-groups design used for the experiment, rather than a repeated-measures or matched-participants design?
5. Briefly state the results that were obtained.
6. Briefly state the conclusion drawn by the researchers.
7. What other information would you want to know before you generalised from the results in this experiment?

Learning Activity 2.9

Evaluation of research by Stroop (1935)

Evaluate the research conducted by Stroop (1935) described in box 2.4 on pages 110–11. Your evaluation should include responses to the following:

1. Construct a hypothesis for each of the three experiments.
2. Identify the independent and dependent variable(s) for each experiment.
3. Identify the different conditions of each experiment.
4. **a** What type of experimental research design did Stroop use?
   b Explain one advantage and one limitation of using this research design.
   c Suggest a reason to explain why Stroop used this experimental research design rather than the independent-groups or matched-participants design.
5. Briefly state the results that were obtained.
6. What conclusions can be drawn from Stroop's experiments?
7. What other information would you want to know before you generalised Stroop's research findings to situations outside the laboratory?

Learning Activity 2.10

Research investigation on controlled versus automatic processing—testing for the Stroop effect

This experiment enables you to test the Stroop effect by comparing the time taken to identify different types of visual stimuli under different perceptual conditions.

Construct a hypothesis related to automatic and controlled processes before conducting the experiment. The hypothesis should be based on your reading of research findings of the Stroop effect. Pairs of experimenters should test four participants for all conditions of the experiment, as described in table 2.2 in box 2.4, using a repeated-measures design. Participants should be volunteers and tested individually. All relevant ethical guidelines must be followed.

In preparation for the experiment, each pair of experimenters will need to develop the stimulus materials shown in table 2.2. In addition, a data sheet will be required to record each participant's responses, such as that in table 2.3 on the next page. A stopwatch (or a watch with a stopwatch function) should be used to precisely record the response time of each participant.

Place the stimulus material for the first condition containing lists of words (see table 2.2) face down on a table in front of the participant in the order of presentation required. At the conclusion of each condition, place the stimulus material for the next condition face down on the table in front of the participant.

Participants should be provided with separate standardised instructions for each condition as follows.

Condition 1 (black print)

'When I say "start", you are required to turn the page. It will contain a list of words. Read aloud the words on the page as quickly as possible, beginning at the top of the word list. When you have read the last word, say "stop" to indicate that you have completed the task.'

Condition 2 (incongruent words)

'When I say "start", you are required to turn the page. It will contain a list of words written in different coloured ink. State the ink colour of each printed word as quickly as possible, beginning at the top of the list. When you have stated the ink colour of the last word, say "stop" to indicate that you have completed the task.'

Condition 3 (colour blocks)

'When I say "start", you are required to turn the page. It will contain a series of coloured blocks. State the colour of each coloured block as quickly as possible, beginning at the top of the series. When you have identified the last coloured block, say "stop" to indicate that you have completed the task.'

Condition 4 (familiar words)

'When I say "start", you are required to turn the page. It will contain a list of words written in different coloured ink. State the colour of each printed word as quickly as possible, beginning at the top of the list. When you have stated the colour in which the last word is printed, say "stop" to indicate that you have completed the task.'

For each condition, record both the time taken (in seconds) and the number of errors made by each participant.

Finally, participants should be thanked for their involvement in the experiment and debriefed.

Results

- Calculate the mean time and mean number of errors for each condition.
- Combine your data with data obtained by others in the class.
- Calculate means for the class results.
- Graph the class data to show the mean time taken for each condition and the mean number of errors for each condition. Ensure you use an appropriate type of graph.
- Write a statement that indicates whether or not the results support your hypothesis.

Analysis and interpretation

- Briefly discuss whether the results obtained are consistent with research findings on the Stroop effect.
- Write a conclusion based on the results obtained.
- State the IV and DV in each of the four conditions of the experiment.
- Describe two potential extraneous or confounding variables. Explain how each of these variables may have affected the results.
- Explain what the results of this experiment indicate about automatic and controlled processes.

Table 2.3 Data sheet of participant responses

Participant	Condition 1		Condition 2		Condition 3		Condition 4	
	Time	Errors	Time	Errors	Time	Errors	Time	Errors
1								
2								
3								
4								

Characteristics of altered states of consciousness

Most people spend about two-thirds of each day in normal waking consciousness during which there are variations in mental alertness, as streams of information flow in and out of awareness. When changes in mental awareness occur to the extent that you can notice differences in your level of mental functioning, you have entered an altered state of consciousness (Glicksohn, 1991).

The term **altered state of consciousness (ASC)** is used to describe any state of consciousness that is distinctly different from normal waking consciousness, in terms of level of awareness and experience, and the quality or intensity of sensations, perceptions, thoughts, feelings and memories that are experienced. In an ASC, mental processing shows distinct changes unique to the particular altered state. In addition, in an ASC, cognitive processes or perceptions of yourself or the world may change, and normal inhibitions or self-control may weaken (Martindale, 1981).

Some ASCs, such as sleep, daydreaming and dreaming, are a normal part of our lives and occur *naturally*. Other ASCs are *purposely induced*—for example, through meditation, hypnosis, alcohol ingestion or by taking certain medications or illegal drugs. There are many reasons why an individual may deliberately try to achieve an ASC. For example, meditation is a useful technique to help people relax and cope with stress. Hypnosis may be practised as part of therapy; for example, in trying to help someone deal with a fear of flying or give up smoking. Alternatively, some people use medications and illegal drugs to reduce pain, for psychological pleasure or as an escape from the pressures of their life.

Although the psychological changes that occur as a result of an ASC vary greatly from individual to individual, ASCs have some common characteristics. These include perceptual and cognitive distortions, a disturbed sense of time, and changes in emotional awareness and self-control.

Figure 2.13 When in an ASC, people experience alterations in their perception of the world, as shown by these sketches drawn by a person while they were in a drug-induced ASC.

Distortions of perception and cognition

Compared with normal waking consciousness, the way we experience sensations and perceptions in an ASC is often different. An ASC seems to have one of two effects on the senses—it either makes them more receptive to external stimuli, or dulls them to such an extent that some sensations are not experienced at all. For example, some drug-induced ASCs make perception of sensory experiences more vivid, so that colours seem brighter, tastes and smells stronger, sounds louder or more variable, and touch more sensitive. In some instances, people may even hallucinate, experiencing perceptions of stimuli or events that are not really occurring. For example, they may see visions or hear non-existent voices. Alternatively, during meditation, an individual may be able to focus their concentration to such an extent that their normal pain threshold (tolerance) is so elevated that regardless of what is done to them, they report experiencing no pain at all.

Perceptions are often so distorted in an ASC that people may lose their sense of identity (who they are). Some people experience the feeling either that they are someone else or that they are 'outside themselves' looking in. The feeling of losing touch with reality accompanies many ASCs.

Cognitive functioning also becomes impaired during an ASC. Thought processes are often more disorganised during a waking ASC, as well as during the ASC of dreaming during sleep. In an ASC, thinking is often illogical and lacking in sequence, and difficulties may be experienced in problem-solving. In addition, people often have trouble remembering events that occur during an ASC. For example, after experiencing an alcohol-induced ASC, people are often unable to recall in detail the events that occurred while they were intoxicated. Furthermore, ASCs induced through marijuana use also result in short-term memory impairment and subtle changes in thinking. In addition, when in an ASC, some individuals also have difficulty recalling information from long-term memory; however, retrieval of information from memory is usually restored when the individual returns to normal waking consciousness.

Time orientation

Estimation of time is frequently distorted in an ASC; that is, time seems to pass at a different speed than normal. In some ASCs and for some individuals, the passing of time may appear to be quicker, while in other ASCs time appears to pass very slowly. For example, when you are woken from a nap you may sometimes be surprised to learn that only an hour has passed since you went to sleep. It may seem as though you have been asleep for much longer. At other times when you wake, you can feel as though you have slept for a much shorter time than you actually have.

Figure 2.14 At a Hindu festival in Singapore, this young woman is able to control her pain response while in an altered state of consciousness.

Changes in emotional awareness

A change in our awareness and experience of emotion is also associated with many ASCs. ASCs appear to sometimes put an individual's feelings into a state of turmoil, resulting in uncharacteristic responses. For example, in an alcohol-induced ASC, some people become more emotional and may express their emotions more openly than in normal waking consciousness. In other ASCs, people have reported feeling emotionless; that is, having no feelings at all for events or situations that in normal waking consciousness would produce a highly emotional reaction in them. ASCs have also been associated with inappropriate emotional reactions, such as laughing at being told of a friend's death or crying when told a joke. Unpredictable emotional responses are also often associated with ASCs. While intoxicated, for example, an individual may burst into tears or become highly aggressive or excitable for no apparent reason.

Changes in self-control

Changes in our ability to maintain self-control are often evident during ASCs. For example, in an alcohol-induced ASC, individuals often have difficulty coordinating and controlling movements, sometimes being unable to walk down a hallway without stumbling into the walls. As described previously, they may also have difficulty maintaining control of their emotions; for example, behaving aggressively or affectionately to people with whom they would normally not behave this way in a state of normal waking consciousness.

Similarly, when in a hypnotic state, people are more susceptible to suggestion than when in their normal waking state. This can result in their behaving in a less inhibited way. An ASC induced through hypnosis has also been shown to help people gain greater self-control. For example, therapeutic use of hypnosis has helped some people to stop smoking, gambling or 'overeating', and has assisted others to manage chronic pain (Miller & Bowers, 1993).

Learning Activity 2.11

Review questions

1. Define the term altered state of consciousness (ASC).
2. In what main ways is an ASC different from normal waking consciousness?
3. Can an ASC be experienced during normal waking consciousness? Explain your answer with reference to an example.
4. State two naturally occurring ASCs and two purposely induced ASCs.
5. An employer is concerned that one of her employees has been arriving at work in an altered state of consciousness and is not in a fit state to operate the machinery for

which he is responsible. She is not sure what the characteristics of different ASCs are and wants to be more confident of her information before discussing the issue with him. Briefly describe four characteristics of ASCs that may be helpful for the employer to know.

Daydreaming

During normal waking consciousness, our thoughts are usually organised, meaningful, clear and real. However, studies have shown that a large proportion of our waking time is spent in another state of consciousness called daydreaming.

Daydreaming is an altered state of consciousness in which we shift our attention from external stimuli to internal thoughts, feelings and imagined scenarios. Some daydreams are pleasurable fantasies, while others involve planning for the future or rehearsing important conversations. The shift in consciousness to a state of daydreaming occurs naturally, and often without us even being aware that it has happened. For example, you could be involved in conversation with friends and suddenly become aware that their conversation is occurring in the background and you are thinking about what to buy your mother for Mother's Day.

Research findings suggest that daydreaming is more likely to occur when we are stationary than when we are moving about, perhaps because it is at these times that our active behaviour and directed attention are 'turned off' (Pope & Singer, 1980). It is also more likely to occur when we are alone, waiting to fall asleep, travelling on public transport, or doing routine or boring activities such as washing dishes. It appears that our consciousness may respond to an unchanging external world by turning inward and creating more interesting thoughts and images.

Daydreams are usually quite different from nightdreams. One study of daydreaming required students to spend 10 hours in a comfortable but bare room with no clocks, books or other distractions. Every five minutes, participants wrote down what they had been thinking about in the previous five-minute period. EEGs monitored their brain wave patterns, and eye movements were also recorded. Unlike nightdreams, the daydreams were associated with minimal eye movements and high levels of alpha brain waves (brain waves associated with a relaxed state and the period of time when we drift from being awake into sleep, known as NREM stage 1 sleep). The content of the daydreams frequently consisted of a series of disjointed, unrelated and emotional thoughts—even less organised and meaningful than many nightdreams (Kripke & Somenschein, 1978).

Austrian psychoanalyst Sigmund Freud believed that the purpose of daydreams is to allow us to do in our fantasies what we are unable to do in reality. He suggested that by daydreaming, we reduce the frustration and tension we would otherwise have experienced as a result of unfulfilled wishes and needs. In our daydreams we can experience success, have the relationships we desire, and seek revenge against those who have wronged us.

Empirical research provides some support for Freud's view. In one American study, students were asked to summarise their daydreams at the end of each day over several days. The results supported Freud's view that many of the students' daydreams involved the fulfillment of wishes. Most participants also reported feeling quite relaxed when the daydreaming was about wish fulfillment, providing further support for Freud's view that daydreams serve the purpose of reducing tension. However, contrary to Freud's view, many of the daydreams were also filled with regret, sadness and guilt. Daydreams that had a sexual theme were often focused on a person whom the individual wanted to know better. These daydreams tended to make the individual frustrated as they knew that they were daydreaming. The consequence of this was that it created tension, thereby contradicting Freud's view (Pope & Singer, 1978).

Psychologists generally believe that daydreaming can serve a number of different purposes. For example, Singer (1975) proposes that daydreaming enables us to mentally try out a range of courses of action that could be applied to particular situations. Schachter (1976) has suggested that daydreaming may also assist us to solve problems. For example, some authors report having created the plot for their novel when daydreaming and some scientists have come up with solutions to problems when daydreaming. It has also been suggested that we daydream in order to stay

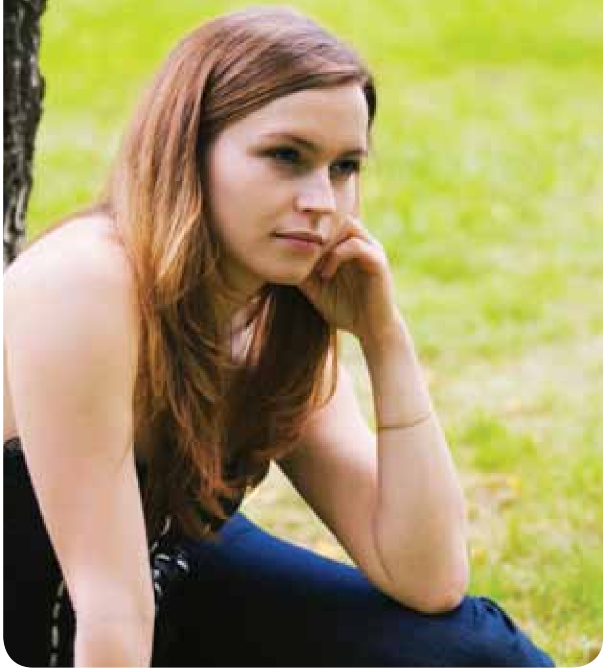


Figure 2.15 Daydreaming is a state of consciousness in which our attention has shifted from external to internal stimuli.

mentally alert in situations in which there is insufficient external stimulation.

Although individuals differ in the frequency and intensity (vividness) of their daydreams, in one study on daydreaming, all participants reported daydreaming daily (Singer, 1975). In another study, researchers found that students daydream about half the time they are in a state of normal waking consciousness (Klinger, 1992). How much of your day is spent daydreaming?

Meditative state

A meditative state of consciousness is intentionally induced through the practice of meditation. There are many techniques that can be used for meditation, including yoga, Zen and transcendental meditation, each of which has its basis in Eastern religions such as Buddhism and Hinduism. However, the practice of meditation doesn't require an understanding of these religions or philosophies and is often undertaken for reasons that have nothing to do with religion.

In relation to consciousness, **meditation** involves the use of a technique to deliberately alter normal waking consciousness in order to induce an altered state of consciousness characterised by a deep state of relaxation. It may also produce a heightened state of personal awareness and feelings of inner peace and tranquility. Although techniques for achieving a meditative state differ, they typically involve altering the normal flow of conscious thoughts. This is achieved by focusing attention on a simple stimulus (such as a word) or by concentrating on a stimulus that is virtually in the background of awareness (such as breathing). For example, when meditating, the individual often sits in a comfortable position with their eyes closed in order to block out any distractions. Attention is selectively focused on one thing; for example, repeating a particular word such as 'one' or '*om*' over and over again, or concentrating on breathing. The purpose of this is to prevent distracting thoughts from entering the mind so it remains free from the stream of continuous thoughts that might normally intrude. True meditation clears the mind completely of any thoughts, which leads some people who practise it to describe it as a state of 'pure consciousness'.

Practising meditation

Research has shown that, in some forms of meditation, brain waves characteristic of the relaxed state of falling into sleep become more prominent in EEG recordings of brain wave activity (Fenwick, 1978). Other forms of meditation have produced brain waves that are rarely observed except when a person is asleep (Matsouka, 1990). This indicates that a person's level of awareness diminishes in a meditative state, and that the experience of sensations is likely to be reduced. In particular, the experience of pain has been found to be less intense and, for some individuals, meditation can provide complete relief from pain for the time they are in the meditative state. This is said to occur because when a person is meditating their senses are less receptive to the intrusions of internal and external messages, which are blocked out because the focus during meditation is on keeping the mind 'clear'.

Although some remarkable claims have been made about meditation, such as that it can increase your creativity, improve the quality of your relationships or even stop the ageing process, these claims are not supported by scientific evidence. However, considerable research evidence indicates that meditation appears to have many psychological and physiological benefits that rest does not (Tooley, 2006).

Figure 2.16 Tai chi is an important practice in many cultures and can bring about a meditative state.

Alcohol-induced state

In everyday use, the term *alcohol* usually refers to drinks such as beer, wine or spirits containing ethyl alcohol—a substance that can cause drunkenness and changes in consciousness, mood and emotions. Ethyl alcohol requires no digestion and after entering the stomach, passes through the gastrointestinal tract, entering the bloodstream via porous capillary walls.

Alcohol is considered to be a psychoactive drug. *Psychoactive drugs* are chemicals that change conscious awareness, perception or moods. This means that many other everyday use substances such as caffeine (in coffee, tea, chocolate or cola) and nicotine (in cigarettes) are psychoactive drugs, along with most legal and illegal drugs. Many people are surprised that alcohol is also classified as a *depressant*. Initially, alcohol produces a mild euphoria, talkativeness and feelings of good humour and friendliness, leading many people to think of alcohol as a stimulant. But these subjective experiences occur because alcohol lessens inhibitions by depressing the activity of brain centres responsible for judgment and self-control (Hockenbury & Hockenbury, 2006).

The specific effects of alcohol on consciousness depend on a wide range of variables. These include the concentration of the alcohol consumed, the amount of alcohol consumed, the conditions under which the alcohol is consumed and variables related to the individual, such as the rate of consumption, drinking history, the amount of food in the stomach, body weight, age, gender, body chemistry, physical wellbeing, emotional state and mood. The effects of alcohol on consciousness are many and varied. A person may experience:

- *a shortened attention span*: for example, difficulties in maintaining concentration
- *impaired perceptions*: for example, a slow down in the processing of information from the senses, and may therefore have trouble seeing, hearing, feeling and so on; pain threshold may increase

Figure 2.17 The effects of alcohol on consciousness depend on a wide range of variables and are many and varied.

- *impaired thinking*: for example, difficulties with understanding, thinking clearly, using good judgment
- *impaired memory*: for example, difficulties forming new memories or memory loss (including recent events)
- *slower reaction times*: for example, not reacting to stimuli or situations quickly
- *reduced self-awareness*: for example, focusing attention on the immediate situation and away from any future consequences to self
- *impaired emotional awareness and control*: for example, exaggerated states of emotional experiences and responses such as anger, aggressiveness, withdrawal
- *impaired perception of time*: for example, estimating time, being aware of the amount of time that has passed, knowing the time
- *less self-control*: for example, being more self-confident or daring or more impulsive; saying the first thought that comes to mind rather than an appropriate comment for the given situation; acting silly
- *difficulties with voluntary muscular control and fine movements*: for example, writing or signing name; experiencing uncoordinated, jerky body movements and loss of balance, stumbling and falling
- *deterioration in performance of complex tasks*.

These and other effects of alcohol on conscious experience are primarily due to the impact of alcohol on brain functioning. The effects on brain functioning and therefore consciousness are directly related to the concentration (%) of alcohol in the blood (BAC level). As shown in table 2.4, the higher the BAC level, the more pronounced the effects on consciousness. Note that excessive alcohol consumption can cause loss of consciousness or even death. The brain stem controls or influences all of the bodily functions that you do not have to think about, such as breathing, heart rate, core body temperature and consciousness. As alcohol starts to influence different areas of the brain stem, a person will start to feel sleepy and may eventually become unconscious as BAC increases. If the BAC gets high enough, a person may stop breathing altogether, and both blood pressure and body temperature will fall. These conditions can be fatal.

Table 2.4 BAC—behavioural effects of blood alcohol levels

BAC level	Possible effects
Up to 0.05%	• talkative • relaxed • more confident • lowered alertness
0.05–0.08%	• talkative • acts and feels self-confident • judgment impaired • inhibitions reduced • less self-control and caution • body movements impaired or uncoordinated • lower alertness • increase in reaction times
0.08–0.15%	• speech slurred • balance and coordination greatly impaired • reflexes slowed; large consistent increases in reaction times • senses impaired • visual attention impaired • unstable emotions: e.g. aggressive, withdrawn or overly affectionate
0.15–0.30%	• unable to walk without help • perception greatly impaired • higher pain threshold: e.g. may not feel pain as readily as when sober • little or no comprehension of the immediate environment • confused: e.g. not know where you are or what you are doing • apathetic • slurred speech • unable to remember events • sleepy
0.30–0.40%	• can barely move at all • cannot respond to stimuli • cannot stand or walk • difficult to wake up • incapable of voluntary action • stuporous but conscious at 0.30% • loss of consciousness (like surgical anesthesia) at 0.35%
Over 0.40%	• coma and/or death (about half at 0.40% die; at 0.50% or higher a person usually stops breathing and dies)

Sources: Drug and Alcohol Services, South Australia (2010); Australian Government Department of Health and Aging (2010).

Learning Activity 2.12

Review questions

1. Define daydreaming.
2. What is a possible explanation for daydreaming occurring more often when alone or doing routine or boring activities?
3. List three possible functions or purposes of daydreaming.
4. Explain the meaning of meditative state of consciousness.
5. In what key ways are daydreaming and meditative states similar and different?
6. a. Explain the meaning of alcohol-induced state of consciousness.
   b. What factors influence the experience of an alcohol-induced state of consciousness?
   c. Give three examples of changes in consciousness that may be associated with alcohol consumption.
   d. Refer to table 2.4 on page 120 and figure 2.6 on page 101. Rank each BAC level on the continuum.

Learning Activity 2.13

Data analysis

1. What type of data are shown in table 2.4: quantitative, qualitative or both?
2. Use the data in the table and the text to complete another table with the following headings:
   - level of awareness
   - content limitations
   - controlled processes
   - automatic processes
   - perceptual and cognitive distortion
   - emotional awareness
   - self-control
   - time-orientation.

   Include examples for each heading and give the table an appropriate title.

Methods used to study level of alertness in normal waking consciousness

A challenge in conducting research on normal waking consciousness is that, unlike the study of physical characteristics such as eye colour or height, or behaviour such as walking and talking, states of consciousness cannot be observed or measured directly. Consequently, consciousness and its various states are referred to as psychological constructs. A **psychological construct** is a concept that is 'constructed' to describe specific 'psychological' activity, or a pattern of activity, that is believed to occur or exist, but that cannot be directly observed or measured. Much of what psychologists know about an individual's state of consciousness can only be inferred or assumed from information provided by the individual (e.g. self-reports), from behaviour that is demonstrated (e.g. experimental research) or from physiological changes that can be measured (e.g. brain recording and imaging techniques). On the basis of such information, inferences are made about an individual's underlying state of consciousness. Observational studies also provide useful information about an individual's state of consciousness, but because they rely on an observer's interpretation of behaviour, this method is often not as reliable or objective (e.g. it is prone to bias). Therefore, greater emphasis is placed on the more objective and thus more reliable measurements of physiological responses when studying consciousness.

Various devices to measure physiological responses are used to give psychologists an accurate reading of bodily changes and responses during various states of consciousness. These measurements have provided psychologists with valuable evidence on levels of alertness and underlying changes during normal waking consciousness and altered states of consciousness. Different patterns of physiological responses are associated with different levels of alertness and states of consciousness. Typically, variations occur in brain wave activity, heart rate, core body temperature and electrical conductivity of the skin.

Electroencephalograph

In 1924, German psychiatrist Hans Berger developed the electroencephalograph (electro-en-sef-uh-low-graf) to record and analyse electrical activity of the brain associated with different behavioural responses and mental processes (Springer & Deutsch, 1998). An

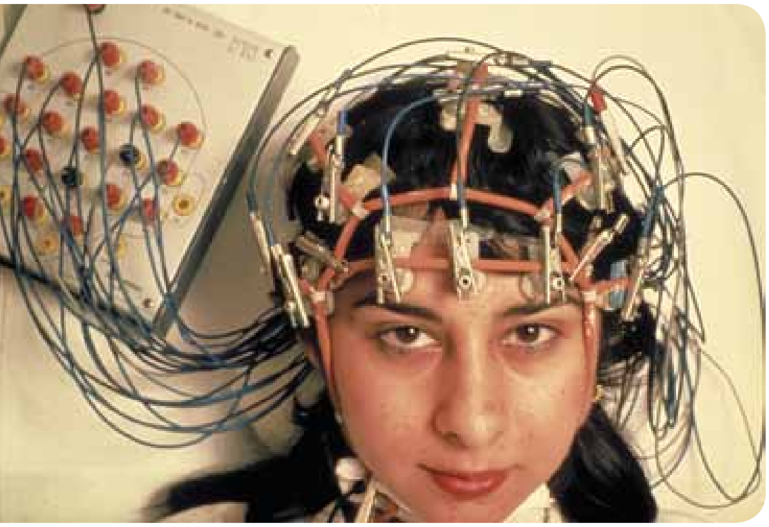


Figure 2.18 An EEG records the electrical activity of a participant's brain through electrodes attached to the scalp.

electroencephalograph, or **EEG**, is a device that detects, amplifies and records general patterns of electrical activity of the brain. The electrical activity constantly produced by the billions of neurons in the brain, particularly neurons in the cerebral cortex just below the scalp, can be detected outside the skull. This activity is detected by small electrodes that are attached (taped or pasted) to the surface of the scalp at the top and sides of the head (see figure 2.18). Alternatively, a participant may be required to wear a device that looks like a swimming cap, but with electrodes attached. The EEG amplifies and translates the relatively weak electrical activity in areas of the brain beneath the electrodes into a visual pattern of **brain waves**. The brain waves are recorded and displayed as a graph on a computer monitor or as a moving sheet of graph paper (see figure 2.19). These EEG records are called *electroencephalograms*.

Brain wave patterns as shown in EEG recordings can vary in *frequency*; that is, the number of brain

Figure 2.19 Typical EEG patterns associated with various states of consciousness

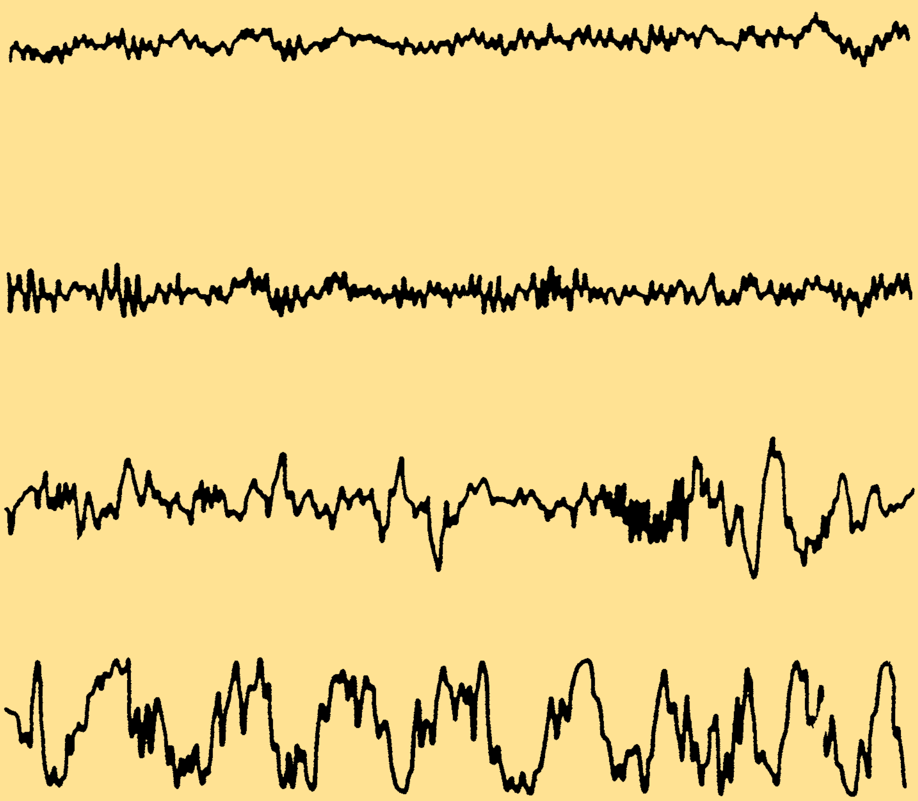
Brain wave patterns

Beta waves
Beta waves have a high frequency (fast) and low (small) amplitude. They are typically associated with normal waking consciousness and focused attention (i.e. someone who is awake, alert and active, with eyes open, and concentrating on some task).

Alpha waves
Alpha waves have a high frequency (but slower than beta waves) and a low amplitude (but slightly larger than beta waves). They are typically associated with a relaxed, wakeful or meditative state.

Theta waves
Theta waves have a medium frequency (slower than alpha and beta waves) and a mixture of high and low amplitude waves. They are typically associated with the early stages of sleep.

Delta waves
Delta waves have the lowest frequency and the highest amplitude. They are typically associated with the deepest stages of sleep.



waves per second. The frequency of a specific brain wave pattern is judged in terms of how many brain waves are produced in a cycle of activity. A pattern of *high-frequency* brain wave activity is faster and therefore has *more* brain waves per unit of time, while a pattern of *low-frequency* brain wave activity is slower, and therefore has *fewer* brain waves per unit of time.

Brain waves can also vary in amplitude or intensity. The *amplitude* of a specific brain wave pattern is judged by the size of the peaks and troughs of the pattern from a baseline of zero activity. *High-amplitude* brain waves have *bigger* peaks and troughs, while *low-amplitude* brain waves have *smaller* peaks and troughs.

Four different groups of brain wave patterns, named after letters in the Greek alphabet, have been identified. Each group of brain wave patterns has a different combination of frequency and amplitude that indicate different kinds of brain activity. When the brain's electrical activity is at its highest—for example, when alert and active during normal waking consciousness—the *beta* wave EEG pattern occurs with high-frequency (fast) and low-amplitude (small) brain waves. When an individual is extremely relaxed or in a meditative state, the alpha brain wave pattern is evident. Typically, the *alpha* wave pattern also has a high frequency with low amplitude (but a slightly larger amplitude than beta waves). In the early stages of sleep, theta waves occur. The *theta* wave pattern has a medium frequency and some high-amplitude (large) waves mixed with some low-amplitude (small) waves. In the deepest stages of sleep, delta waves occur. *Delta* waves are the slowest of the brain waves. They have a pattern of low-frequency (slow) and high (large) amplitude. Brain wave patterns are used in conjunction with other physiological or psychological measures to help identify and describe an individual's state of consciousness (see figure 2.19).

Heart rate

Changes in heart rate are also associated with different states of consciousness and can indicate levels of alertness. In some ASCs, the heart rate increases from that recorded in normal waking consciousness, while in other ASCs it decreases.

Figure 2.20 We don't have to be physically active to experience a change in heart rate.

Learning Activity 2.14

Brain activity associated with different states of consciousness

Different brain wave patterns are associated with different states of consciousness. For each of the following activities, state which kind of brain wave pattern would probably be dominant (alpha, beta, theta or delta):

- lying on the beach, having just fallen asleep
- playing a computer game
- alcohol-induced state with a BAC level of 0.01%
- alcohol-induced state with a BAC level of 0.4%
- sleepwalking that occurs in the deepest stages of sleep
- sitting down and getting ready to induce a meditative state
- in a meditative state
- learning how to use a mathematical formula for the first time
- watching a Disney 'family' movie
- watching a suspenseful horror movie.

For example, while a person is asleep, meditating or unconscious, heart rate is likely to decrease. In contrast, when a person is experiencing an ASC associated with the use of a substance that is a stimulant, heart rate is likely to increase.

Heart rate normally changes in relation to physical activity. The more physically active the individual, the higher their heart rate is likely to be and vice versa. Similarly, heart rate can change in relation to psychological activity. For example, consider how your heart rate may change when watching a Disney family movie compared to a suspenseful horror movie, or when queuing at the canteen in the middle of lunchtime compared to when you are queuing to enter the room where you will sit an important VCE exam.

Body temperature

Core (internal) body temperature is less variable than heart rate but can also change in relation to physical activity during normal waking consciousness. However, the physical activity usually has to be strenuous and the environmental conditions extreme to induce a marked or prolonged change in core body temperature. A general pattern has been identified indicating that body temperature changes with an ASC; for example, an ASC induced by a physical health problem or disease. The most predictable change in core body temperature is the drop in body temperature that is evident during the ASC of sleep.

Galvanic skin response

The **galvanic skin response (GSR)** is a physiological response that indicates the change in the resistance of the skin to an electrical current (that is, the electrical conductivity of the skin). To measure the GSR, electrodes are usually attached to the sides of a finger or the palm of a hand, as these areas of skin lack hair. If, for example, the sweat glands in the finger secrete sweat, such as during physiological arousal, the resistance of the skin to an electrical current decreases (that is, the electrical conductivity of the skin increases). The electrodes enable detection and measurement of how easily the electrical current passes through the skin.

Changes in GSR are closely associated with emotional experiences and can also indicate levels of alertness. The experience of high emotional arousal often gives rise to increased sweating, which is shown in a GSR as an increase in electrical conductivity (that is, a decrease in electrical resistance). Since ASCs are also closely associated with both heightened and reduced emotional reactions, the GSR can be used as one indicator of an alteration in an individual's state of consciousness.

Measures of physiological responses can provide useful information about an individual's state of consciousness, particularly levels of alertness and the state they are likely to be experiencing. However, using information about physiological responses as the *only* indicator of a state of consciousness can be misleading. Changes in physiological responses occur for many reasons apart from a change in the state of consciousness; for example, as a result of anxiety or a physical health problem. Therefore, psychologists typically use measures of physiological responses in conjunction with other observations and data-collection techniques in order to obtain more accurate data on the experiences associated with normal waking consciousness and altered states of consciousness.

Figure 2.21 This device measures GSR and other responses.

Learning Activity 2.15

Review questions

1 Why is consciousness (and any ASC) referred to as a psychological construct?

2 a What is the galvanic skin response?
  b Describe the GSR that could be expected of someone in
    i an alcohol-induced state of consciousness
    ii a meditative state when they became highly emotional and distressed.

3 Construct a table to summarise the frequency (slow or fast) and amplitude (large or small) of the four different kinds of brain wave patterns. In addition, state whether each brain wave pattern is associated with normal waking consciousness or an ASC.

4 Construct a table to summarise how heart rate, body temperature and GSR may differ during high and low levels of alertness *and* during normal waking consciousness.

Learning Activity 2.16

Experimental design

Outline an experimental research design that could be used to study one or more of the key characteristics associated with normal waking consciousness or an ASC. In describing your experiment, make sure that you:

- construct a hypothesis
- identify the IV(s) and DV(s)
- identify potential extraneous and confounding variables, and how they would be controlled
- identify a population and sample for study, and describe a sample-selection procedure
- describe the experimental conditions (e.g. experimental and control groups)
- describe the participant allocation procedure
- explain why the results could be generalised
- identify relevant ethical guidelines that would need to be followed.

Learning Activity 2.17

Research investigation—perception of time during an altered state of consciousness

This experiment enables you to investigate the effects on perception of time of being in a relaxed meditative state of consciousness. The technique used to achieve the meditative state is simple and does not require participants to know or adopt any philosophical or religious beliefs.

Construct a hypothesis before conducting the experiment, ensuring that you consider relevant research findings and the procedures of the investigation. Pairs of researchers should test volunteer participants. Convenience sampling may be used; for example, a small group or class of students at your school or college that is willing and available to participate. All relevant ethical guidelines should be followed.

The experiment uses an independent-groups design, with one group of participants in an experimental group and the other in a control group. A random allocation procedure should be used to assign participants to different groups. This may be done if participants are individually identified when planning the experiment or during the experiment (as described below). Participants in the experimental group will be required to attain a relaxed, meditative state, whereas those in the control group will not. Participants in each group are given a different set of instructions, which they are required to read silently and follow.

You will need a watch, a paper and pen for each participant, sufficient copies of instructions (A and B), and sufficient copies of the rating scale. The rating scales should be marked or labelled so that you can distinguish between the experimental and control groups. You should also organise access to a room free from distractions such as external noise. The room should preferably be carpeted and have free-standing furniture that can be moved to the perimeter so that there is sufficient space for the participants to sit on the floor in a comfortable position without being too close to anyone else.

When you are ready to conduct the experiment, ask the participants to remove their watches and place them in their pockets or bags. If there is a clock in the room, shield its face from view. If necessary, explain these actions with a statement such as 'It's part of the procedure. I'll explain it later'.

Tell the participants that they will be learning a method for relaxing. Give a very general description of a relaxation (meditative) technique; for example, a composite of the techniques described in instructions A and B, which follow. If your results are to be collated with those of other researchers (so that class results can be used for a report on the investigation), the initial instructions should be standardised (along with all other procedures). Do not give specific details when presenting the initial instructions. Participants should not know the condition to which they have been assigned and that each group has different instructions.

Randomly assign the participants into the experimental group and the control group. Participants in the experimental group will carry out the instructions for achieving a relaxed meditative state (A). Participants in the control group will carry out the instructions directing them to simply sit quietly with their eyes closed (B).

Distribute copies of the instructions and ask participants to read them silently and independently. Tell them that you will be giving signals to start and stop the activity. Answer any questions, and then give the start signal.

After 15 minutes give the stop signal. Allow participants a little time to regain their alertness. Then hand out the rating scales face down. Ask all participants to write down the number of minutes they believe elapsed between the start and stop signals for the activity. When they have finished, ask them to turn over the sheet and write down their degree of relaxation, on a scale of 1 to 10, with '1' representing extremely relaxed and '10' representing extremely tense.

Collect all data sheets, ensure participants collect their watches and other belongings, then fully debrief all participants and thank them for participating in the experiment. You should also allow participants the opportunity to ask questions about the research and its procedures. All questions should be answered honestly.

A Instructions for experimental group

1. Sit quietly in a comfortable position and close your eyes.
2. Deeply relax all your muscles, beginning at your feet and progressing up to your face. Keep them deeply relaxed.
3. Breathe through your nose. Become aware of your breathing. As you breathe out, say the word 'one' silently to yourself. *Breathe easily and naturally.*
4. Do not worry about whether you are successful in achieving a deep level of relaxation. Maintain a passive attitude and permit relaxation to occur at its own pace. When distracting thoughts occur, ignore them by thinking 'oh well' and return to repeating 'one'.

B Instructions for control group

1. Sit quietly and close your eyes.
2. Try to be comfortable.
3. Keep your eyes closed and let your mind wander.

Rating scale

1	5	10
extremely relaxed	neither relaxed nor tense	extremely tense

Results

- If required, combine your data with those of others in the class.
- Calculate the mean or median time estimates for each group (condition).
- Graph the data using an appropriate graph.
- Check the deviations from the actual elapsed time. (It is possible that time estimates for the two groups could be the same on the average but still differ in variability.)
- Write a statement that indicates whether or not the results support your hypothesis.

Analysis and interpretation

- Briefly discuss whether the results obtained are consistent with research findings.
- Write a conclusion based on the results obtained.
- State the IV and DV in the experiment.
- Describe three potential extraneous or confounding variables. Explain how each of these variables may have affected the results.
- Explain why the independent-groups design was used rather than a repeated-measures or matched-participants design.
- Explain the potential benefit of collecting self-reports that require participants to describe the state of consciousness they experienced during the 15-minute period.
- What do the results of this experiment indicate about the perception of time during an ASC?
- To what extent can the results be generalised to different populations? Explain your answer.

Source: adapted from Grivas, J., & Lawrie, P. (1991). *Psychology experiments and activities*. Marrickville, NSW: Harcourt Brace Jovanovich, pp. 163–165.

Chapter 2 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Consciousness is directly observable.

2 ______ Levels of alertness vary within normal waking consciousness.

3 ______ Some altered states of consciousness occur naturally.

4 ______ Normal waking consciousness is a psychological construct.

5 ______ A GSR measures heart rate.

6 ______ Measure of heart rate can indicate level of alertness.

7 ______ Automatic processing can be parallel.

8 ______ Meditation is a normal waking state of consciousness.

9 ______ Alpha brain wave patterns are typically associated with tasks requiring a high level of alertness.

10 ______ Reduced self-awareness may occur during an alcohol-induced state of consciousness.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 2 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 A basketball player is given a penalty shot at the goal from the free-throw line. The brain wave pattern associated with this activity would have ______ frequency and a ______ amplitude.

A high; low
B high; high
C low; high
D low; low

Q2 Normal waking consciousness is best described as

A a state of wakefulness.
B awareness of internal states and the external world.
C a state of full alertness and focused attention.
D a mixture of automatic and controlled processes.

Q3 Which of the following is **not** an altered state of consciousness?

A daydreaming
B meditative state
C alertness
D alcohol-induced

Q4 Activities requiring automatic processes usually involve

A focused attention.
B minimum attention.
C a shift in attention from internal to external stimuli.
D a shift in attention from external to internal stimuli.

Q5 Normal waking consciousness differs from an altered state of consciousness because in normal waking consciousness

A level of awareness is at a consistent predictable level.
B perception of time is distorted.
C it is difficult to store and retrieve information from memory because of distractions throughout the day.
D the content of our consciousness is usually organised and logical.

Q6 The term state of consciousness is **best** described as

A a continuum.
B a person's level of awareness of their internal state and external events.
C a person's level of awareness of their internal state without awareness of the external environment.
D a person's physiological responses to external stimuli.

Q7 A researcher wanted to test whether a particular drug induced a state of relaxation. Which of the following would most reliably indicate a state of relaxation?

A galvanic skin response
B body temperature
C amount of sleep
D EEG records

The following information relates to questions 8 and 9.

In an experiment to find out the effects on driving performance of using a hands-free mobile phone while driving, researchers advertised for 100 research participants in the daily newspaper. They accepted the first 20 responses in each of the following age groups: 18–20, 21–25, 26–30, 31–35 and 41–45. Within each age group, participants were randomly allocated to either the control group or the experimental group. The control group drove in a driving simulator without using a hands-free mobile phone. The experimental group drove in the driving simulator using a hands-free mobile phone. Researchers measured the number of driving errors each participant made.

Q8 What type of experimental design was used by the researchers?

A repeated-measures
B independent-groups
C mixed-participants
D matched-participants

Q9 The sample used is best described as a ______ sample.

A random
B convenience
C random-stratified
D convenience-random

Q10 Simon has a very high fever after contracting a virus. While lying awake in bed, he begins to feel as though ants are crawling all over his body, and says he can see them, despite there being no ants.

Simon is most likely experiencing ______ with ______.

A normal waking consciousness; self-control
B normal waking consciousness; a psychological construct
C an altered state of consciousness; perceptual distortions
D normal waking consciousness; perceptual distortions

Q11 One reason there are content limitations in normal waking consciousness is that, during normal waking consciousness,

A we can usually consciously control the information coming into consciousness.
B information is continually flowing in and out of consciousness.
C there is a limit to the amount of time we are awake.
D controlled processes dominate automatic processes.

Q12 High-frequency brain waves are ______ and therefore have ______ brain waves per unit of time.

A faster; more
B slower; less
C faster; less
D slower; more

Q13 High-amplitude brain waves have _______ peaks and troughs, whereas low amplitude brain waves have _______ peaks and troughs.
- **A** bigger; smaller
- **B** smaller; faster
- **C** bigger; faster
- **D** smaller; bigger

Q14 A loss of self-control is most likely to be associated with which state of consciousness?
- **A** daydreaming
- **B** alcohol-induced
- **C** relaxed–meditative
- **D** tense–meditative

Q15 Which of the following stimuli is **least** likely to attract or maintain someone's attention?
- **A** an important stimulus
- **B** a novel stimulus
- **C** an unchanging stimulus
- **D** a changing stimulus

The answers to the Chapter 2 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain why daydreaming is considered to be an altered state of consciousness.

____

____

____

____

1 mark

Question 2

Explain why consciousness is considered to be a psychological construct.

____

____

____

____

2 marks

Question 3

William James described consciousness as ______________________________

____

____

whereas René Descartes described consciousness as ______________________

____

____ .

2 marks

Question 4

Distinguish between normal waking consciousness and altered states of consciousness.

____

____

____

____

____

2 marks

Question 5

Explain how one of the following measures of physiological responses can be used to study the level of alertness in normal waking consciousness and what specific types of responses would indicate high and low levels of alertness.

- heart rate
- core body temperature
- galvanic skin response

____

____

____

____

____

____

3 marks

The answers to the Chapter 2 short-answer questions are available at www.OneStopScience.com.au

3 Sleep

At least once every day, most often at night, we experience various altered states of consciousness. This occurs when we sleep. During the altered states of consciousness associated with sleep, our awareness and perception of ourselves and the events occurring around us differ from when we are awake and in a state of normal waking consciousness. Just as we experience differing states of consciousness or levels of awareness within normal waking consciousness, it is the same when we sleep. Psychologists have identified different kinds of sleep associated with different experiences of consciousness. For example, when we dream while we are sleeping, we experience an altered state of consciousness that is distinctly different from the states of consciousness we experience when we are asleep but not dreaming.

While there is no single definition of sleep used by all psychologists, **sleep** can be described as a regularly occurring altered state of consciousness that typically occurs spontaneously and is primarily characterised by a loss of conscious awareness. Although sleep occurs naturally, various drugs such as alcohol and tranquillisers (sleeping pills) can induce sleep.

Over a lifetime, we spend about one-third of our time asleep. If we live to around 75 years of age, we will spend about 25 years sleeping (including about five years dreaming). What does psychological research indicate about sleep? Is it simply a period of restful inactivity when the brain 'switches off'? How can you tell that someone has actually fallen asleep? What actually happens during sleep? Why is it harder to wake someone up at certain times during their sleep than at other times? Do we dream every night? How can we predict when someone will dream after they fall asleep? What are the effects of not getting 'enough' sleep? Does missing a few hours or even a few nights of sleep actually harm us? How long does it take our body to recover from prolonged sleep loss? How efficiently does our body recover?

With advances in technology for detecting and recording physiological responses while people sleep, sleep researchers have increasingly been able to unravel the mysteries of sleep.

Methods used to study sleep

Most sleep research takes place in *sleep laboratories*, sometimes called *sleep study units* or *centres*, often attached to public and private hospitals. Here, patients with **sleep disorders** can be diagnosed and treated, as well as studied for research purposes. Individuals without a sleep disorder may also be studied for research purposes.

An individual's sleep can be affected by their surroundings and their routine before going to sleep. Consequently, a sleep laboratory has one or more small 'bedrooms', furnished and decorated to be as homelike and comfortable as possible (but also soundproof). The person is connected to an adjoining 'control room' where researchers monitor sleep patterns throughout the night. Research participants go to bed at their usual time to keep behaviour patterns as close to normal as is reasonably possible. They might arrive at the sleep laboratory in time for an evening meal, then sit around watching television or reading, following their usual routine before going to sleep.

The procedure for conducting sleep observations or tests in a sleep laboratory (or an individual's home) is commonly called polysomnography. **Polysomnography** is an intensive study of a sleeping person involving simultaneous monitoring and recording of various physiological responses of the sleeper during the course of the night. Three sources of data that provide useful information on physiological changes that occur as we fall asleep and during sleep itself are electrical activity of the brain, information about eye movements, and the body's muscle tone or 'tension'; that is, the extent to which muscles are relaxed. Other physiological responses such as heart rate, body temperature, respiration, the amount of oxygen in the blood, body position, and leg movements or even snoring noises can also be recorded, depending on what information is required. Although all the different devices used to monitor and record

Figure 3.1 A participant spends a night in the 'bedroom' of a sleep laboratory, while an experimenter in an adjacent control room monitors devices that record brain wave activity, eye movements, muscle tension and other physiological responses.

the physiological responses can look and feel cumbersome when attached, after an initial period of adjustment the person usually falls into their regular sleep pattern. An important advantage of the devices used for a polysomnographic study or test is that precise observations and measurements can be made during sleep without actually waking the person. As shown in figure 3.1, many sleep laboratories are also fitted with one or more video cameras that use infrared light so the person is not disturbed. Video cameras enable ongoing visual contact with the sleeping person and can be used to monitor and record 'involuntary' sleep behaviours such as sleepwalking and night terrors.

Data on physiological responses of sleeping research participants (or patients) have provided psychologists with a great deal of valuable information on the nature of sleep and what people typically experience during sleep. For example, it is now evident that sleep has different stages through which we progress in a cyclical way. Self-reports are another important source of information about what happens during sleep. These can be obtained through questionnaires, by asking research participants to keep a sleep diary for a period of time and/or by waking them during various stages or different types of sleep and asking them to describe their experiences. The use of self-reports has been particularly valuable in providing information about mental processes such as thoughts and feelings associated with different stages and types of sleep. They have also been useful in diagnosing and assisting people with sleep problems and disorders.

Electroencephalograph

An electroencephalograph (EEG) can be used to detect, amplify and record the electrical activity spontaneously generated by the brain during sleep and dreaming. As shown in figure 3.2, electrical activity is represented as distinctive brain waves, which are displayed as a graph.

Sleep studies using EEG recordings indicate that as we fall asleep, and throughout a typical sleep period, the brain produces distinguishable patterns of electrical activity that tend to follow a regular sequence. Identification of different brain wave patterns during sleep has enabled researchers

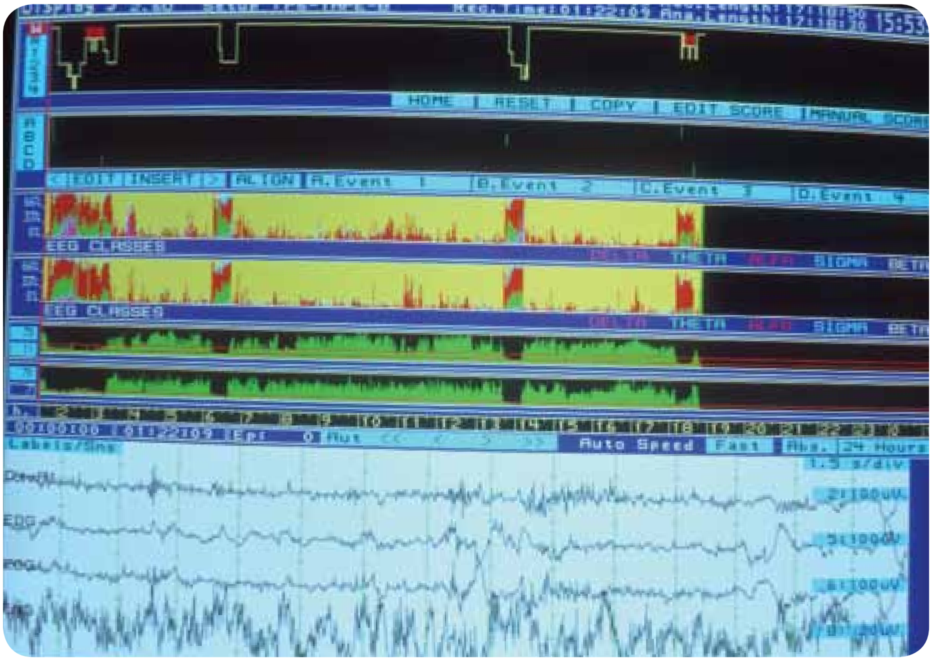


Figure 3.2 EEG activity during sleep is displayed on a monitor and can be produced on graph paper.

(a)

(b)

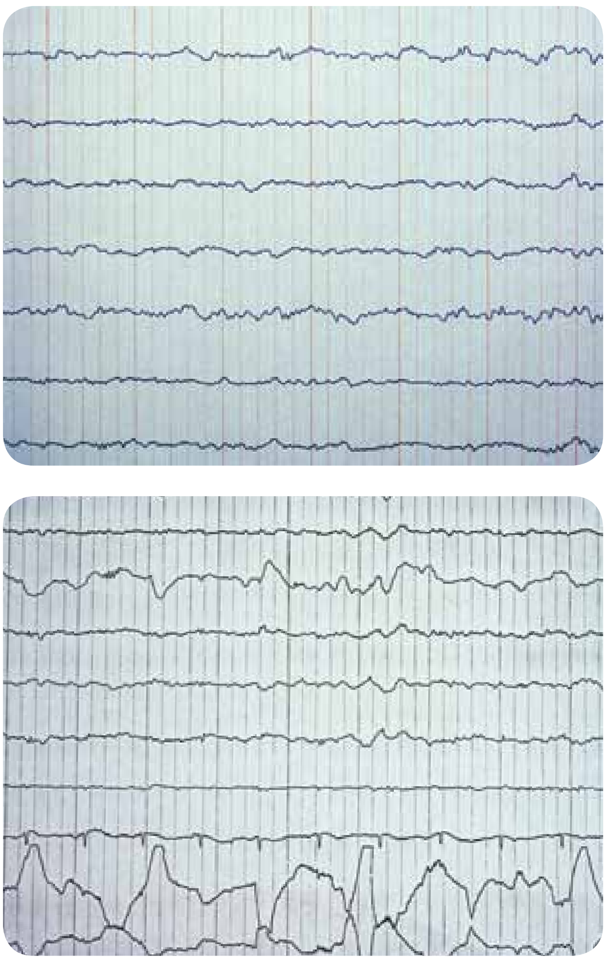


Figure 3.3 (a) EEG recordings of a person in a drowsy state just before falling asleep; (b) EEG recordings of a person who is asleep and dreaming

to distinguish between four different stages of sleep and two types of sleep that tend to be experienced by all people during a typical night's sleep. Corresponding to changes in brain wave patterns recorded by the EEG are changes in other physiological responses, such as muscle tension or relaxation.

Electromyograph

The **electromyograph**, or **EMG**, is a device used to detect, amplify and record the electrical activity of muscles. EMG recordings generally show the strength of electrical activity occurring in the muscles, which indicates changes in muscle activity (movement) and muscle tone (tension). This information is obtained by attaching electrodes to the skin above the particular muscles whose activity is being monitored. Sometimes the activity in facial muscles is recorded. At other times, leg muscles, muscles on the trunk, or a combination of these are recorded. The records of the EMG are displayed as line graphs, similar to those produced by the EEG. They can be produced on paper or on a computer monitor.

As with EEG recordings, EMG records show that there are identifiable changes in muscular activity during the course of a typical night's sleep. For example, our muscles progressively relax (decrease in muscle tone) as we pass into deeper stages of sleep. There are also distinguishable periods when our muscles may spasm (during light sleep) or be completely relaxed (during deep sleep).

Electro-oculargraph

The **electro-oculargraph**, or **EOG**, is a device for measuring eye movements or eye positions by detecting, amplifying and recording electrical activity in eye muscles that control eye movements.

Figure 3.4 EMGs and EOGs are used to record muscle activity and eye movement during sleep. Electrodes attached to the skin on facial areas above muscles that control eye movements detect electrical activity of the muscles and hence eye movements. These are then amplified and recorded.

This is done through electrodes attached to areas of the face surrounding the eyes. The records of the EOG are displayed as line graphs, similar to those produced by the EEG and EMG. They can also be produced on paper or on a computer monitor.

The EOG is most commonly used to measure changes in eye movements over time during different stages of sleep and while dreaming. In particular, sleep research studies that have used the EOG have been of immense value in clarifying the distinction between two different types of sleep, called *rapid-eye-movement* sleep and *non-rapid-eye-movement* sleep.

Heart rate and core body temperature

As with the study of normal waking consciousness, heart rate and core body temperature are also commonly measured physiological responses in the study of sleep and other altered states of consciousness. Both heart rate and core body temperature gradually drop as we progressively drift from light sleep into deeper and deeper sleep, then gradually increase and drift from deeper sleep to lighter sleep. As shown in figure 3.6, core body temperature can drop by more than 1 °C while we are asleep. However, unlike body temperature during sleep, there can be sudden and quite dramatic changes in heart rate. These are commonly associated with dreaming that accompanies sleep and the experience of sleep phenomena such as nightmares and night terrors, and sleep disorders such as sleep apnea.

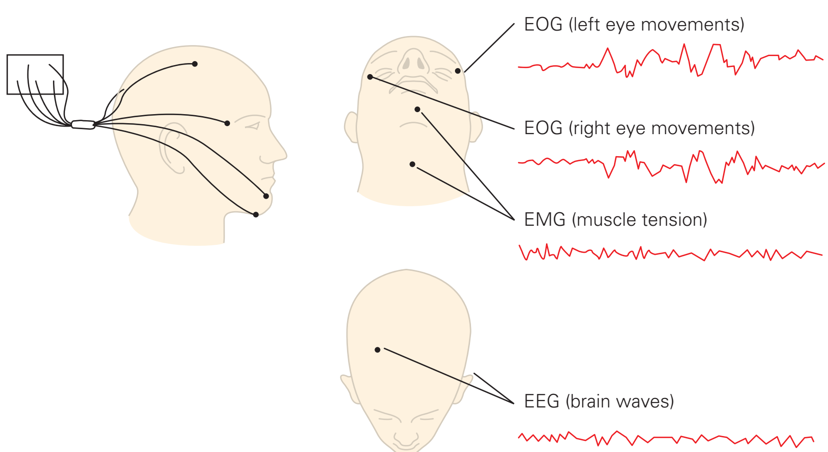


Figure 3.5 Researchers study sleep by measuring physiological responses. Three commonly used responses are the electrical activity of the brain, measured using an EEG; muscle tension, measured using an EMG; and eye movements, measured using an EOG. Electrodes that are strategically placed on the scalp (EEG), around the eyes (EOG) and near muscles on the face and body (EMG) detect, amplify and record patterns of activity.

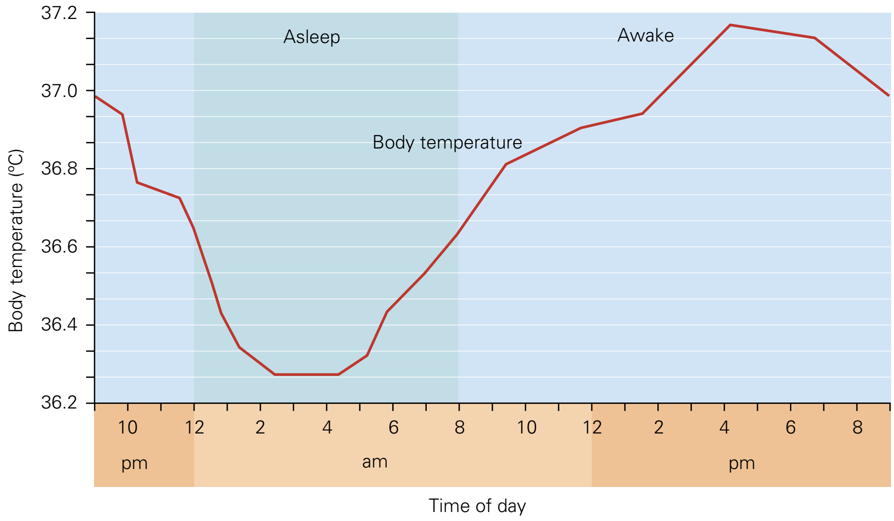


Figure 3.6 The 24-hour core body temperature cycle

Video monitoring

Most sleep laboratories are fitted with one or more video cameras to record externally observable physiological responses accompanying sleep (including dreaming) and changes in types and patterns of sleep. The video cameras can simultaneously record sounds and use infrared technology so that recordings can be made in conditions of little or no light. Recordings are made in real time but computer-assisted technologies can be used for later analysis of a scene or even a single frame. For example, software packages can be used for frame-by-frame analysis (motion segmentation), enhancement of blurred images and 3D enhancements. Video monitoring is particularly important with participants (or patients) who have a serious sleep disorder.

Box 3.1

Preparing for sleep in a sleep laboratory

Figure 3.7 At the Alfred Hospital's Sleep Disorders and Ventilatory Failure Service in Melbourne, a research participant is prepared for a night's sleep during which her physiological responses will be simultaneously recorded (polysomnography) as she falls asleep, while she is asleep, and as she wakes.

Figure (a) shows electrodes being attached to the research participant's scalp for EEG recordings of brain wave activity. She also has electrodes behind her knees for EMG recordings of muscular activity.

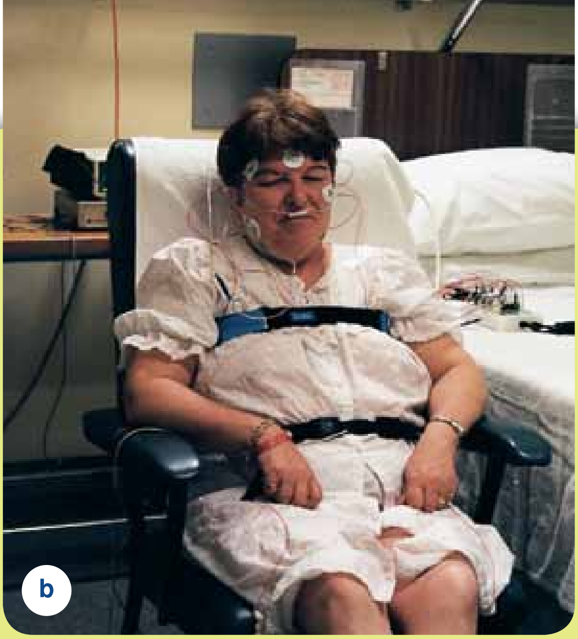

b

Figure (b) shows the participant fully 'wired up' before she goes to bed. Note the electrodes for EOG recordings of eye movements. Other devices are used to record respiration and heart rate.

Figure (c) shows the participant resting comfortably in bed. The blue strap across the chest is used to monitor respiration.

Figure (d) shows a research assistant in the adjacent control room monitoring the various recording devices. Note the video monitors, which enable ongoing visual contact with the participant. Video recordings are also made of the participant during sleep.


c


d

Self-reports

Self-reports are commonly used in the study of sleep; for example, sleep diaries and questionnaires on sleep-related problems. A **sleep diary**, or *sleep log*, is a self-reported record of an individual's sleep and waking time activities, usually over a period of several weeks. When the activities need to be recorded for children, a parent may maintain the required records. Sleep diaries are most commonly used in conjunction with polysomnographic tests to support the assessment of sleep disorders and problems, particularly their nature, severity and causes.

The data an individual is required to record in a sleep diary depends on what is being studied. Typically, records are kept of the time when trying to fall asleep; the time when it is believed sleep onset occurred; the number, the time and length of awakenings during sleep; the time of waking up in the morning; and the time of getting up following morning awakening. In addition, records may be kept on naps, alcohol, caffeine and use of medication, meals, exercise and significant events when awake or asleep.

An example of a sleep diary is shown in figure 3.8. The participant (or patient) is given detailed verbal and written instructions on how to record entries and maintain the diary.

Figure 3.8 Sleep diary

Sleep diary

Instructions

1. Write the data, day of the week, and type of day: work, school, day off or vacation.
2. Draw a downward arrow (↓) when you lie down to sleep.
3. Draw an upward arrow (↑) when you wake up.
4. Shade in all the boxes that show when you are asleep at night or when you take a nap during the day.
5. Leave boxes unshaded to show when you are awake at night and when you are awake during the day.
6. Write the following letters in the diary when you do any of the following:
   C = when you have coffee, cola or tea
   M = when you take medicine
   A = when you drink alcohol
   E = when you exercise
7. Complete this diary in the morning and evening. Do not complete this diary during the night. Write any additional comments on the back.

SAMPLE

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am
16 August	↑	C		M			A	M	↓				

WEEK 1

Date	6 am	8 am	10 am	12 pm	2 pm	4 pm	6 pm	8 pm	10 pm	12 am	2 am	4 am	6 am

Learning Activity 3.1

Review questions

1 What is sleep?
2 Why is sleep considered to be an altered state of consciousness?
3 What is polysomnography?
4 Describe how self-reports may be used to study sleep.
5 Construct a table that summarises the recording devices that may be used in a sleep study. Headings should include *name of device*, *description* and *what it measures* in relation to sleep.

Characteristics and patterns of sleep

Over the course of a typical night's sleep we experience two distinctly different states, or types, of sleep known as **NREM sleep** (non-rapid-eye-movement sleep) and REM sleep (rapid-eye-movement sleep). These occur in continuous cycles, with one following the other. In adults, one cycle of NREM sleep lasts for about 70 to 90 minutes, and consists of four distinct stages, each of which can be identified by a different brain wave pattern. As shown in figure 3.9, a period of REM sleep follows each period of NREM sleep. Consequently, some researchers refer to REM sleep as a fifth stage of sleep. A complete sleep cycle consists of a period of NREM sleep (but not necessarily all four NREM stages) and a period of REM sleep (which tends to increase in duration as the night progresses). Generally a complete sleep cycle lasts for about 80 to 120 minutes, and we go through this cycle approximately four or five times during eight hours of sleep each night.

NREM sleep

Approximately 80% of our sleep time is spent in NREM sleep, and typically the first half of the night has more NREM sleep than the second half of the night (see figure 3.9). During NREM sleep the brain is active (as shown by EEG recordings), but not as active as during REM sleep, or during normal waking consciousness. Some psychologists have proposed that NREM sleep may be the time when the body recovers, repairing body tissue, removing waste products and replenishing neurotransmitters that are vital to communication between neurons (Inoue, Honda & Komoda, 1995). For example, research on the effects of strenuous physical activity on subsequent sleep patterns indicates that deep sleep experienced in NREM sleep increases during nights after vigorous exercise (Vein & others, 1991).

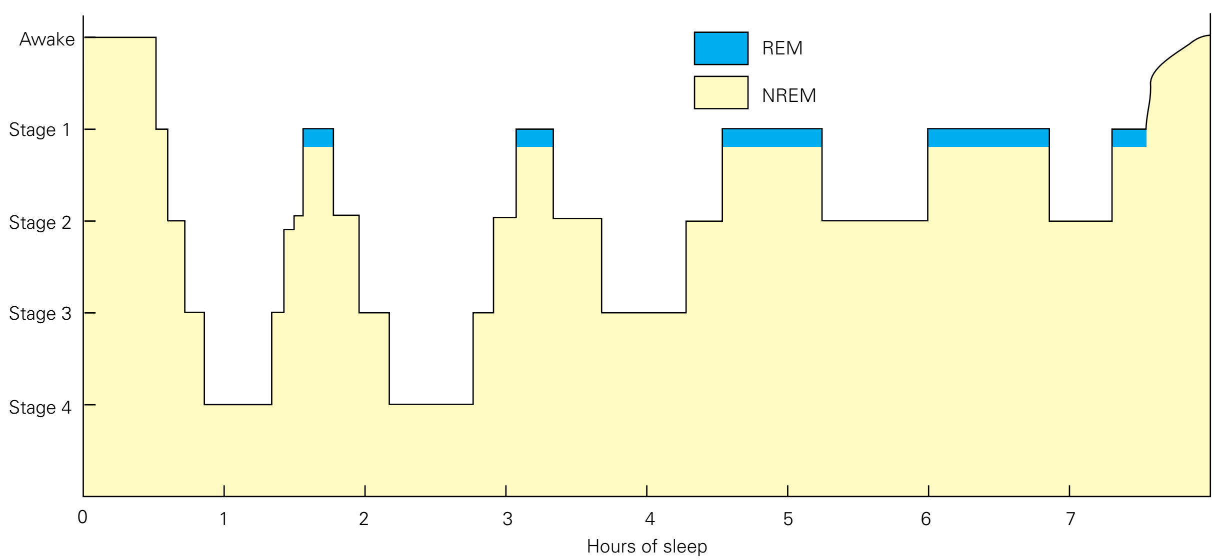


Figure 3.9 During an eight-hour sleep period in a typical night, we experience four or five complete cycles of sleep consisting of NREM and REM sleep periods. Note that NREM sleep has four different stages and that stage 3 and 4 (deepest sleep) may not be experienced as morning approaches. Furthermore, as sleep progresses, periods of REM sleep tend to get longer and be closer together.

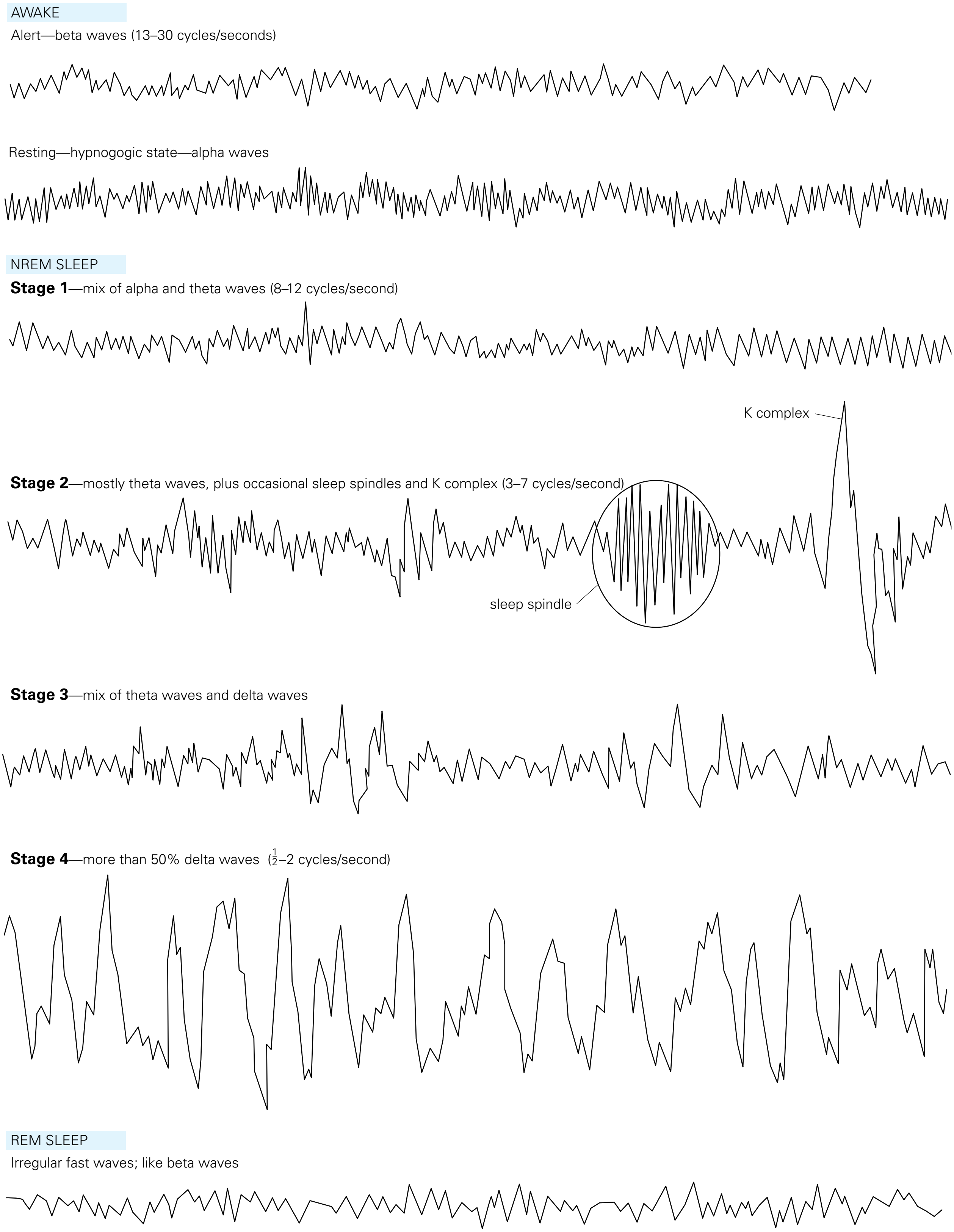


Figure 3.10 NREM and REM sleep are characterised by different brain wave patterns recorded by the EEG. When we are in NREM sleep, brain waves gradually decrease in frequency and increase in amplitude as we progress from lighter through to deeper sleep. When we are in REM sleep, the brain waves are similar to those that are recorded when we are awake and alert.

NREM sleep consists of four different stages in which the sleeper progresses from a stage of light sleep to the stage of deepest sleep and back again through one or more stages to light sleep. Psychologists can determine an individual's stage of sleep by examining the characteristics of EEG recordings. Every stage of sleep is dominated by a particular identifiable brain wave pattern or rhythm that is different from that of the other stages. Each brain wave pattern can be distinguished in terms of two characteristics: the number of brain waves and the intensity of the brain waves. The term **frequency** is used to describe the number of brain waves. For example, low frequency would refer to relatively few brain waves (per second) or 'slow' brain wave activity, and high frequency would refer to a lot of brain waves (per second) or 'fast' brain wave activity. The term **amplitude** is used to describe the intensity of the brain waves and is estimated by the size of the brain waves; for example, the peaks ('highs') and troughs ('lows') evident in the pattern of activity (see figure 3.10).

It has been found that when we first close our eyes and begin to relax before actually going to sleep, our brain emits bursts of alpha waves. *Alpha wave* patterns are associated with relaxation and drowsiness and are characterised by a fairly regular pattern of relatively high-frequency and medium-amplitude brain waves, as recorded by the EEG. This transition period from being awake to being asleep is sometimes called the *hypnogogic state*, or the twilight stage of sleep, and it is characterised by slow, rolling eye movements. During this stage, which may last for a minute or two, some people experience flashes of light or colour, feelings of floating and weightlessness, dreamlike images that resemble vivid photographs, or swift, jerky movements and a sense of falling or slipping. In this pre-sleep stage our body is winding down and beginning to drift towards the first stage of the NREM sleep cycle.

NREM—stage 1

Stage 1 in the NREM sleep cycle occurs as we drift into and out of a true sleep state. We tend to gradually lose awareness of ourselves and our surroundings, but some of the time we are actually aware of faint sounds in our environment (Coren, 1996). Physiological changes that indicate a lower level of bodily arousal—such as a decrease in heart rate, respiration, body temperature and muscle tension—are all evident in stage 1. As a result of the muscles relaxing, we sometimes experience a 'jerking' sensation whereby our body, or a part of our body, seems to go into a spasm. This is known as a *hypnic jerk* and it is a common occurrence during stage 1. In addition, the EEG pattern shows a decrease in alpha wave production as these brain waves are replaced by more irregular medium-frequency *theta waves*, which have a mixture of high and low amplitude. Stage 1 lasts for about five to ten minutes. If we are woken during this stage, we may feel we have not been asleep at all.

NREM—stage 2

Stage 2 of NREM sleep is a light stage of sleep, and some researchers identify this as the point at which someone can be said to be *truly asleep*. Although our sleep is less easily disturbed than it is in stage 1, we can still be easily aroused from this sleep stage (Coren, 1996). During stage 2, which lasts for about ten to 20 minutes, body movements lessen, breathing becomes more regular, blood pressure and temperature continue to fall, and heart rate is slower. Brain waves are mainly theta waves, but are slightly lower in frequency and higher in amplitude than the theta waves produced in stage 1. During stage 2, brief bursts of higher frequency brain wave activity called *sleep spindles* periodically appear on the EEG recording. A burst of sleep spindles lasts for about one second, and their presence is an indicator that the person is truly asleep.

Although we are asleep, the brain still responds to various external and internal stimuli, such as the sound of a knock on a door, or muscle tension in a leg as we move. EEG patterns also show bursts of low frequency and slightly higher amplitude waves, called *K complexes*, in response to arousing stimuli (Halasz, 1993) (see figure 3.10). About midway through stage 2, we are unlikely to respond to anything except extremely strong or loud stimuli, indicating that sleep has become noticeably deeper. In comparison to stages 3 and 4 NREM sleep, stage 2 NREM sleep is still considered to be light sleep—if you awaken people from this stage, about seven out of ten will tell you that they really didn't think they were asleep, but were just dozing and thinking (Coren, 1996).

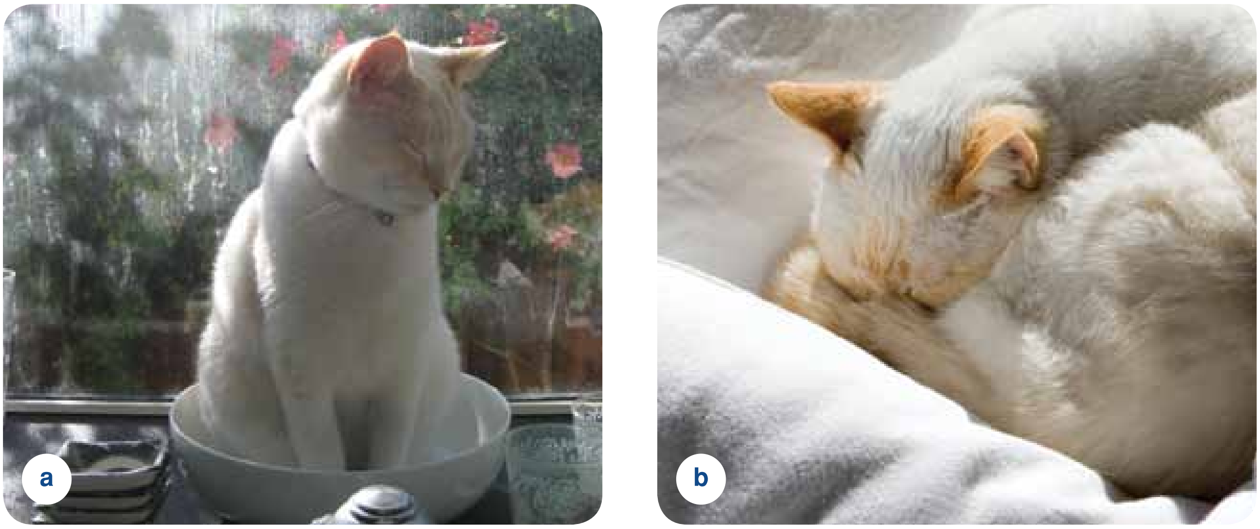


Figure 3.11 Like humans, cats experience both NREM and REM sleep periods. (a) However, a cat in NREM sleep often remains upright. (b) With the onset of REM sleep, the muscles completely relax and the cat lies down.

NREM—stage 3

Stage 3 is the start of the deepest period of sleep, and lasts for about ten minutes. Stage 3 might be best called *moderately deep sleep* (Coren, 1996). Heart rate, blood pressure and body temperature continue to drop, and breathing rate continues to be slow and steady. The individual is extremely relaxed and becomes less and less responsive to the outside world. In this stage, people are difficult to arouse, but if they are awoken they are often groggy and disoriented. EEG activity is also noticeably different from that of earlier NREM stages. During stage 3, there is a reduction in the brain's electrical activity, and delta waves begin to appear in the EEG recording. *Delta waves* make up about 20–50% of the brain waves recorded during stage 3, being slow, large, regular brain waves. They are lower in frequency and higher in amplitude than the alpha and theta waves of stages 1 and 2.

The presence of delta waves marks the beginning of *slow wave sleep (SWS)*, so called because of the slower frequency delta waves. Generally, we begin SWS within an hour of falling asleep, and remain in SWS for about 30 minutes. When the EEG recordings show that delta waves comprise more than 50% of the brain wave activity, the person has entered stage 4, the deepest stage of sleep, and they will be extremely difficult to rouse.

NREM—stage 4

Stage 4 is the deepest stage of sleep. It might best be called *very deep sleep* (Coren, 1996). The physiological signs of NREM stage 4 are similar to those in NREM stage 3 and, in fact, some recent classifications merge stages 3 and 4. In addition, muscles are completely relaxed and we barely move. Delta waves dominate the EEG pattern and are even slower and larger than those in stage 3. A person in stage 4 is very difficult to wake. It is the point at which people are often said to be 'sleeping like a log' or 'out like a light'. When they are woken, they can take up to ten minutes to orient themselves, and usually have a poor memory of sleep events. This is sometimes referred to as 'sleep drunkenness', although psychologists prefer the term *sleep inertia* when referring to the post-awakening 'mental lag'.

In the first cycle of sleep, a person may spend up to 20 minutes in stage 4. However, as the night progresses, less and less time is spent in stages 3 and 4. In sleep cycles close to the morning, there may be no stage 3 or 4 sleep at all (see figure 3.9). This has led to the belief that 'sleep before midnight' is best because it may be the most beneficial and rejuvenating sleep, since people deprived of stage 4 sleep often complain of muscle aches and tension.

It is during the very deep sleep of stages 3 and 4 that sleep phenomena such as sleepwalking, sleep talking and night terrors occur. It is also the period

Figure 3.12 Night terrors tend to occur during the very deep sleep of stages 3 and 4. A person experiencing a night terror may awaken suddenly, screaming and perspiring profusely. Unlike the experience of a nightmare, a person has little or no recall of their night terror episode on awakening.

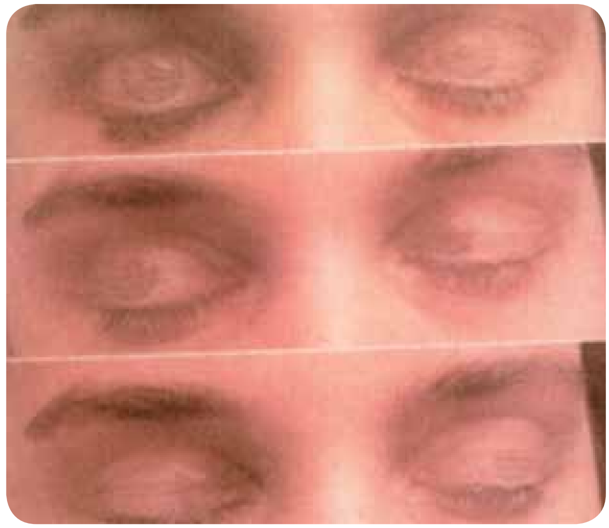


Figure 3.13 These double-exposure photographs capture the rapid eye movements of REM sleep, during which vivid dreaming occurs, as do heightened levels of physiological functioning.

of sleep when bedwetting may occur (more so than in other stages).

The progression through the NREM sleep cycle from stage 1 to stage 4 takes about 45 to 60 minutes before we progressively move back up through stages 3 and 2. Having passed through one complete NREM sleep cycle, we do not awaken, although our brain and body begin to respond as if we are on the point of waking up. These are signs that we are about to move into REM sleep.

REM sleep

As the term suggests, **REM sleep** is a period of rapid-eye-movement sleep during which the eyeballs rapidly move beneath the closed eyelids, darting back and forth and up and down in jerky movements. The brain wave pattern associated with REM sleep is irregular, consisting of low-amplitude, relatively high-frequency *beta waves* like those produced during alert wakefulness. However, REM sleep is considered to be *deep sleep* because people are difficult to wake during this period.

The body's internal functioning is more active during REM sleep than during NREM sleep. The heart rate is faster and more irregular. Blood pressure rises, and breathing is quicker and more irregular. However, the sleeper is totally relaxed. Although there are occasional twitching movements in the small muscles of the face, fingers and toes, most of the skeletal muscles (that is, those attached to bones) are limp, and the body shows few outward signs of movement. An observer might say the sleeper appears paralysed during REM sleep. Consequently, REM sleep is called *paradoxical sleep*—internally, the brain and body are active, while, externally, the body appears calm and inactive. The purpose of the apparent body paralysis is still unknown. However, some psychologists have suggested that it may have evolved to prevent us from acting out our dreams, and thereby minimise any potential harm (Pressman & Orr, 1997).

Research indicates that it is during REM sleep that most dreaming occurs. In sleep laboratories, if a research participant is woken during REM sleep, about 80% of the time they will report having been dreaming at the time of being woken. Although some people believe they do not dream, research findings suggest that we dream several times a night, even though we may not remember dreaming. Dreaming also occurs during NREM sleep, but the dreams are less frequent, less memorable, less vivid and less fragmented than those of REM dreams. Some people believe that the rapid eye movements characteristic of REM sleep correspond to activity in dreams. However, it has been found that a dreamer's eye movements are unrelated to the content of their dreams.

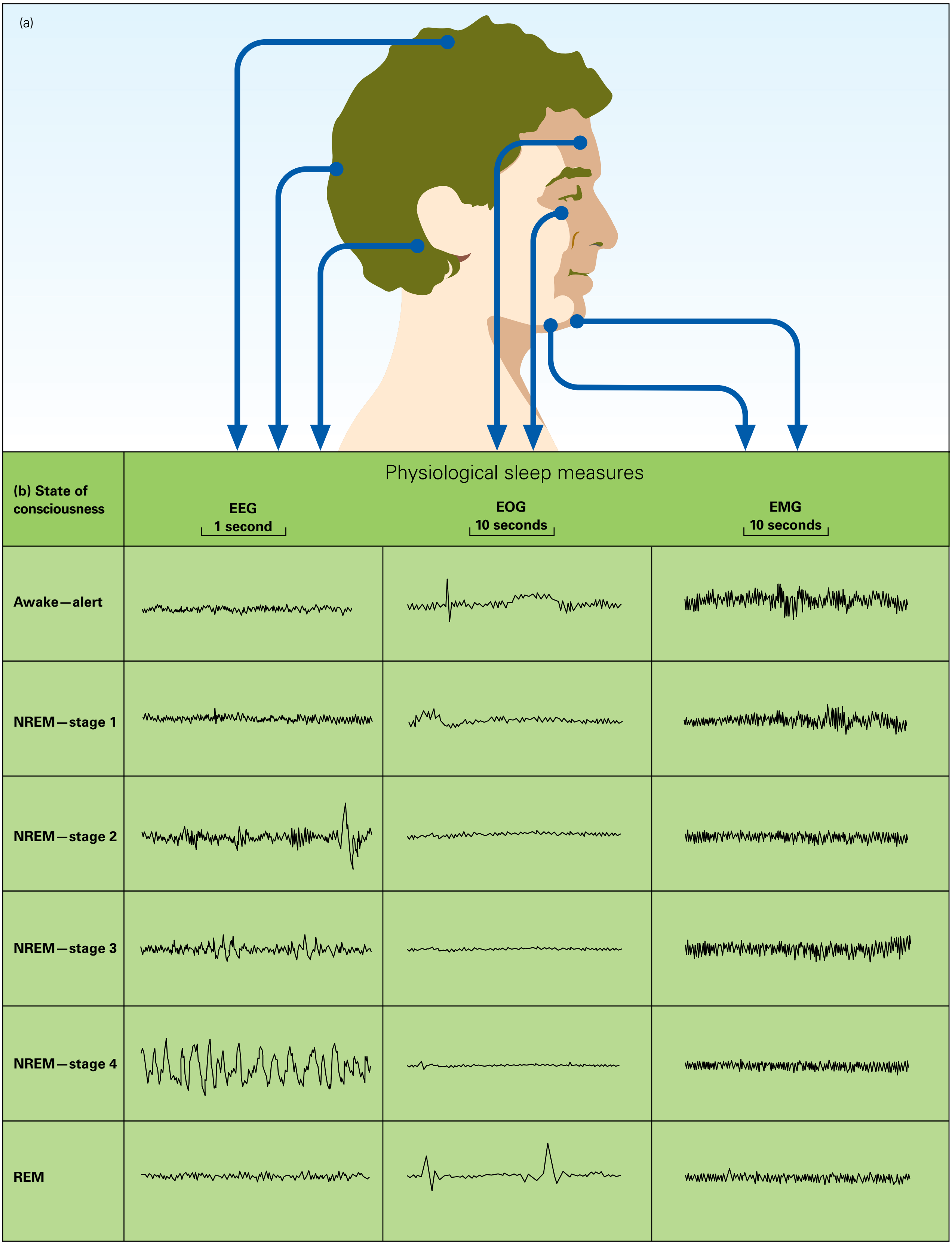


Figure 3.14 Brain wave patterns, as shown by an EEG, EOG and EMG

Some researchers believe that eye movements are simply physiological activity that is occurring at the same time as random neural activity of the brain. Although many psychologists support this view, the specific reason for the eye movements is unclear.

Throughout the night, we pass continuously through NREM and REM sleep cycles, with REM periods lengthening and occurring closer together as the night progresses. A REM period that occurs early in the night may last for only a few minutes, while a later REM period may last up to an hour or so. This may explain why you are often dreaming when you are woken by an alarm in the morning.

Box 3.2

Case study: the man without REM sleep

Y.H. was studied in a sleep laboratory because he had been waking during the night in a panic and shouting loudly. Sleep researchers believed these experiences could have been either associated with nightmares during REM sleep or with night terrors, which occur mainly during stages 3 and 4 of NREM sleep. Y.H. was an Israeli Army veteran who had sustained brain damage from shrapnel during the 'War of Attrition' in the early 1970s. He was confined to a wheelchair and had difficulty using his hands and in speaking. Y.H. also experienced damage to structures and areas of the brain involved in sleep.

On his first night in the sleep laboratory, Y.H.'s EEG recordings indicated that his sleep pattern was normal apart from the absence of REM sleep. The complete absence of REM sleep is extremely rare. It is sometimes observed in people who take a high dose of medications such as antidepressants or tranquillisers to assist sleeping, as well as in people who are under the influence of strong drugs such as heroin or cocaine. However, Y.H. was not taking medication or other drugs and he did not suffer from depression. When he awoke, he reported that he had slept well and normally.

EEG recordings of Y.H.'s second night again revealed that he had not experienced any REM sleep. Researchers compared Y.H.'s failure to experience REM sleep to that of a person without a heartbeat. Because Y.H. was such a unique case, the researchers asked him to spend an additional six nights in the sleep laboratory so they could further monitor his sleep patterns. Y.H. agreed to this, as well as to further diagnostic testing using brain scanning techniques to confirm the precise location of the shrapnel that was lodged in his brain. CAT scans showed that, apart from the shell splinters that were lodged in the left hemisphere of the cerebral cortex, there was an additional, previously undetected shrapnel splinter located in the pons at the base of the brain. The pons is a brain structure that is believed to control the activation of REM sleep.

Over the next six nights, there was evidence of REM sleep at different times. However, on each occasion, the amount of REM did not exceed 2–5% of his total sleep. In physically healthy people of the same age, REM accounts for about 20% of total sleep. The researchers concluded that Y.H.'s troubled awakenings during the night were not the result of nightmares (which occur in REM sleep), but night terrors that are characteristic of deep NREM sleep. The results of eight nights of testing in the sleep laboratory further showed that Y.H. slept for only 4.5 to 5 hours per night, but he appeared to show no ill-effects throughout the day from this apparent lack of sleep.

The case of Y.H. has been of considerable interest to sleep researchers. When people with healthy, intact brains are deprived of REM sleep, they typically increase their amount of REM sleep when they are allowed to sleep uninterrupted. This is called *REM rebound* and relates to an apparent need to catch up on missed REM sleep. So, how could someone with such limited amounts of REM sleep show no REM rebound or any side effects? Y.H.'s experiences suggest that the answer probably has something to do with the role of the pons, but exactly why and how damage to the pons affects REM sleep requires further research.

Source: adapted from Lavie, P. (1996). *The enchanted world of sleep.* New Haven: Yale University Press.

Box 3.3

What happens during a typical night's sleep

Some people think they don't move at all during sleep. However, well-known American sleep researcher Allan Hobson, with the assistance of a photographer, demonstrated that this is not true. According to Hobson (1988), everybody makes at least eight to 12 major posture shifts in a typical night's sleep. Poor sleepers may even double or triple this figure. Most people change their sleeping position twice per cycle. The first change usually occurs at the end of NREM stage 4 sleep, and the next major movement occurs just before commencing REM sleep.

To demonstrate the movements during a typical night's sleep, Hobson arranged for a photographer to set up a camera in a sleep laboratory so that a photograph was automatically taken of a sleeping person approximately every four minutes over the course of a night. The sleeper was also attached to an EEG and an EOG.

The series of photos showed that in four sleep cycles, the person shifted posture nine times. According to Hobson, if a person moves too frequently, the tossing and turning results in a disturbed sleep, and the person may awaken in the morning not feeling refreshed.

Figure 3.15 Couples who regularly sleep in the same bed tend to have synchronised NREM and REM sleep cycles and movements.

Box 3.4

Why we dream

Psychologists have learned a great deal about the physiology of dreaming; that is, what happens to our brains and bodies when we dream. But why we dream and what dreams mean, if anything, are still puzzling.

A number of theories have been proposed in an attempt to explain these issues. One of the earliest theories was proposed by Sigmund Freud. In his theory, Freud suggested that we dream to fulfil our wishes and desires—things that we may not be able to attain in real life. Another theory about why we dream, proposed by psychologists Allan Hobson and Robert McCarley, is that our brain constructs dreams from random neural activity during sleep. In a more recent explanation of dreaming, neuroscientist Jonathan Wilson proposed that dreaming may play an important role in the processing of memories.

Freud's wish-fulfilment theory

Freud first described his theory on the purpose of dreams in the early 1900s. He developed his theory primarily by analysing many of his own dreams and those of his family and patients.

Freud believed that 'a dream is the fulfilment of a wish'. According to Freud, what is expressed in our dreams are the wishes, desires or fantasies that we are unable to fulfil in our waking lives, often because we may experience too much anxiety or guilt. For example, if you were very angry with the way a friend had treated you, but felt unable to say anything to them for fear of losing their friendship, according to Freud this would be a repressed (hidden) wish that might be expressed in your dreaming. Thus, dreams enable us to express impulses or desires that would normally be censored during waking consciousness. In this sense, Freud believed that dreams are therapeutic and allow us to get rid of tension or anxiety we would otherwise harbour.

To protect ourselves from the anxiety associated with the content of a dream, Freud suggested that we often disguise the real issue by dreaming in symbols. For example, if your best friend is the person with whom you are angry, the hostility you experience in the dream may be directed towards someone else, such as a teacher or sibling. According to Freud, the symbolism occurs to protect the dreamer and to prevent them from waking up during the dream as a result of too much anxiety. Symbols are not just substitutes for people, but may also be used in our dreams to represent thoughts, feelings, objects and events.

While much of what we dream about is symbolic, according to Freud we don't always dream in symbols. Sometimes, Freud cautioned, 'a cigar is a cigar' and it is not symbolic of anything else.

Hobson and McCarley's activation–synthesis theory

Based on experiments performed on cats, American psychologists Allan Hobson and Robert McCarley (1977) identified structures deep within the brain that appear to be directly associated with REM sleep—specifically, the pons and the reticular activating system. These structures appear to be involved in shutting down the brain's access to movement during REM sleep, resulting in the 'muscular paralysis' we experience. During our waking state, however, when specific neurons in the brain stem are activated, muscular movements result, such as running, walking and other motor behaviours.

When we are in REM sleep and our body is in a state of 'paralysis', certain neurons in the brain stem are randomly activated. Therefore the neural messages about body movement cannot be acted upon. Higher brain centres detect this neural activity, and the information is assembled in an attempt to give some sort of meaning to these random and uncoordinated messages by *synthesising* (or combining) them with existing knowledge and memories. According to Hobson and McCarley, the result is a dream. They suggest, by way of example, that if neurons fire in the part of the brain that controls balance, you might dream about falling. This is the brain's way of giving some sort of meaning to the activation of that part of the brain. Hobson and McCarley suggest that the random and uncoordinated nature of the neural messages may explain why dreams are so often a disjointed connection of seemingly unrelated events, and why so often they make little logical sense.

Memory-processing explanation

Recent findings from neuroscientific research suggest that dreams may actually be meaningful. Studies of the hippocampus (a brain structure crucial to memory), of REM sleep and of theta brain wave activity suggest that dreaming may play an important role in the processing of memory. In particular, studies of theta brain wave rhythms in subprimate animals may provide an evolutionary clue to the meaning of dreams. According to Jonathan Winson, dreams are the nightly record of a basic mammalian memory process: the means by which animals form strategies for survival and evaluate current experience in light of those strategies. Winson (2002) proposes that the meaning of dreams in human beings could also be explained in this way.

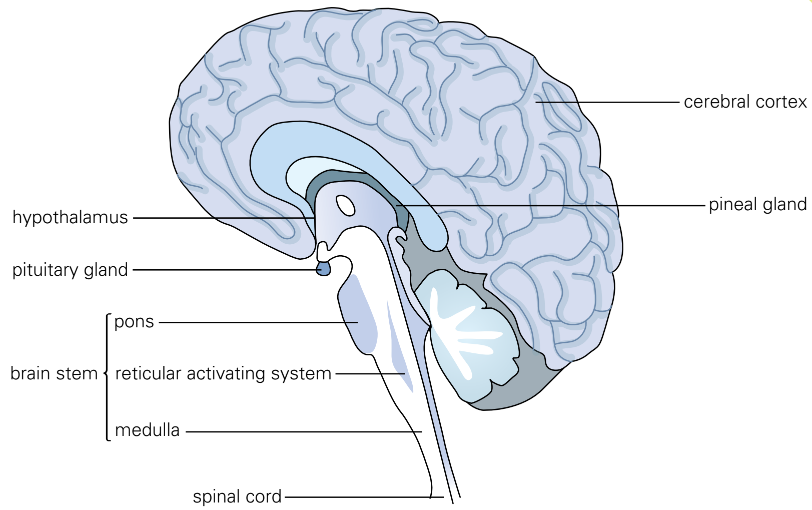


Figure 3.16 Brain structures involved in regulating the sleep–waking cycle. The sleep–waking cycle is believed to be regulated by the pineal gland. The pineal gland produces melatonin in various quantities at different times of the day in response to environmental cues. The amount of melatonin in our bloodstream appears to be responsible for how sleepy we feel.

Learning Activity 3.2

Review questions

1 Copy and complete the table below to summarise the main distinguishing characteristics of NREM and REM sleep periods.

Type of sleep	EEG records	EOG records	EMG records	Other physiological responses	Duration
NREM stage 1					
NREM stage 2					
NREM stage 3					
NREM stage 4					
REM					

2 Briefly describe the *pattern* and *proportions* of NREM and REM sleep in a typical night's sleep.
3 Why are NREM stages 3 and 4 referred to as slow wave sleep?
4 Why is REM sleep sometimes referred to as paradoxical sleep?

Learning Activity 3.3

Data analysis

A researcher obtained sleep data on three participants observed in a sleep laboratory. Extracts from the data are summarised below. Consider the data for each participant and identify the NREM stage during which the data were obtained or whether the data indicate REM sleep.

Participant 1

Physiological indicators: regular breathing; drop in blood pressure, temperature and heart rate
EEG pattern: medium-amplitude, medium-frequency theta waves with occasional sleep spindles and K complex
EOG pattern: limited eye movement
EMG pattern: little muscle tension and movement
Observations:

- Participant reported that they were 'just dozing' during this time.
- Participant reported hearing something smash on the floor in the sleep researcher's office.

Participant 2

Physiological indicators: fast and irregular heart rate and breathing; relatively high blood pressure
EEG pattern: irregular high-frequency, low-amplitude beta-type brain waves
EOG pattern: frequent eye movements
EMG pattern: no muscle tension or movement apart from occasional facial twitches
Observations:

- Participant was difficult to awaken.
- Participant reported they had been dreaming and could describe the dream in vivid detail.

Participant 3

Physiological indicators: heart rate, blood pressure and temperature all low; slow and steady breathing
EEG pattern: low-frequency, high-amplitude delta waves
EOG pattern: limited eye movement
EMG pattern: almost no muscle tension or movement
Observations:

- Participant was difficult to awaken.
- Participant was disoriented on awakening.
- Participant talked in their sleep.
- Participant reported they had been dreaming but had limited recall of the dream.

Learning Activity 3.4

Visual presentation—comparing NREM with REM sleep

Prepare a poster that differentiates the characteristics of NREM stages 1–4 and REM sleep. In your poster, ensure you refer to:

- the type and pattern of brain wave activity in each stage, including a description of frequency and amplitude of brain waves
- characteristics that differentiate each stage, such as muscle tone and bodily movement, physiological changes, subjective experiences, ease of waking and responsiveness to external stimuli.

Changes in sleep patterns over the lifespan

The duration of time spent in each stage of NREM sleep or in REM sleep is highly variable. The amount of time differs for each individual as the night progresses. Some people spend more time in one stage than other stages. For example, poor sleepers are likely to spend less time in stage 4 and REM sleep. Furthermore, the amount of total sleep time spent in NREM and REM sleep changes across different stages of the lifespan.

As shown in Figure 3.17, from birth onward, the amount of time we spend sleeping gradually decreases as we get older. In addition, the proportion of total sleep time spent in REM sleep decreases markedly from infancy to adolescence, and then remains relatively stable into adulthood and old age. For example, a newborn infant sleeps for around 16 hours a day, about 50% of which is REM sleep. By the end of infancy, total sleep time drops to around 12–13 hours and about 25–30% is REM sleep. By the end of childhood and onset of adolescence, total sleep time drops to around nine hours and about two hours or 20% is REM sleep. The gradual decrease in total sleep time continues through adolescence and adulthood. By late adulthood, the total sleep time averages about six to seven hours, with about one-third in REM sleep.

Individuals in their sixties and older tend to report that their sleep is much lighter with increased awakenings than when they were younger. This coincides with polysomnography research findings that NREM sleep of elderly people is mostly stage 2 shallow sleep. Furthermore, by age 90, stage 3 and stage 4 sleep is rarely experienced, if at all. The age-related decrease and eventual disappearance of stages 3 and 4 NREM sleep is also seen in other mammals (Rosenzweig, Breedlove & Leiman, 2002; Lavie, 1996).

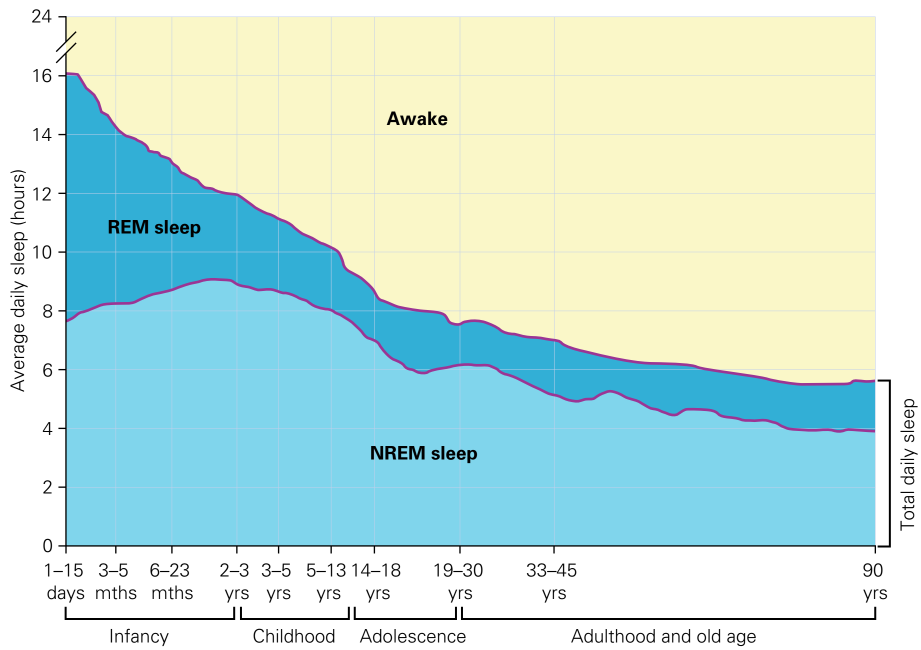
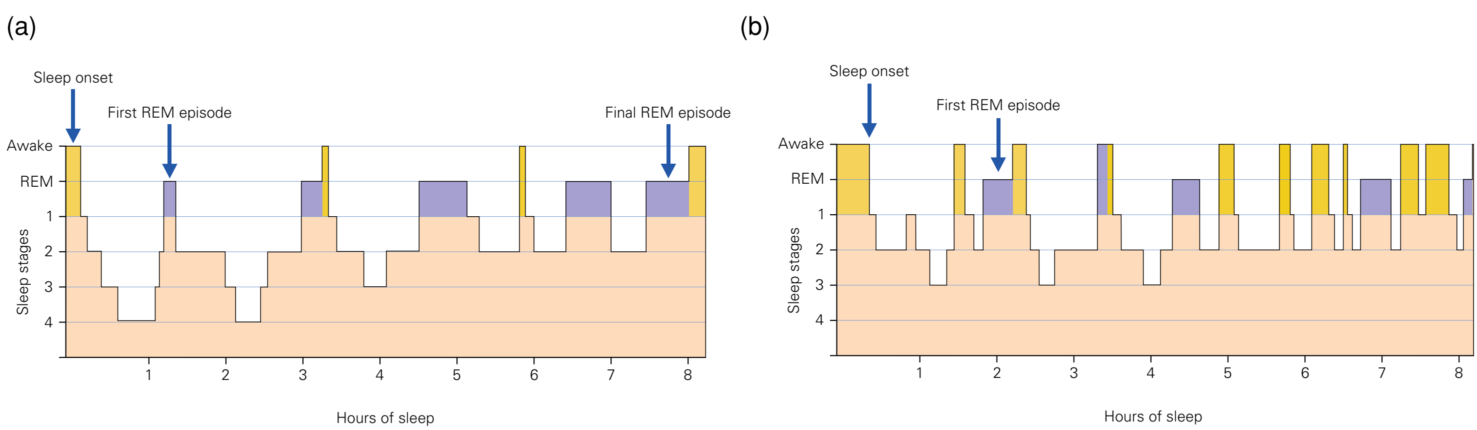


Figure 3.17 The amount of time we spend sleeping decreases as we get older. In addition, the proportion of total sleep time spent in REM sleep decreases markedly from infancy to adolescence, and then remains relatively stable into adulthood and old age. The amount of NREM sleep time also decreases, but compared with the drop in REM sleep up to adolescence, NREM sleep tends to be relatively stable.



Source: Rosenzweig, M.R., Breedlove, S.M., & Leiman, A.L. (2002). *Biological psychology: An introduction to behavioural, cognitive, and clinical neuroscience.* (3rd ed.). Sunderland, Massachusetts: Sinauer Associates, pp. 445, 450.

Figure 3.18 Typical sleep patterns of young adults and elderly persons. Figure (a) shows a typical night of sleep in a young adult. Note the differences in episodes of REM sleep and stages 3 and 4 sleep when compared with figure (b), which shows a typical night of sleep in an elderly person.

Sleep–wake cycle shift during adolescence

In general, the amount of sleep adolescent males and females between the ages of 13 and 19 years get each night declines substantially from about ten hours to less than eight hours (see figure 3.17). Yet numerous research studies have found that adolescents require more than nine of hours sleep a night to function well when awake (Joseph & Blunden, 2009). In addition, studies of adolescent sleep patterns indicate that this population tends to have sleep problems, such as requiring a lengthy time to fall asleep, insufficient night-time sleep on weekdays and difficulty waking up in the mornings. Insufficient sleep can have significant affects on normal daytime functioning. For adolescents at school, daytime impairments can include difficulties concentrating in class, mentally 'drifting off' or falling asleep in class, lethargy, problems with staying motivated to do class work, mood swings and difficulties controlling behaviour (Gradisar, 2010).

Psychologists explain adolescent sleep patterns and problems in terms of biologically (physiologically) driven sleep needs and patterns, and psychological and social factors that exert considerable pressure towards later sleep times.

Biological influences on an adolescent's sleep primarily involve the body's natural, inbuilt timing system, or 'biological clock'. Each day our body goes through a cycle during which hormones are produced to control body functions. This is called the **circadian rhythm** (or *circadian cycle*) and the sleep hormone melatonin causes us to feel sleepy at night. The cycle is linked to external cues in the environment, such as the presence or absence of sunlight, alarm clocks, meal times and even television (see box 3.7). During adolescence, there is a hormonally induced shift of the body clock forward by about one to two hours, making the adolescent sleepier one to two hours later. This is known as the **sleep–wake cycle shift**. This affects the adolescent's ability to fall asleep at the earlier times expected of them as a child. This shift in onset of the sleep period (called *sleep phase onset*) also means that there is a biologically driven need to sleep one to two hours longer. However, early school (or work) starts don't allow the adolescent to sleep in and have the additional sleep that would naturally occur. This nightly sleep loss can accumulate as a **sleep debt**; that is, sleep that is owed and needs to be made up. For example, a nightly sleep debt of 90 minutes between Monday and Friday would add up to a total sleep debt of seven and a half hours. On the weekends, adolescents will often sleep in to make up their sleep loss. However, this usually results in the adolescent going to bed even later, which can temporarily shift the sleep period further forward so that by Monday morning, getting out of bed to go to school (or work) is harder than on any other day.

Psychological and social factors also influence an adolescent's sleep habits, often in ways that contribute to sleep problems and sleep deprivation. Adolescents typically like to exert their growing need for independence, which can include making decisions about when to go to bed or sleep. Many usually decide to go to sleep later, particularly as early sleep times are associated with childhood. Adolescents also experience increased demands on their time for socialising and increased academic or work demands compared to when they were children. Many have casual or part-time jobs. Adolescents who work long hours or who stay up late doing homework, studying, talking on the phone, catching up with others on the internet, watching DVDs, playing computer games and listening to music are more likely to experience greater difficulty waking up in the morning than those who do not. Essentially, sleep is a low priority for many adolescents. This typically results in erratic sleep habits that compound sleep problems and result in sleep deprivation to an extent that impairs functioning during waking time. According to Australian psychologist and sleep researcher Michael Gradisar (2009), up to 50% of Australian adolescents may be affected by a sleep problem. Furthermore, his research has found that adolescents should sleep for around eight or nine hours per night for optimal brain functioning; anything less disadvantages short-term memory and other mental processes. There is also research evidence that sleep problems that continue into adulthood can lead to the development of anxiety disorders in the late 20s and can also lead to major depression.

Studies linking lack of sleep with poorer academic performance use the correlational research method to identify the type (direction) and strength of co-relationship between variables of interest (see box 1.9 on pages 48–9). The results of some of these studies can be questioned. For example, it has been found that more sleep, earlier bedtimes and later weekday risings are associated with better grades. Although greater amounts of sleep may help students to perform better, it is also possible that students who do better in school may tend to sleep more. A third variable, such as personality characteristics or stress, may also be involved and account for the results. For example, adolescents who are more anxious or have greater problems managing stress may sleep less (Kaplan, 2004).

Figure 3.19 Biological, psychological and social (i.e. biopsychosocial) factors combine to influence the sleep–wake cycle during adolescence in a way that leads to the accumulation of a sleep debt.

Box 3.5

National Sleep Foundation report on adolescent sleep needs and patterns

The National Sleep Foundation in America is a not-for-profit organisation that undertakes research and programs to 'alert the public, healthcare providers and policymakers to the life-and-death importance of adequate sleep'. Its membership and advisers comprise internationally prominent and respected sleep researchers. The Foundation's Sleep and Teens Task Force's report summarises research findings about sleep-related issues affecting adolescents. Following are key findings of the report.

Research studies conducted throughout the world have identified several changes in sleep patterns, sleep–wake systems and circadian timing systems associated with adolescence. These changes contribute to excessive sleepiness that has a negative impact on daytime functioning in adolescents, including increasing their risk of injury. Researchers believe that these sleep-related problems are due largely to conflicts between physiologically driven sleep needs and patterns, and behavioural and psychosocial factors that influence sleep habits.

Key changes in sleep patterns and needs that are associated with puberty include the following.

Physiological patterns

- Adolescents require at least as much sleep as they did as pre-adolescents (in general, 8.5 to 9.25 hours each night).
- Daytime sleepiness increases—for some, to pathological levels—even when an adolescent's schedule provides for optimal amounts of sleep.
- Adolescents' sleep patterns undergo a phase delay—that is, a tendency toward later times—for both sleeping and waking. Studies show that the typical high school student's natural time to fall asleep is 11.00 pm or later.

Behavioural and psychosocial patterns

- Many adolescents do not get enough sleep, especially during the week. Survey data from American studies show that average total sleep time during the school week decreases from 7 hours, 42 minutes in 13 year olds to

7 hours, 4 minutes in 19 year olds. Only 15% of adolescents reported sleeping 8.5 or more hours on school nights, and 26% of students reported typically sleeping 6.5 hours or less each school night.

- Adolescents have irregular sleep patterns; in particular, their weekend sleep schedules are different from their weekday schedules, to some extent as a direct consequence of weekday sleep loss. These differences include both the quantity and the timing of sleep. One study of more than 3000 adolescents showed that the average increase of weekend over weekday sleep across ages 13–19 was one hour and 50 minutes. In 18 year olds, the average discrepancy was more than two hours. In addition, 91% of the surveyed high school students reported going to sleep after 11.00 pm on weekends, and 40% went to bed after 11.00 pm on school nights. Irregular sleep schedules—including significant discrepancies between weekdays and weekends—can contribute to a shift in sleep phase (i.e. tendency toward morningness or eveningness), trouble falling asleep or awakening, and fragmented (poor quality) sleep.

Consequences of poor sleep in adolescence

- Increased risk of unintentional injuries and death—drowsiness or fatigue has been identified as a principal cause in at least 100 000 traffic crashes in America each year. In addition, about one million, or one-sixth, of traffic crashes in the USA are believed to be attributable to lapses in the driver's attention; sleep loss and fatigue significantly increase the chances of such lapses occurring. One study found that drivers aged 25 or younger caused more than one-half (55%) of fall-asleep crashes. The same symptoms of sleepiness that contribute to traffic crashes can also play a role in non-traffic injuries, such as those associated with handling hazardous equipment in the workplace or in the home. Furthermore, adolescents who have not received sufficient sleep and who consume even small amounts of alcohol are at greater risk of injury than those who are not lacking sleep, because sleep loss has been shown to heighten the effects of alcohol.
- Low grades and poor school performance—high school students who describe themselves as having academic problems and who are earning Cs or below in school reports are getting less sleep, having later bedtimes and having more irregular sleep schedules than students reporting higher grades. (Note: a causal relationship has not yet been established.)
- Negative moods (e.g. anger, sadness and fear), difficulty controlling emotions and behaviour problems—in one study, female high school students who went to sleep on the weekend two or more hours later than their typical weeknight bedtime reported feeling more depressed than those who did not stay up late on the weekends. Studies also suggest that sleep loss may be associated with a decreased ability to control, inhibit or change emotional responses. Some signs of sleepiness, such as inability to stay focused on a task, impulsivity, difficulty 'sitting still', and problems completing tasks, resemble behaviours common also in attention deficit hyperactivity disorder (ADHD).
- Increased likelihood of stimulant use (including caffeine and nicotine), alcohol and similar substances—teenagers who are heavily involved in school and community activities, their jobs and other responsibilities appear to be at greater risk for the above effects of sleepiness than those who are less involved in activities and who either do not hold jobs or who work fewer hours.

Source: National Sleep Foundation Sleep and Teens Task Force (2000). *Adolescent sleep needs and patterns: Research report and resource guide*. Washington, DC: National Sleep Foundation, www.sleepfoundation.org.

Box 3.6

Sleep tips for adolescents

1 Sleep is food for the brain. Lack of sleep can make you look tired and feel depressed, irritable or angry. Even mild sleepiness can hurt your performance—from taking school exams to playing sports or video games. Learn how much sleep you need to function at your best—most adolescents need between 8.5 and 9.25 hours of sleep each night—and strive to get it every night. You should awaken refreshed, not tired.

2 Keep consistency in mind: establish a regular bedtime and waketime schedule, and maintain this schedule during weekends and school (or work) vacations. Don't stray from your schedule frequently, and never do so for two or more consecutive nights. If you must go off your schedule, avoid delaying your bedtime by more than one hour. Awaken the next day within two hours of your regular schedule, and, if you are sleepy during the day, take an early afternoon nap.

3 Get into bright light as soon as possible in the morning, but avoid it in the evening. The light helps to signal to the brain when it should wake up and when it should prepare to sleep.

4 Understand your circadian rhythms. Then you can try to maximise your schedule throughout the day according to your internal clock. For example, to compensate for your 'slump' (sleepy) times, participate in stimulating activities or classes that are interactive. Try to avoid classes and potentially unsafe activities, including driving (see box 3.5).

5 After lunch (or after noon), stay away from caffeinated coffee and colas as well as nicotine, which are stimulants. Also avoid alcohol, which disrupts sleep.

6 Relax before going to bed. Avoid heavy reading, studying and computer games within one hour of going to bed. Don't fall asleep with the television on—flickering light and stimulating content can inhibit restful sleep.

Figure 3.20 A good night's sleep can be achieved by making slight adjustments to your behaviour patterns.

Source: National Sleep Foundation Sleep and Teens Task Force (2000). *Adolescent sleep needs and patterns: Research report and resource guide*. Washington, DC: National Sleep Foundation, www.sleepfoundation.org.

Change school hours for teens

Adele Horin

HIGH SCHOOLS should start at 10 am to tackle the chronic sleep deprivation of Australian teenagers, says an expert who has studied adolescent sleep patterns.

Dr Greg Murray, convenor of clinical psychology programs at Swinburne University, said adolescents were getting almost an hour less sleep a night on average than they needed during school term—and modern technology was not to blame.

'It's not just that these young people are choosing to play on the net,' he said. 'Our findings strongly suggest if you took all that away, they'd be sitting on their beds twiddling their thumbs … in the more extreme cases till 1 am.'

As children turned into adolescents they naturally became sleepier later. But they still needed as much sleep as primary school students—between 8½ hours and eight hours 45 minutes a night, he said. However, it was only during holidays that students managed to get this amount. The sleep deprivation contributed to the students' irritability, bad mood, inability to concentrate, poor memory, lethargy and possibly to depression, the self-reports from the students indicated.

Dr Murray said, 'A forward-thinking school would look seriously at how to modify their schedule to improve the outcomes for adolescents.'

Dr Murray and his co-researchers Suzanne Warner and Denny Meyer compared the sleep patterns of 310 year 11 students during school term and holidays.

Unsurprisingly students went to bed later and woke up later in the holidays than during school term, but rather than laziness being the cause, this pattern was likely to reflect the young people's real needs, the research showed. The difference in sleep duration in term and holidays was particularly marked on Sunday to Thursday nights.

'The real concern is we have kids in these classes who are half-awake. Their ability to function, their mood, and their interactions with peers is being incredibly affected by a structure that doesn't suit them,' Dr Murray said.

He said most parents would probably feel comfortable about letting boys aged 15 and over get up at 8.30 and get themselves to school by 10.

At Edmund Rice College in Wollongong, the year 11 and 12 students start at 11.45 am and finish at 5 pm. When the regime began in 1991, adolescent sleep was not the main motivating factor, rather better use of school resources, and providing a different experience for the senior boys, the headmaster, David Lear, said. 'But my feeling was the later start suited more of the older boys.'

Source: Horin, A. (2008, April 4). Change school hours for teens. *The Sydney Morning Herald*.

Box 3.7

The sleep–waking cycle as a biological rhythm

When studying the behaviour of organisms, researchers have observed that people and animals seem to have internal 'biological clocks' that regulate some behaviours which occur in particular rhythms or patterns. Most psychologists believe, however, that the internal biological clock does not operate in isolation of the environment. They suggest that the biological clock determines *when* certain changes in the organisms' behaviour will occur. At the same time, environmental cues (stimuli from the outside world), such as light and dark, help to keep the internal biological clock in harmony with the physical world.

To test the presence of a biological clock, researchers have taken people and animals from their usual environment and placed them in artificial conditions where the environment remains constant—for example, in conditions where light intensity, temperature, air pressure and humidity do not change. These studies have consistently found that when living in such artificial conditions, many organisms continue to show the same rhythmic changes in behaviour that occur in their natural environment. These *biological rhythms*, or rhythmic changes in biological processes, result in organisms being more biologically suited to behaving in a particular way at certain times.

Bodily functions that go through a full cycle about once every 24 hours are called *circadian rhythms*. The most extensively studied circadian rhythm is the *sleep–waking cycle*. Research suggests that our sleep–waking cycle adjusts to match the day and night cycles of our environment; that is, daylight and darkness. Thus, our sleep–waking cycle makes us more likely to fall asleep at night-time when it is dark and to wake when it gets light.

Environmental cues are necessary to keep our internal biological clocks 'in sync', or in harmony, with the external world. Studies of circadian rhythms under constant environmental conditions when no indicators of the time of day are available have consistently shown that most individuals naturally operate on a 25-hour day.

One of the first researchers to investigate this phenomenon was German psychologist Jurgen Aschoff (1967, 1965). Aschoff built a special underground laboratory (like a bunker) in which participants could live in complete isolation for an extended period of time. While living in the bunker, the participants had no environmental cues that would enable them to distinguish night from day; for example, they had no natural lighting or devices such as clocks and radios. Regular meals were provided and participants were asked to lead as normal a life as possible in the restricted conditions. An important finding was that on each successive day, participants tended to go to sleep and awaken a little later as they naturally drifted into a 25-hour sleep–waking cycle (see figure 3.22).

Aschoff's studies also show how our body maintains harmony with the external environment. For instance, although out of sync with the environment after their isolation, participants quickly shifted back to their normal sleep–waking cycles after they were exposed to environmental time cues such as the natural day–night cycle. These research findings have also led psychologists to conclude that exposure to daylight is important in the regulation of our biological clocks.

The biological clock that controls the circadian sleep–waking cycle is believed to be regulated by the *pineal gland*, which is located near the hypothalamus at the centre of the brain. The pineal gland secretes the hormone *melatonin* in various quantities at different times of the day.

The amount of melatonin present in the bloodstream influences how sleepy a person becomes, and higher melatonin levels result in greater sleepiness. The amount of melatonin that is secreted varies with the level of light in the environment. Less melatonin is secreted in daylight, and as night falls, the reduction in illumination triggers the pineal gland to secrete more melatonin. This helps to explain why we are generally more sleepy at night.

Figure 3.21 Aschoff's underground laboratory

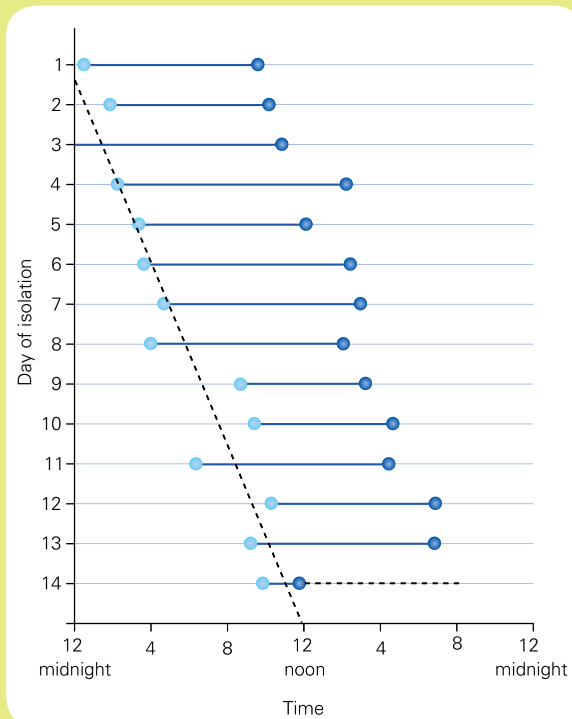


Figure 3.22 This graph shows the sleep–waking cycle of a volunteer who lived removed from all time cues for two weeks. Light blue circles indicate when the participant went to bed, and dark blue circles show when they woke. As time progressed, the participant retired and woke on average 49 minutes later each day. The shift to a 25-hour cycle is indicated by the dotted line.

Box 3.8

Delayed sleep phase syndrome

Everyone differs in their need for sleep and their sleeping habits but once we have adapted to a particular sleeping pattern, most of us are able to keep to that schedule. People who suffer from *delayed sleep phase syndrome* (DSPS) are unable to get their sleep pattern back in line with what is considered normal and even if they do, they are not able to maintain this. This is a significant problem to the person suffering from DSPS, leading to insomnia and possibly depression.

What is delayed sleep phase syndrome?

DSPS is believed to be a disorder of the body's timing system—the biological clock. DSPS sufferers have difficulty falling asleep and difficulty waking because their biological clocks are out of phase with the sleeping and waking times expected of them.

What are the symptoms of DSPS?

People with DSPS have sleep-onset insomnia; that is, they have great difficulty falling asleep. This may mean that they do not fall asleep until the early hours of the morning. If they need to wake up for school or work the next day, they will not get enough sleep and feel extremely tired. As the day progresses they feel less tired and the next night, rather than catching up the sleep they missed by going to sleep early, they will again have trouble falling asleep. This cycle goes on indefinitely. When allowed to sleep longer—for example, at the weekend—they may sleep until the afternoon and wake refreshed. DSPS doesn't bother everyone who has it. Some people are happy and healthy with a late sleeping schedule, and have found ways to adjust their lifestyle to it.

Who suffers from DSPS?

Adolescents are particularly susceptible. This may be from the conflict between stresses of school or university and the peer pressure to maintain an active social life, although new research suggests that at least some adolescents are programmed to sleep and wake late. DSPS has been estimated to affect about 7% of adolescents but it can occur at any age.

What causes DSPS?

It is thought that DSPS may be caused by an inability to reset the sleep–wake cycle in response to the environmental time cues—perhaps the biological clocks of DSPS sufferers have an unusually long cycle, or perhaps they are not sensitive enough to time cues. There may be an imbalance in some of the hormones that help to maintain this sleep–wake cycle, particularly melatonin, which may be used to treat the disorder.

How is DSPS diagnosed?

DSPS is a sleeping pattern and there is no simple diagnostic test that will show whether the person has DSPS. Referral to a sleep specialist is usually necessary. The sleep specialist may ask detailed questions about sleep patterns and ask the person to keep a sleep diary for a couple of weeks. This involves a daily recording of:

- the time they tried to fall asleep
- the time they think they fell asleep
- any night-time awakenings
- the time they woke up
- the time they got out of bed
- the time they had to be up
- whether they woke up naturally
- any daytime naps—how long and when
- what medications are used.

How is DSPS treated?

DSPS may eventually get better by itself; however, in the short term, the sleep specialist may suggest one of three main ways that may be effective in keeping DSPS under control.

- Exposure to bright light in the early morning will help to advance the sleep phase and maintain a more regular sleeping pattern. Taking a walk in the early morning sunlight or reading the newspaper outside may help but bright-light units may be required. These are used for an hour or more after awakening. They must be used in combination with manipulation of sleeping times to try and establish an acceptable pattern.

- Psychological or psychiatric help to address any underlying depression and provide advice on good sleep habits may be recommended.
- Melatonin is a naturally occurring hormone that is released in response to darkness and helps in the onset of sleep by lowering body temperature. Melatonin needs to be taken under the supervision of a doctor and after sleep diary data has been collected. Research suggests that small doses of melatonin are just as effective as larger doses in changing the circadian rhythm and are often given a number of hours before sleep onset. The treatment is new and long-term effects are not known at this time. It is important not to consume alcohol or drive if you have taken melatonin.

Source: adapted from Sleep Disorders Australia (2006). *Delayed sleep phase syndrome*. Sleep Disorders Australia, South Australia Branch, www.sleepoz.org.au.

Box 3.9

Are you a morning lark or a night owl?

A lark is a bird that rises early in the morning to satisfy its thirst with the morning dew. When that is done, the lark will often begin singing a song that, in spring, serves as its mating call. People who are like larks, or who show the psychological tendency that some psychologists have called *morningness*, are early risers. From the moment they get out of bed they seem awake, alert and ready to begin daily activities. They work busily through the morning but start to fade as the afternoon wears on. They usually become tired and sleepy early in the evening.

These morning larks can be contrasted with night owls: people who show the psychological tendency called *eveningness*. Getting up early is difficult for night owls. They drag themselves through the morning but begin to feel more alert and energetic as the day progresses. By evening they are alert and active, and they can often be found working late into the night or the early hours of the morning.

Larks and owls both have 24-hour sleep–waking cycles that are synchronised with the daytime and night-time of the 24-hour 'environmental day' (see box 3.7). However, their sleep–waking cycles differ. The owl cycle peaks about two hours later than the lark cycle. The difference also occurs in other naturally occurring bodily activities that follow a 24-hour cycle of activity, such as the daily rise and fall of body temperature and the increase and decrease in various hormones. Psychologically, however, the differences in the sleep–waking cycle and other 24-hour cycles of bodily activities seem to be much greater. Larks do their best work in the morning; owls do their best work late in the evening. Owls find it difficult to be motivated in the morning, whereas larks are buzzing around enjoying the morning light and being awake. At night, owls feel energetic and ready to play, while larks are beginning to crash for the day.

A number of simple tests have been designed to determine whether someone is a morning lark (high score on morningness) or night owl (high score on eveningness). To find out if you are a lark or an owl, respond to the statements in table 3.1 on the next page by circling the answers that apply to you.

To score this test, count the number of responses that you circled in the right-hand column. If you have seven or more circled, you are clearly an owl; if you have three or fewer circled, you are clearly a lark. If your responses are between four and six you have no clear larkish or owlish tendencies.

Note that it is difficult for someone to change from being a lark to being an owl, and vice versa. However, this does not mean that change is impossible. Several studies have now confirmed that as we grow older, we all develop a bit more of a tendency towards morningness. Owls, however, show the greatest changes, becoming much more larkish with age.

Table 3.1 Morning lark and night owl questionnaire

1	I am most alert during the	morning	evening
2	I feel that I have the most energy during the	morning	evening
3	I feel that I remember material better if I read it or hear it in the	morning	evening
4	I am the most productive during the	morning	evening
5	I come up with my best ideas during the	morning	evening
6	I feel that I am most intelligent during the	morning	evening
7	I prefer recreation during the	morning	evening
8	Considering what makes me feel best, if I were completely free to plan my day, I would get up	before 8 am	after 8 am
9	Considering what makes me feel best, if I were completely free to plan my day, I would go to sleep	before 11 pm	after 11 pm
10	During the first hour after I wake up in the morning I would judge my alertness and energy as	fairly high	fairly low

Source: adapted from Coren, S. (1996). *Sleep thieves*. New York: The Free Press, p. 92.

Learning Activity 3.5

Review questions

1 Briefly describe two general trends in the pattern and proportions of NREM and REM sleep across the lifespan.

2 Compare and contrast sleep–wake patterns of children, adolescents and adults with reference to two distinguishing features of each lifespan stage.

3 **a** Explain the meaning of the term sleep–wake cycle shift.
b Briefly describe the sleep–wake cycle shift occurring during adolescence.
c What are three potential consequences of this shift?
d To what extent may it be possible to readjust or compensate for this shift? Explain your answer.

4 Explain the meaning of the following terms:
a delayed onset of sleep
b sleep debt.

Learning Activity 3.6

Data analysis

1 Compare and contrast the typical sleep patterns of young adults and elderly people shown in figure 3.18 on page 150. Ensure that you refer to:
- sleep onset
- REM episodes
- NREM stages 1 and 2 episodes
- awakenings.

2 Suggest a possible limitation of the data.

3 Write a conclusion on the typical sleep pattern of young adults and elderly persons based on the data.

Learning Activity 3.7

Media response

Read ‘Change school hours for teens’ on pages 154–5 and answer the following questions.

1 On what grounds does Dr Murray argue the case to ‘change school hours for teens’?

2 To what extent is the article’s explanation of adolescent sleep deprivation consistent with the text’s explanation in terms of biological, psychological and social factors?

3 Write a letter to the editor in which you identify potential psychological benefits of a later start to the school day, but also argue a case that it may be too simplistic a solution for the problem(s) proposed in the article.

Learning Activity 3.8

Research investigation

Conduct an investigation in which you compare the sleep patterns of people in three different age groups: children, adolescents and adults.

Use a sleep diary (see page 138) to collect self-reported data from one or more participants in each age group; for example, age, type of night (weekday or weekend), bedtime, time of onset of sleep, rise time and amount of time asleep.

Collate, tabulate and graph individual data for comparison across the three different age groups. Draw a conclusion from the results and comment on whether the results are consistent with those derived from more formal psychological research.

The purpose of sleep

An individual who never sleeps has yet to be identified, which seems to suggest that everyone sleeps. Infants sleep longer on average per day than adults sleep—about 16 hours compared with about eight hours for adults. And during old age, the need for sleep seems to diminish further to an average of about six to seven hours per night.

Staying awake for extended periods of time when one would normally be sleeping (being deprived of sleep) has varying effects on different people. Research on extended sleep deprivation with animals has shown that animals die if they are kept awake for a prolonged period of time (Rechtschaffen, 1989).

Observations about the differing needs for sleep between individuals and among people of different ages, and research findings on the effects of sleep deprivation, have led psychologists to propose various theories about why we sleep. One set of theories proposes that sleep has restorative functions.

An alternative theoretical approach suggests that we sleep to enhance our survival by being inactive at night. Although these theories adopt different approaches in explaining the purposes of sleep, they are not necessarily mutually exclusive. There may be more than one reason to explain why we sleep.

Restoration

Restorative theories on the purpose of sleep are the ones with which most people are familiar and believe. Generally, **restorative theories** propose that sleep provides 'time out' to help us recover from depleting activities during waking time that use up the body's physical and mental resources. For example, sleep provides an opportunity for the body to replenish the stores of energy that have been depleted during the day. It also allows any damaged cells to be repaired and various muscles to be detoxified or to rid themselves of waste products. This view is supported by the experiences most people have of feeling tired before they sleep and feeling refreshed and more energetic upon waking. Furthermore, people usually sleep for a longer period of time during an illness, suggesting that sleep may have something to do with the recovery process. Research evidence supporting restorative theories includes findings from sleep laboratory studies that sleep is a period of physiological rest. For most of the time when we are asleep, large and small muscles throughout the body are relaxed, body functions such as heart and breathing rates slow down, and the rate of neural activity in various structures of the brain is slightly reduced. Furthermore, growth hormone, which also promotes body repair, is secreted at a much higher rate when asleep than when awake (Siegal, 2003; Douglas, 2002).

In one study on the effects of strenuous physical exercise on sleep, researchers observed athletes who participated in a 92-kilometre ultramarathon. It was found that when allowed to sleep for as long as they needed to, the runners slept significantly deeper and longer in the two nights following the race (Shapiro & others, 1981) (see figure 3.23). However, it should be noted that this study involved extreme physical activity over a prolonged period of time. There is little evidence that shows we sleep more than usual after a particularly active day (Horne & Minard, 1985). Other research findings supporting the restorative theory come from sleep deprivation studies with animals. For example, experiments with rats have found that prolonged sleep deprivation results in breakdown of various bodily tissues (e.g. skin sores fail to heal), and death within three weeks (Everson, 1993).

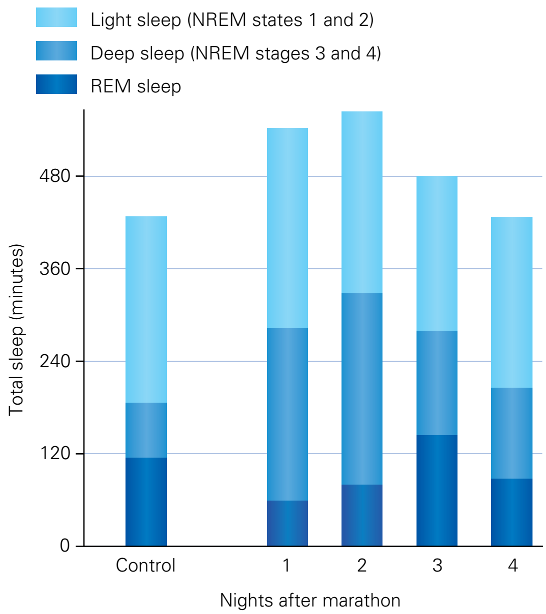


Figure 3.23 Effect on sleep of running a marathon. This graph shows the average time spent in each sleep stage by athletes on each of four nights following a 92-kilometre marathon, compared with control nights (two weeks before and two weeks after the marathon). Notice that the main effects were an increase in the time spent in deep slow-wave sleep (stages 3 and 4) and a decrease in REM sleep on the first two nights after the marathon (from Shapiro & others, 1981).

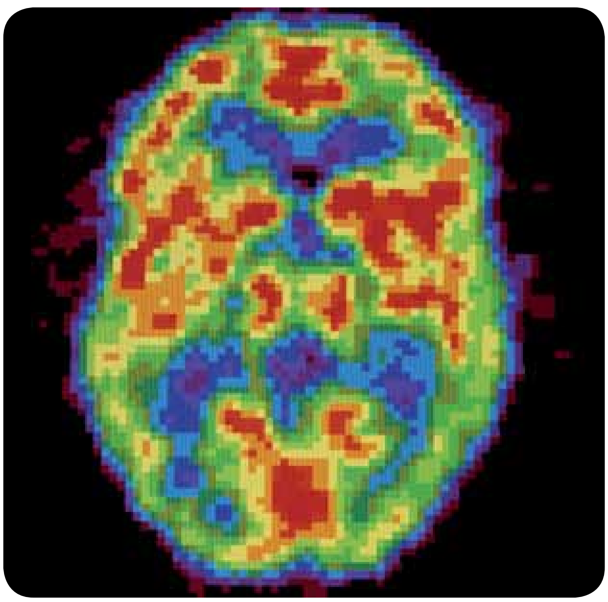


Figure 3.24 A PET scan of the brain during an REM sleep period: different colours are used to show highly active brain areas (red) through to inactive areas (blue). The scan reveals that the brain is active and dreaming—activity similar to that of the brain when we are awake.

It is also suggested that NREM and REM sleep tend to have different restorative effects. Generally, NREM sleep is believed to be important for restoring and repairing the body and REM sleep is believed to restore the brain and may have a role in higher mental functions such as learning and memory. For example, physical growth, tissue repair and recovery from the effects of fatigue occur during stages 3 and 4 (deep sleep) of NREM sleep, and brain growth and restoration occur during REM sleep. The different restorative role of REM sleep is suggested by the fact that REM sleep is much more abundant in the developing fetus and infants than in childhood and subsequent lifespan stages. This indicates that REM sleep may play an important part in the peak period of brain development that occurs in the early stages of the lifespan (Hockenbury & Hockenbury, 2006).

It has also been proposed that REM sleep has a restorative role throughout the lifespan by providing regular 'exercise' to groups of neurons in the brain that form circuits, thereby promoting the maintenance of brain circuits (Hobson, 1988). The connections between neurons (synapses) can deteriorate if they go too long without being active (Edelman, 1987), so the increased brain activity observed during REM sleep may help preserve important neural pathways in the brain. This theory may also help explain why REM sleep occurs to a much greater degree in fetuses and infants than in adults, regardless of species (Gray, 2007).

It has also been proposed that REM may assist in consolidating or embedding the memory of newly learned information in the brain by strengthening neural connections that form during the learning process (Kavanau, 2000). For example, an experiment with laboratory-bred rats found that the rats performed better on a learning task (such as running a maze) several hours after learning if they were permitted REM sleep soon after learning, compared with rats deprived of REM sleep during that time (Smith, 1985). A similar experiment with people found an improved performance when REM sleep occurred after learning a particular motor task, such as pressing a key on a keyboard after visually locating an object hidden in a textured background (Karni & others, 1994). Learned motor skills such as tapping one's fingers in a particular sequence, as if playing notes on a piano, also improve significantly when a period of REM sleep follows initial practice (Walker & others, 2002). However, the research evidence does not show a similar improvement after REM sleep for the recall of verbally learned factual information.

Among psychologists there is general agreement that REM sleep probably serves an important biological need. In the controlled conditions of sleep laboratories, people have been woken up each time they lapsed into REM sleep, with no obvious ill-effects. However, when they were allowed to sleep uninterrupted following periods of interrupted REM sleep, they spent more time than they normally would in the REM stage. It seemed that for some reason they needed to make up for lost REM sleep (Dement & Vaughan, 1999). Psychologists refer to this as REM rebound. **REM rebound** involves catching up on REM sleep immediately following a period of lost REM sleep by spending more time than usual in REM sleep when next asleep.

While some research findings suggest that NREM and REM sleep have restorative functions in relation to the body and the brain, it has not been conclusively established precisely what, if anything, is actually restored, repaired or revitalised during sleep and at no other time. Nor has it been established that restoration is the only function of sleep. If restoration were the only function of sleep, we would expect that a physically disabled person confined to bed would sleep less than a physically active person. This, however, is not the case.

Survival

The **survival theory** of sleep (also called *evolutionary theory* and *preservation and protection theory*) proposes that sleep evolved to enhance survival by protecting an organism through making it inactive during the part of the day when it is most risky or dangerous to move about (Meddis, 1977). For example, once an organism has fulfilled all its survival functions such as eating, drinking, caring for its young and reproducing, it must spend the rest of its time conserving energy, hidden and protected from predators. While sleeping, an organism is not physically interacting with the environment and is less likely to attract the attention of potential predators. Thus, according to the survival theory, sleep serves the function of protecting the sleeper from harm or death, and therefore enhances survival of the species.

Box 3.10

Can you reduce the amount of sleep you need?

Is it possible to learn to function just as effectively on less sleep than you normally have? For many students around exam time this would be the ideal situation.

Research suggests that it is possible to learn to reduce the amount of sleep you need, but this takes some time to do. There have been several attempts by regular eight-hour sleepers to reduce their sleep time to four or five hours. Over a few months, participants gradually went to bed progressively later, but continued to get up at the same time. When participants had reduced their sleep to five hours per night, they found that it was increasingly difficult to get up in the morning. They experienced tiredness, lack of energy and difficulty concentrating, and felt less happy and were less friendly towards others. In one research study, two participants asked to withdraw from their four-hour sleep schedule after three weeks because of unwanted mood changes and poor performance at work. In another research study, participants stopped reducing the amount of sleep they were getting at five hours because of the unwanted mood changes.

However, four months after the studies ended, most of the participants were sleeping one to two hours less per night than they had prior to their involvement in the studies. It seems that if you are willing to tolerate an initial period of fatigue and unpleasant mood changes, you may be able to reduce your sleeping time by an hour or two over time (Friedmann & others, 1978; Mullaney & others, 1978; Johnson, 1973).

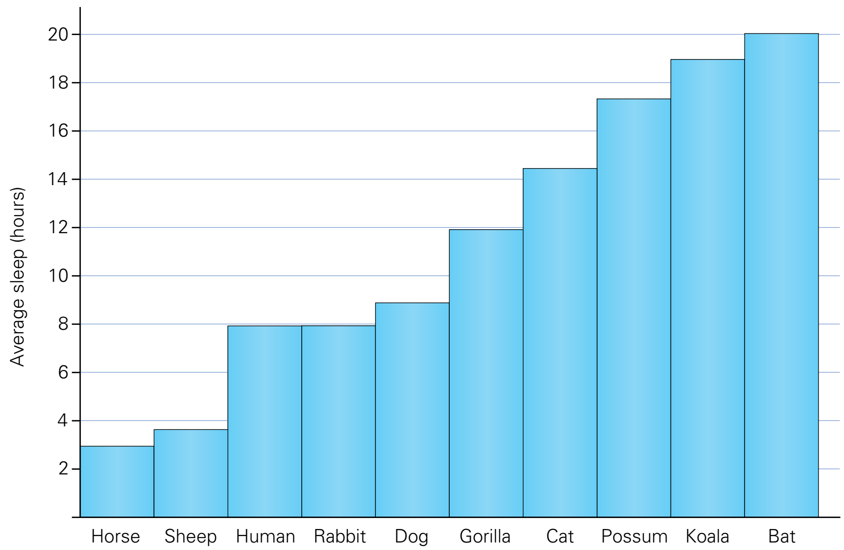


Figure 3.25 A comparison of the daily hours of sleep of various species

Figure 3.26 What is the purpose of sleep? To restore the body and its functions or to enhance the individual's survival by protecting them from potential danger when they are most vulnerable? Perhaps it is both, and/or something else that is still unknown.

Research evidence for this theory comes from studies on behaviour patterns and sleep–waking cycles of different species. For example, animals with few natural predators, such as lions, tigers and gorillas, sleep as much as 15 hours a day. Grazing animals such as horses, zebra, cows and buffalo have many predators and struggle to escape from their predators. They cannot hide easily, climb trees or burrow quickly to escape danger. Thus, they are safer awake and tend to sleep for short periods that total only about four hours per day. Conversely, smaller animals such as possums and bats eat less food and need less time to find and digest it. They are also able to sleep in safe places away from their natural predators. Consequently, they do not need to be awake for so long each day, nor to spend so much time each day safeguarding against attack from predators. When considered from this perspective, humans sleep at night because we are highly visual animals who need light to find food and do other things necessary for survival. Consequently, we are not well adapted to searching for food in the dark or protecting ourselves from nocturnal predators. At night, it may have been best for us, during most of our evolution, to be tucked away asleep in a cave or other hiding place so as not to be tempted to walk about and risk falling off a cliff or being attacked by a nocturnal predator. Only during the past few centuries, which is an insignificant speck of time in the context of evolution, have lights and other technologies we have created made the night relatively safe for us. Our pattern of sleep at night may simply be a carryover from a period when the night was a time of great danger. To the degree that night-time is still more dangerous than daytime, our pattern of sleep may continue to serve an adaptive function (Gray, 2007).

One criticism of survival theory is that it does not explain why sleep involves a loss of awareness, since the loss of consciousness during sleep may place the organism at greater risk. While asleep, the organism's senses are less attuned to the environment and muscles are in a relaxed state—not ready to respond to danger.

While the restorative and survival theories of sleep provide some insights into the possible reasons for sleep, there is only limited evidence for each theory. Psychologists have no definite answers to the question of why we sleep. It seems sleep has multiple purposes, two of which may involve restoration and survival. It is clear, however, that we have little choice about sleeping after a certain period of time has elapsed, so sleep seems to be an automatic process over which we have only limited control. Research to investigate why we sleep has often focused on what happens if we are deprived of sleep. Results of these studies have provided useful information for understanding sleep.

Learning Activity 3.9

Review questions

1. a. Briefly describe the purpose of sleep in terms of restorative theory.
   b. Outline the differing restorative effects of NREM and REM sleep.
   c. Explain the meaning of REM rebound and why it occurs.
   d. Outline empirical research in support of restorative theory.
2. a. Briefly describe the purpose of sleep in terms of survival theory.
   b. Outline empirical research in support of survival theory.
3. Which theory do you believe better explains the purpose of sleep? Give a reason for your answer.

Sleep deprivation

Research on sleep deprivation has provided insights into our need for sleep and the purpose of sleep. The term **sleep deprivation** means going without sleep. Generally, there are different effects for different kinds of sleep loss. Sleep deprivation falls into the broad categories, partial and total. *Partial sleep deprivation* involves having less than what is normally required. *Total sleep deprivation* involves not having any sleep at all.

Psychologists have conducted research on both types of sleep deprivation. Their studies have investigated the effects of partial and total deprivation across short and prolonged periods of time. It would be unethical and therefore not permissible to conduct research studies in which human participants were totally sleep deprived for extremely long periods of time, because of the potential for psychological and physiological harm. Therefore, much of what psychologists have learned about the effects of total sleep deprivation has come from research with animals. Valuable information has also come from case studies of individuals who have subjected themselves to prolonged sleep deprivation for non-research purposes; for example, to raise money for a charity or to challenge a world record in the *Guinness Book of Records*.

In studying sleep deprivation, researchers investigate psychological and/or physiological effects of sleep loss. Sometimes they study sleep loss in general and, at other times, loss of either NREM or REM sleep. In many cases, they also study sleep recovery patterns following sleep loss as this provides insights on sleep patterns, sleep functions and other aspects of sleep.

Partial sleep deprivation

You have undoubtedly experienced the effects of partial sleep deprivation. It often results in a range of uncomfortable side effects such as tiredness, lack of energy, lapses in attention, inability to concentrate for a long period of time, a low level of motivation, impaired motor skills, irritability and occasional headaches. The severity and extent of the side effects depend on the individual, the amount of sleep lost, and the period of time over which the sleep deprivation occurs (Coren, 1996).

Research studies have found that in many cases of prolonged partial sleep deprivation, people have shown a decline in their ability to perform cognitive tasks (Quigley & others, 2000). They have slower reaction times on motor tasks, tend to think in irrational and illogical ways, and have difficulty making decisions and solving problems that require creative thinking (Seigel, 2000). In one experiment, research participants were required to complete simple, monotonous repetitive tasks such as identifying bleeps and flashing lights on a radar screen. When deprived of sleep, participants made significantly more errors than when they had not been deprived of sleep (Koslowsky & Babkoff, 1992).

Generally, partial sleep loss over a relatively short period of time has temporary and relatively minor psychological and physiological effects. We can also quickly recover from the sleep loss effects when the accrued sleep debt is repaid. However, many psychologists believe that most people underestimate the effects of partial sleep loss over a prolonged period, particularly when a large sleep debt is carried. For example, prominent American sleep researcher William Dement (1999) believes that millions of people throughout the world are 'living less than an optimal life and functioning at less than optimal level, impaired by an amount of sleep debt that they are not even aware that they are carrying'. He also believes that, due to sleep loss and problems associated with adolescent sleep phase shift, many students are 'dangerously sleep deprived' and are 'at high risk of some accident' because ongoing sleep deprivation, even if partial, increases the likelihood of making errors of judgment and mistakes. This is potentially fatal. It can also impact on the lives of others. For example, people driving cars, taxis, buses, trucks and other forms of transport while sleep deprived are more vulnerable to road accidents—harming themselves or others as a result of failing to negotiate an unexpected object that appears on the road. Australian research findings have identified that some 30% of road accidents occur when drivers fall asleep on long monotonous stretches of road. Research findings also show that even after only four hours of sleep deprivation, reaction time is 45% slower on a perceptual motor task such as driving (Maas, 1998).

Figure 3.27 For many shift workers—including doctors in hospital emergency departments, who have to grab opportunities to sleep whenever they can—prolonged sleep deprivation can impact on their ability to think clearly and make decisions.

The deterioration in cognitive functioning from prolonged partial sleep deprivation has further implications for people in high-pressure jobs who do shift work and who consequently may be more likely to experience sleep deprivation, such as pilots, doctors, air-traffic controllers, emergency services workers and long-distance road transport drivers. For example, for a pilot or air-traffic controller, who must continually scan their computer screen for small but significant changes in aircraft position, it is critical that important information is not missed. Likewise, a doctor operating on a patient cannot afford to miss any changes in vital signs and must be able to think clearly and make decisions quickly if the patient's condition changes. In these situations, errors in judgment, as well as wrong decisions and lack of clear, logical thinking, may result in loss of human life.

Memory processes may also be impaired as a result of prolonged sleep deprivation. While accessing information from long-term memory tends to be only slightly affected, processing information in short-term memory can be significantly impaired, making it difficult to keep details in our conscious awareness for use when required. Psychological effects of partial sleep deprivation may be experienced by people involved in industrial negotiations or crisis meetings, where discussions often continue without a break over long periods of time with no time out to sleep. Eventually they may find it difficult to keep the various arguments and details of the negotiations or discussions in their short-term memory.

Total sleep deprivation

Numerous experiments have been conducted with rats in which they have been totally deprived of sleep for prolonged periods of time. The sleep-deprived rats typically were unable to maintain a constant body temperature, resulting in excessive heat loss. They eventually died after two to three weeks of no sleep (Rechtschaffen, 1989). In other studies of prolonged total sleep deprivation using rats, autopsies conducted after their death showed that their immune systems had collapsed, resulting in blood poisoning and ultimately death.

These research findings suggest that sleep is vital to the regulation and stability of a rat's internal environment and this may also apply to humans (Rechtschaffen, 1997; Rechtschaffen & Bergmann, 1995).

Studies on the effects of prolonged total sleep deprivation in humans have tended to rely on convenience samples. For example, data collected from various individuals who have completely deprived themselves of sleep for various periods of time up to about 11 days indicates that prolonged total sleep deprivation has no long-lasting effects, either psychologically or physiologically. In fact, most of the observed and self-reported experiences of sleep deprivation were temporary and disappeared after the individual slept uninterrupted. In one case study of prolonged total sleep deprivation, 17-year-old Randy Gardner stayed awake for a world record of 264 consecutive hours (11 straight days) as part of a high school science project. While Gardner experienced a range of debilitating psychological and physiological effects during the period of his sleep deprivation, it was found that he experienced no lasting significant psychological or physiological effects from his sleep loss. For the first three days after his prolonged sleep loss, Gardner slept longer than his usual eight hours (15 hours on the first night, 12 hours the second night and 10.5 hours the third night). During the day, he continued his usual activities without difficulty. Follow-up tests confirmed that Gardner has suffered no long-term harmful effects (Dement, 1978).

However, some individuals experienced quite significant and disturbing psychological effects during prolonged total sleep deprivation, such as depression, hallucinations, delusions (false beliefs that are held despite evidence to the contrary) and paranoia (a false belief that others want to harm you). For example, in 1959, American disc jockey Peter Tripp remained awake for eight consecutive days to raise money for charity. After about the first 100 hours, he started to experience severe psychological disturbances. He began to hallucinate, seeing a rabbit run across the radio booth and cobwebs in his shoes. He also had difficulty thinking clearly and remembering things. Towards the end of this time, he became paranoid, believing people were trying to force him

Figure 3.28 After 201 hours without sleep, disc jockey Peter Tripp developed hallucinations, delusions and paranoid thinking, all of which disappeared after he had 13 hours of continuous sleep.

to fall asleep by putting drugs into his food and drink (Dement, 1972). After Tripp was escorted home, following 201 hours without sleep, he slept continuously for 13 hours. When he awakened, his thinking, memory and perceptions were normal, and his mood was back to the playful level that was characteristic of him (Coren, 1996).

Obvious but consistently experienced physiological effects of prolonged total sleep deprivation are sleepiness and fatigue. Other physiological effects may include hand tremors, drooping eyelids, difficulty focusing the eyes, lack of energy and strength, slurred speech and an increased sensitivity to pain. After a continuous waking period of five consecutive days and nights, the heart and respiratory system tend to be slower, and body temperature drops. Some biochemical changes have also been found to occur, such as impaired functioning of the disease-fighting immune system and impaired production of certain hormones by the endocrine system (Coren, 1996).

It has also been proposed that using additional energy to stay awake, and the changes in eating patterns that often accompany extended periods of wakefulness, may result in the desychronisation of biological rhythms (see box 3.7). However, studies show that once a sleep-deprived person is able to catch up on some of the lost sleep and resynchronise (reset) their biological clock, the physiological effects of sleep deprivation also tend to disappear.

Box 3.11

Research on 72 hours of sleep deprivation

In this experiment, 15 adult females went for 72 hours without sleep. Every three hours they rated their subjective feeling of tiredness on a scale from 0 to 200 on which 100 meant 'normal fatigue' and 200 meant 'twice as fatigued as normal'. As shown in figure 3.29, each successive 24-hour period, the highest fatigue ratings occurred around 2 am to 6 am and the lowest fatigue ratings occurred around 2 pm to 8 pm.

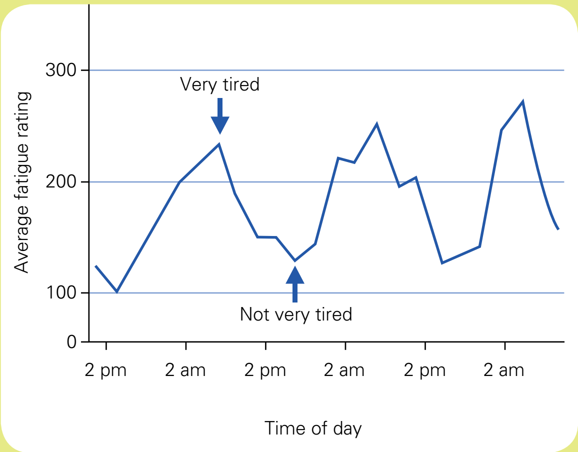


Figure 3.29 Change in the level of fatigue reported during 72 hours of sleep deprivation

Figure 3.30 Despite the weary look in the 'after sleep deprivation' picture (on the right), the volunteer participants suffered no long-lasting ill-effects from their sleep deprivation.

The observation that there are usually few lasting effects of sleep deprivation is explained by some psychologists as a result of the difficulty in ensuring that participants in sleep deprivation experiments are, in fact, completely sleep-deprived. *Total* sleep deprivation is difficult to ensure because after three or four sleepless days, people automatically drift into periods of microsleep over which they have no control. A **microsleep** is a very short period of drowsiness or sleeping that occurs while the person is apparently awake. During a microsleep, the EEG pattern resembles that of the early stages of NREM sleep. After a microsleep, which usually lasts for a very brief period of time, individuals may have no recollection of what happened during the microsleep. For example, if you had a microsleep in a maths class while the teacher was explaining a new formula, on your return to normal waking consciousness you would have a gap in your knowledge of that information.

It seems that the more obvious effects of partial and total sleep deprivation, however prolonged, are temporary and usually persist only until the individual is able to sleep and catch up on the accrued sleep debt. Various research studies on sleep deprivation have found that we do not need to *fully* compensate for the lost hours of sleep to restore our psychological and physiological wellbeing. Most people make up for lost sleep by getting a few extra hours of sleep over the next few nights. However, sleep loss also affects us in more subtle ways. For example, sleep deprivation suppresses immune cells that fight off viral infections and cancer. According to American psychologist David Myers (2007), this may help explain why people who sleep seven to eight hours a night tend to outlive those who are chronically sleep deprived, and why older adults who have no difficulty falling or staying asleep tend to live longer. When infections do set in, we typically sleep more, boosting our immune cells.

Box 3.12

Shiftwork and sleep

Many jobs within our society involve working shifts. For example, shiftwork is common to pilots; doctors and nurses; police, ambulance and fire officers; industrial workers; taxi, train and truck drivers; and mail sorters. Studies of people who work rotating shifts have consistently found that shiftworkers are likely to suffer from negative effects that may occur as a result of disruption to their sleep–waking cycles. Our natural sleep–waking cycle is biologically 'set' for being awake during the daylight and for sleeping at night (Wallace, 1983). People are not *nocturnal* (alert at night) by nature, and this may account for the significant number of on-the-job accidents in the middle of the night or in the early hours of the morning, when employee performance also tends to be significantly lower (Dement & Vaughan, 1999).

Many shiftworkers also complain about sleep disorders, such as problems getting to sleep and/or staying asleep, and about the quality of their sleep (Torsvall & others, 1989). The specific reasons for these sleep disorders are not clear, but they may be at least partly due to the higher levels of the hormone adrenaline during the day, which result in greater alertness at a time when a person wants or needs to sleep. However, environmental factors can also play an important part in the lack of sleep that night shiftworkers generally suffer during the day. For example, during the day, the temperature is usually higher than at night, there is more light, phones ring more frequently and visitors may arrive. All these can interfere with daytime sleeping.

The conflict between expectations of work performance for shiftworkers (especially while doing the night shift) and the biological tendency to sleep during the night may also result in nervous disorders, which have been associated with sleep deprivation as well as with digestive and gastric problems (Wallace, 1983).

Overcoming problems of shiftwork

The most difficult work routines to adjust to are those that are constantly changing because the sleep–waking cycle does not have a chance to adjust. Psychologists suggest that if rotating shifts have to be endured, the longer a person works on a particular shift, the more likely it is that their sleep–waking cycle will make at least some adjustments, and the better for the individual. A shift roster in which the individual has longer periods of time on each shift before rotating to the next shift is also beneficial because it allows the individual to have a longer period of time off between one shift rotation and the next. This gives the body time to 'reset' its sleep–waking cycle so it is in sync with the environment. A roster with three-week shifts is preferable to one-week or three-day rotations.

The body also adapts more quickly when the worker is assigned to successively later shifts rather than to successively earlier shifts. Thus, the move from one shift to the next should be a forward move so the new shift begins later in the day. For example, if a person has been working day shift from 7 am to 3 pm, the next shift they do should be the afternoon shift, from 3 pm until 11 pm, rather than moving backwards to the 11 pm to 7 am shift (Czeisler, Moore-Ede & Coleman 1982). Because our natural sleep–waking cycle is 25 hours (see box 3.7), by moving forwards through the shift rotation, the cycle is disrupted less than if a worker moved backwards through a shift rotation. Thus, workers will adapt better and experience less disruption to their physiological and psychological functioning with a forward move than a backward move. Following these principles, the restructure of work schedules in one study of police officers resulted in a 40% decrease in on-the-job car accidents. In addition, the officers used fewer sleeping pills and less alcohol in response to the effects of sleep deprivation. Furthermore, officers on the night shift reported a 29% increase in alertness (Czeisler, Moore-Ede & Coleman, 1982).

Figure 3.31 Incidents of early-morning accidents may involve out-of-sync sleep and waking requirements. For example, this may have contributed to a train crash that occurred at 3.50 am (Lauber & Kaytan, 1988).

Box 3.13

Are you sleep-deprived?

The following questionnaire is designed to determine whether you are getting as much sleep as you need. Answer each question by circling *Yes* or *No*.

1	Do you usually need a loud alarm clock to wake you up in the morning?	Yes	No
2	Do you usually hit the snooze control to get a few minutes more of sleep when the alarm goes off in the morning (or simply turn off the alarm and try to catch a bit more sleep)?	Yes	No
3	Do you find that getting out of bed in the morning is usually a struggle?	Yes	No
4	Do you sometimes sleep through the alarm?	Yes	No
5	Do you usually find that a single beer, glass of wine or other alcoholic drink has a noticeable effect on you?	Yes	No
6	Do you sleep longer on weekends than you normally do during the week?	Yes	No
7	On holidays, do you sleep longer than you normally do in regular school or work weeks?	Yes	No
8	Do you often feel that your get-up-and-go has got up and gone?	Yes	No
9	Do you find that it is more difficult to attend to details or routine chores than it used to be?	Yes	No

10	Do you sometimes fall asleep when you had not intended to?	Yes	No
11	Do you sometimes find yourself getting very sleepy when you are sitting and reading?	Yes	No
12	Do you sometimes find yourself getting very sleepy or dozing off when you are watching TV?	Yes	No
13	When you are passenger in an aeroplane, car, bus or train and the trip lasts more than an hour without a break, do you commonly find yourself getting very sleepy or dozing off?	Yes	No
14	Do you usually feel extremely sleepy or doze off when you are sitting quietly after a large lunch without alcohol?	Yes	No
15	Do you tend to get sleepy when you are sitting quietly in a class, in an assembly or in a cinema?	Yes	No
16	Have you sometimes found yourself getting extremely sleepy with the urge to doze when you drive or are a passenger in a car or bus and are stopped for a few minutes in traffic?	Yes	No
17	Do you drink more than four cups of coffee, tea or other drinks containing caffeine during the day? (Remember to count refills and also count extra-large takeaway cups as two cups.)	Yes	No

To score this questionnaire, count the number of times you circled *Yes*. The interpretation of your scores is as follows.

4 or less
You are obtaining an adequate amount of sleep and are not showing significant signs of any sleep deprivation.

5 or 6
You are probably getting an adequate amount of sleep on most days, although there are some days when you don't get enough sleep, which may cause you to be less than 100% alert on some activities.

7 or 8
You are showing evidence of sleep deprivation that may cause a noticeable reduction in your efficiency at school or work and your ability to finish your required activities on time. Things to watch for are simple errors and short episodes of inattention. You will occasionally just 'slip up', act clumsily, reach a wrong conclusion or miss an important detail. Usually at this level you will recognise the errors if you have the chance to recheck your work, although the ones that get through may be embarrassing or costly.

Source: adapted from Coren, S. (1996). *Sleep thieves*. New York: The Free Press, pp. 264–265.

Learning Activity 3.10

Review questions

1 **a** To what does the term sleep deprivation refer?
b How are partial and total sleep deprivation defined?

2 **a** List key findings of research with sleep-deprived animals.
b Describe three relevant ethical guidelines that psychologists must follow when conducting research on sleep deprivation with human participants.

3 Summarise common psychological and physiological effects on people of partial and total sleep deprivation.

4 How quickly and how well do people usually recover from the side effects of
a partial sleep deprivation?
b total sleep deprivation?

5 What key factor(s) influence(s) recovery from sleep deprivation?

6 What is a microsleep and when is it more likely to occur?

Learning Activity 3.11

Effects of sleep deprivation

Twins Sara and Adam partied for three consecutive nights on the weekend of their 18th birthday and had almost no sleep during this time. On the morning after the last party, the twins both attended their part-time jobs. Sara is employed as a lifeguard at the local pool, where her duties include closely monitoring activity in the pool to ensure swimmers' safety, responding quickly to unsafe situations and dealing calmly with swimmers behaving in an unsafe manner. Adam is employed at a Tattslotto agency, where his duties include scanning Tattslotto tickets into the computer, identifying when to pay out on winning tickets from beeps on the computer and explaining to customers the processes involved in filling out their tickets.

Describe the possible impact for Sara and Adam of their sleep deprivation on their respective abilities to do the required tasks involved with their part-time jobs. Ensure you refer to research findings and reports on the effects of prolonged sleep deprivation.

Learning Activity 3.12

Experimental design: sleep deprivation

Describe an experiment that could be conducted to compare the effects of prolonged sleep deprivation on performance of simple and complex tasks.

Present your experimental design as a flowchart showing the key features; for example, aim, ethical issues, hypothesis, IV(s) and DV(s), sampling procedure, experimental groups and participant allocation procedure.

If the hypothesis were supported, what results might be obtained, what conclusion(s) could be drawn, and what generalisation(s) could be made? Ensure that your results are consistent with theoretical expectations.

Explain your choice of experimental design and identify two potential extraneous or confounding variables that are taken account of in the design.

Learning Activity 3.13

Research investigation

Conduct an investigation on sleep deprivation among adolescents using the sleep-deprivation questionnaire in box 3.13.

Each student should collect data from a convenience sample of four adolescents. Collate the individual data for analysis and interpretation. Draw a conclusion from the results and comment on whether the results are consistent with those derived from more formal psychological research.

Learning Activity 3.14

Evaluation of experimental research on sleep

To test the effectiveness of a new sleeping pill, a researcher conducts an experiment at the participants' homes rather than in a sleep laboratory.

Eighteen volunteer adult participants, who reported that they have been suffering from sleep-onset insomnia for more than a year, are each given a packet of 14 pills and asked to take one each night for 14 consecutive nights, 15 minutes before their usual sleeping time. They are also given a special apparatus to record the time they fall asleep. The apparatus, worn on the body, measures various physiological responses associated with sleep–awake states, has a timing device and has been reported by participants in previous studies as not being uncomfortable in any way.

The participants do not know that they have been randomly allocated to either of two groups. The researcher's assistant is also unaware of the group to which each participant has been allocated. Group 1 has nine participants whose pills are arranged in the pack so that pills 1 to 7 are the new sleeping pills, and pills 8 to 14 look and taste like the sleeping pills but do not contain the sleep-inducing chemical. Group 2 also has nine participants, but their pills are arranged so that pills 1 to 7 are the fake pills and pills 8 to 14 are the new sleeping pills.

The results are shown in the following table.

Table 3.2 Time taken to fall asleep

Group	Mean time (minutes)	
	Sleeping pills	Non-sleeping pills
1	37	64
2	78	31

1 What is the independent variable in the experiment?
2 What is the dependent variable in the experiment?
3 Name the experimental design.
4 Explain the meaning of the term counterbalancing in relation to this experiment.
5 Identify what counterbalancing is used to control in this experiment.
6 Identify the experimental and control groups, if any.
7 Explain the difference between a placebo effect and an experimenter effect in relation to this experiment.
8 Name and describe the procedure(s) used to control placebo and experimenter effects in this experiment.
9 Identify a relevant extraneous or confounding variable that may have affected the results of the experiment.
10 Explain a way in which this variable may have been minimised or controlled in the experiment.

Chapter 3 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each item.

1 ______ Some people never sleep.

2 ______ Sleep can be a purposely induced altered state of consciousness.

3 ______ NREM sleep is often described as paradoxical sleep.

4 ______ REM sleep periods tend to lengthen and occur closer together during a normal night's sleep.

5 ______ An electro-oculargraph can detect and record eye position.

6 ______ The total sleep time in old age averages about eight hours.

7 ______ About 75% of a child's sleep is REM sleep.

8 ______ Slow wave sleep is rarely experienced by people aged 90 years or older.

9 ______ REM rebound involves microsleeps that enable recovery of lost REM sleep.

10 ______ The observation that people consistently sleep longer after a particularly active day provides support for restorative theories of sleep function.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 3 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 As we drift in and out of sleep at the start of a typical night's sleep, we enter a sleep period known as

A REM sleep.
B NREM sleep.
C slow wave sleep.
D delta sleep.

Q2 Compared with stages 1 and 2 of the NREM sleep period, in stages 3 and 4

A sleep is lighter and it is easier to wake the sleeper.
B theta waves are more common.
C muscle tone, heart rate, blood pressure and body temperature all increase.
D delta waves are more common.

Q3 With each complete progressive sleep cycle throughout the nightly sleep of an adolescent,

A duration of REM sleep increases.
B duration of NREM sleep increases.
C duration of REM sleep decreases.
D the brain becomes less active.

Q4 The most accurate physiological measure for distinguishing between the different stages of NREM sleep is

A the pattern of brain wave activity.
B the presence or absence of rapid eye movements.
C sudden changes in heart rate and muscle tone.
D changes in body temperature.

Q5 The effects of partial sleep deprivation impairing daily functioning are best explained in terms of

A proportions of REM and NREM sleep.
B external cues in the environment.
C biologically induced hormones.
D accrued sleep debt.

Q6 A mix of alpha and theta brain waves is most commonly observed during _____ sleep.

A REM
B REM stage 1
C NREM stage 2
D NREM stage 3

Q7 Which of the following is **not** true of REM sleep?

A During the night, REM sleep lengthens in duration.
B During the night, REM sleep occurs after an NREM sleep cycle.
C Muscle tone increases during REM sleep.
D REM follows the lightest stages of sleep.

Q8 Studies indicate that, on average, the amount of nightly sleep required in adolescence is about _____ hours.

A 6.5
B 7
C 9
D 10–12

Q9 Which of the following can be used to collect self-reports when studying sleep?

A video monitoring
B sleep diaries
C experiments
D polygraphy

Q10 A researcher conducted an experiment to test whether sleeping immediately after learning improves memory of the learned information. On the first evening of the experiment, volunteer non-Spanish-speaking participants were required to learn a list of Spanish words. They were then allowed to sleep for an hour. On awakening, they were asked to recall as many of the words as they could. On the second evening, the same participants learnt a new list of Spanish words. They then watched a television program for an hour, after which they were asked to recall as many of the words as they could.

The research design of this experiment is best described as

A repeated-measures.
B independent-groups.
C mixed-participants.
D matched-participants.

Q11 In a subsequent experiment investigating the effect of sleep on learning, half of the participants attempted condition 1 on the first day (sleeping after learning the Spanish words), then condition 2 on the second day (watching television after learning the Spanish words). The other half of the participants attempted condition 2 on the first day, then condition 1 on the second day.

The experimenter used _____ to control _____ .

A order effects; counterbalancing
B counterbalancing; order effects
C single-blind; order effects
D order effects; confounding

Q12 Someone who has been sleep-deprived for a prolonged period of time is likely to _____ than they would when not deprived of sleep.

A make more errors on all types of tasks
B make fewer errors on simple, boring tasks
C make more errors on complex or interesting tasks
D make more errors on simple, boring tasks

Q13 Which stage or period of sleep is characterised by brain wave activity consisting mainly of theta waves?

A REM sleep
B NREM stage 1
C NREM stage 2
D NREM stage 4

Q14 A sleep researcher is recording details of Elka's sleep patterns in a sleep laboratory. Elka's EEG recording shows that she is currently experiencing low-frequency, high-amplitude delta waves. Her EOG shows no sign of activity. The researcher can hear Elka talking, but cannot make out what she is saying.

Elka is most likely experiencing

A REM sleep.
B muscle paralysis.
C NREM stage 2 sleep.
D stage 4 sleep.

Q15 Which of the following statements is **true** of sleep deprivation?

A Sleep deprivation has no psychological effects.
B Sleep deprivation affects one's ability to perform cognitive tasks.
C Sleep deprivation has lasting physiological effects.
D The effects of sleep deprivation disappear only after the individual has slept for the same amount of time they were sleep-deprived.

The answers to the Chapter 3 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

The procedure for simultaneously monitoring and recording various physiological responses during an intensive study of sleeping person is called ______________________________.

1 mark

Question 2

An ______________________________ is used to collect data on muscle tone and activity, whereas an ______________________________ is used to collect data on eye movements and position.

2 marks

Question 3

Identify two distinguishing characteristics of a microsleep.

____

____

____

____

2 marks

Question 4

What is REM rebound and when does it occur?

2 marks

Question 5

Name and describe two different theories on the purpose of sleep.

3 marks

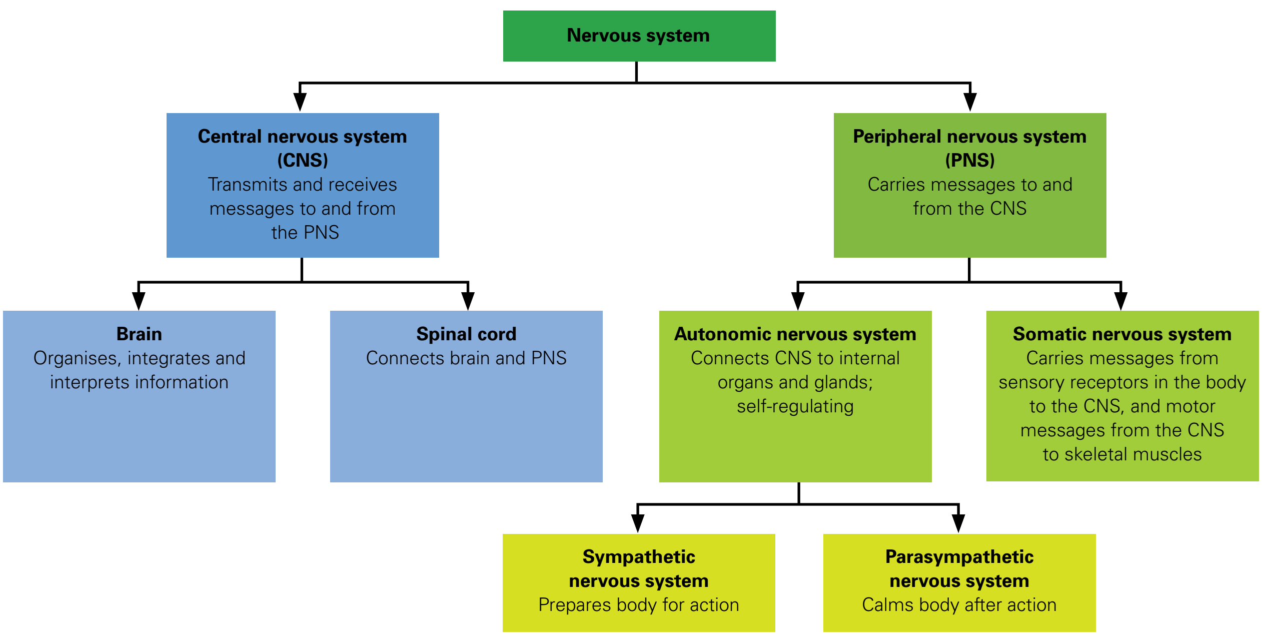
The answers to the Chapter 3 short-answer questions are available at www.OneStopScience.com.au.

4 The central nervous system

The human nervous system is a complex combination of neurons that enables the brain to obtain information about what is going on inside and outside the body and to respond appropriately. Our nervous system can be organised into different divisions, or branches, on the basis of the main functions carried out by each division. The central nervous system is one of the two major divisions of the human nervous system; the other major division is the peripheral nervous system. The **central nervous system (CNS)** comprises the brain and the spinal cord. The spinal cord connects the brain and the peripheral nervous system. The **peripheral nervous system (PNS)** includes all parts of the nervous system that lie outside the brain and the spinal cord. It links the central nervous system to all other parts of the body, carrying messages to and from the central nervous system. If we think of the brain as the central business district of the nervous system and the peripheral nervous system as a network of roads that carry neural messages, both incoming and outgoing, then the spinal cord provides the 'on and off ramps' for messages to enter and exit the central nervous system.

In this chapter we focus on the roles of the central nervous system in mental processes and behaviour. We examine the roles of the peripheral nervous system in the next chapter.

Figure 4.1 Organisation of the human nervous system



The brain

Consider what your brain is doing as you read this passage of text. In order to read, symbols are seen on the page, organised into words, and the words are connected with meanings from memory. Then the meanings are combined to form thoughts and interpretations. While you focus your attention on reading, you are less aware of any background sounds, such as the whispers of people around you, footsteps of someone outside the room or the ticking of the clock. In addition, you are less aware of other types of sensory information, such as the pressure of your bottom on the seat and where your arms and legs are. Once you pay attention to any of these, you will become fully aware of them and your brain will start processing that information in some way.

In addition to processing the information you are reading, your brain is also performing numerous other functions to keep you alive, such as ensuring that your heart beats, that you breathe, and that your digestive system processes any food you have eaten. These are activities that you are generally unaware of. Your brain sends and receives messages through its nervous system via the spinal cord to control your breathing, maintaining just the right amount of oxygen in your bloodstream,

Figure 4.2 The human brain has a complex structure and is responsible for virtually everything we think, feel and do.

as well as adjusting your blood pressure to keep fresh oxygenated blood flowing throughout your entire body. Your brain continuously monitors and regulates almost all of the internal conditions in your body. For example, it regulates the nutrient content in your bloodstream, which provides one of the signals to eat again. It also regulates your body temperature, the amount of water your body needs to stay in chemical balance, the activity of the endocrine system that secretes hormones into your bloodstream and, among other things, it helps regulate the normal functioning of your bodily processes and influences your growth, moods and response to stress (Bloom, Nelson & Lazerson, 2001).

The brain is often referred to as the 'master' organ as it is responsible for virtually everything you think, feel and do. Consequently, the answers to many questions about our behaviour and mental processes are linked to physical and biological processes involving the brain.

The human brain is encased in a hard protective skull and weighs, on average, about 1.5 kg in adults. It has the consistency of firm jelly and is covered by a strong plastic-like membrane. There is a small gap between the brain and the skull, which is filled with fluid. The fluid provides a cushion against knocks to the head, protecting the brain from damage unless the knock is quite hard. For such a compact organ, the brain has a complex structure of billions of *neurons* and trillions of connections between the neurons. These connections form 'circuits' or pathways that enable transmission of information between neurons (called *neurotransmission*) and therefore throughout the brain.

Within the brain, neurons are organised into many identifiable structures and areas. It was once believed that particular parts of the brain were entirely responsible for specific functions. However, it is now well understood that the functions performed by specific structures or areas of the brain are so interrelated that to study one brain structure or area in isolation misrepresents the complexity of how the entire brain functions. For example, the apparently simple task of naming a familiar object, such as a pen or pencil, triggers activity in many structures and areas of the brain. These include areas involved with vision (to process visual information received from the eyes), memory (recovering the correct information for identification) and language (for stating the name of the object). However, for study purposes, we tend to focus on each area, or region, of the brain separately because to examine several areas at once is often too complicated.

The cerebral cortex

The cerebral cortex is one part of the brain that many people can easily recognise. It is recognisable as the convoluted (folded) outer layer or covering of the two cerebral hemispheres ('halves') of the brain (see figure 4.2). Like a screwed-up piece of paper, the cerebral cortex bends and folds inwards so that its surface area (about 0.25 m^2) can fit into the limited amount of space available in the skull. If it were flattened out, the cerebral cortex would cover about four pages of this textbook. Although it is only about 2–4 mm thick, the cerebral cortex contains about three-quarters of the entire brain's neurons (Hubel & Weisel, 1979). Only one-third of the cerebral cortex is visible when looking from outside the brain. The rest of it is hidden within the many wrinkles and folds (Bloom, Nelson & Lazerson, 2001).

The **cerebral cortex** is involved with information-processing activities such as perception, language, learning, memory, thinking and problem-solving, as well as the planning and control of voluntary bodily movements. For example, it is involved whenever you read; speak; learn; estimate time; recognise a favourite tune; experience an emotion; recall an answer to a test question; plan what you will do during the weekend or next year; make a decision; assign meaning to specific sights, sounds, smells and sensations; daydream; appreciate a new song; catch a tennis ball; go for a jog; or play basketball.

Some areas of the cerebral cortex are dedicated to specific functions. For example, the *primary visual cortex* is almost entirely involved in receiving and processing visual information from the eyes. Most areas of the cerebral cortex, however, do not have such specific functions. Instead, they perform multiple functions, often integrating (combining) information from other areas of the cortex and from other structures within the brain, enabling us to think, feel or behave in the required ways. The areas of the cerebral cortex and their main functions can be organised into three broad categories: the various *sensory cortex* areas, which receive and process information from our different senses; the *motor cortex* area, which receives, processes and sends information about voluntary bodily movements; and *association cortex* areas, which integrate sensory, motor and other information and are involved in the more complex mental abilities, such as perceiving, thinking and problem-solving.

It is believed that the size of a species' cerebral cortex is linked to intellectual ability. For example, the bigger the cerebral cortex, the more capable that organism is of behaviour we regard as intelligent, such as thinking, problem-solving and decision-making. And, therefore, the better it is able to survive due to its superior ability to learn and adapt to a complex and changing environment. Frogs, turtles and fish have no cerebral cortex at all. Rats and mice have a tiny cortex; dogs and cats also have relatively small cortices. But primates such as chimpanzees and humans have a much greater proportion of cortical area. As shown in figure 4.4, the amount of association cortex in the cerebral cortex increases noticeably from simpler

Figure 4.3 A close-up of a human brain's cerebral cortex. The protective membrane has been removed to reveal the detail of the bulges and grooves that account for the increased amount of cortex in humans.

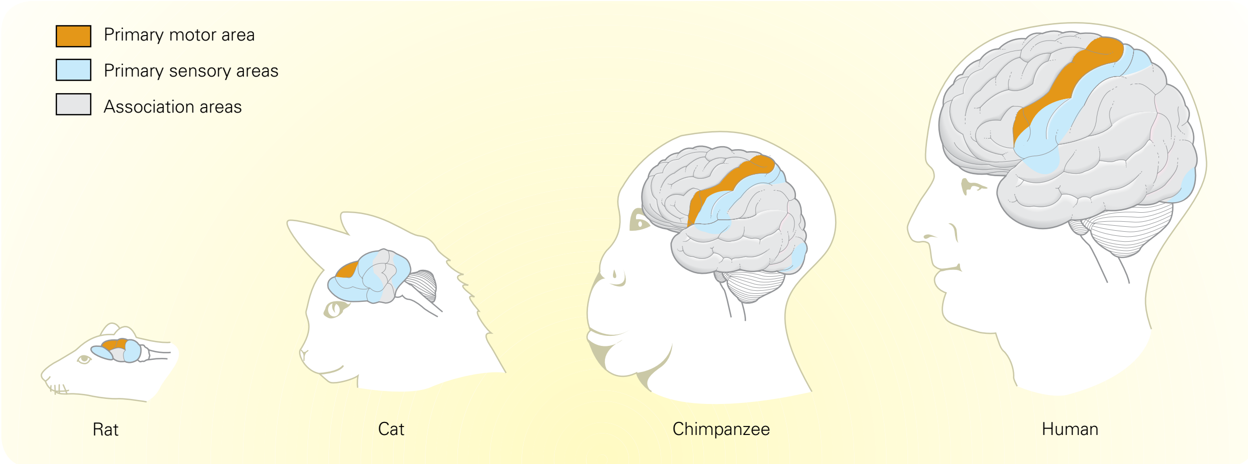


Figure 4.4 A comparison of the brains of four mammals. Note that the more complex mammals (humans and chimpanzees) have a greater amount of cerebral cortex (particularly association cortex) than do the simpler mammals (rats and cats).

(or 'lower order') mammals, such as the rat and cat, to more complex (or 'higher order') mammals, such as the chimpanzee and human.

While it may appear that much is known about *what* functions are performed by the cerebral cortex, there is still much to learn about *how* these functions are performed. For example, although it is known that memory is associated with cerebral cortex activity, it is not fully understood how the brain goes about locating and retrieving a specific memory. Nor is it known exactly how specific memories are stored or how apparently new ideas are generated, even though these are often linked to memories.

Learning Activity 4.1

Review questions

1. What is the central nervous system and what are its main roles in mental processes and behaviour?
2. What are the main functions of the cerebral cortex?
3. Where is the cerebral cortex located?
4. Of what does the cerebral cortex mainly consist?
5. Name the three different categories of cortical areas and briefly describe the functions performed by each of these areas.
6. Describe the relationship between the size of the cerebral cortex and the mental capabilities of an organism.

Cerebral hemispheres

The cerebral cortex is described as having two 'halves', called cerebral hemispheres (see figure 4.5). The **cerebral hemispheres** are two almost-symmetrical brain structures that appear to be separated by a deep groove (known as the *longitudinal fissure*) running from the front to the back of the brain. However, the hemispheres are not completely separated; they are connected at several points by strands of nerve tissue. The largest and most important of these strands is a bundle of nerve fibres called the *corpus callosum*. The two different hemispheres are referred to respectively as the left hemisphere and the right hemisphere.

The left and right hemispheres not only appear to be alike in overall size, shape and structure, but they also have many of the same functions. Furthermore, the particular part of the hemisphere responsible for each of these functions is located in approximately the same place in each hemisphere. For example, each hemisphere has motor and sensory areas that perform the same motor and sensory functions, each for a different side of the body. The left hemisphere receives sensory information from the *right* side of the body and controls movements on the *right* side. The right hemisphere receives sensory information from the *left* side of the body and controls movements on the *left* side. In addition to the hemispheres having common functions, each hemisphere

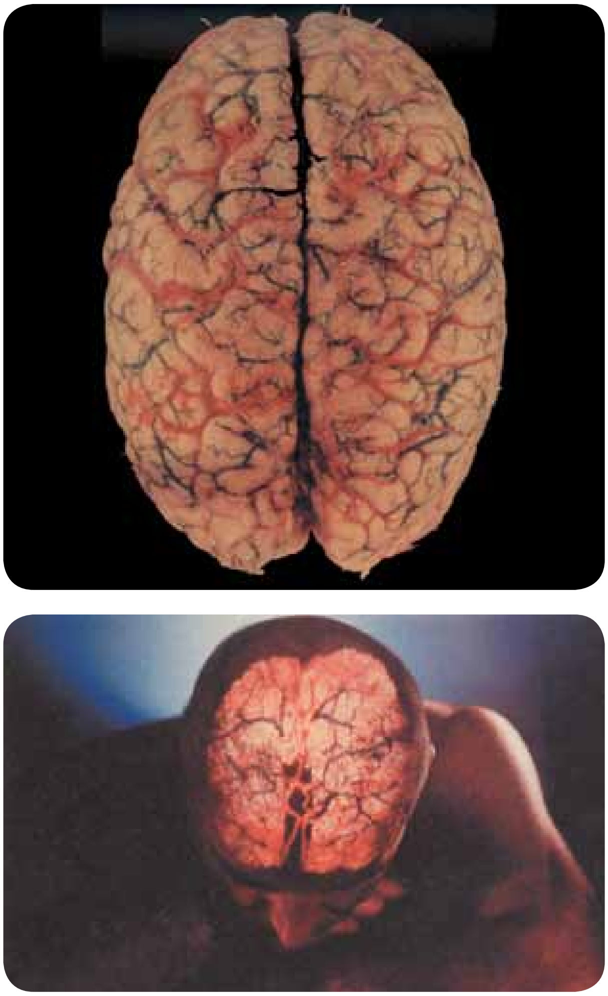


Figure 4.5 When viewed from directly above the top of the head, only the cerebral cortex covering the two cerebral hemispheres is visible. The two hemispheres are alike in size, shape and structure. While they appear to be two completely separate parts of the brain, they are connected by strands of nerve tissue enabling them to communicate and thereby function in a coordinated way.

also has specialised functions. For example, human language is primarily a function of the left hemisphere, and the right hemisphere is primarily involved in many functions that are not dependent on language, such as spatial and visual thinking and the recognition of faces and tunes.

Corpus callosum

Although there is considerable research evidence that supports specialisation in each of the hemispheres and greater control or 'dominance' of one hemisphere in certain functions, the two hemispheres do not function independently. Both hemispheres are involved in virtually everything we think, feel and do, exchanging information and functioning together in an interactive, coordinated way. The interaction between the hemispheres occurs mainly through the corpus callosum.

The **corpus callosum** is a band of nerve tissue that connects the left and right cerebral hemispheres and serves as the main communication pathway between them (see figures 4.6 and 4.7). Its function is one of a 'bridge' for neural messages between the two cerebral hemispheres. Its many millions of nerve fibres each cross over from one hemisphere to the other, interconnecting corresponding areas of the cerebral cortex. In this way, information can be exchanged between the two hemispheres when performing their many functions as we think, feel and behave in everyday life. However, it is not the only nerve connection between the hemispheres. There are other nerve fibres as well.

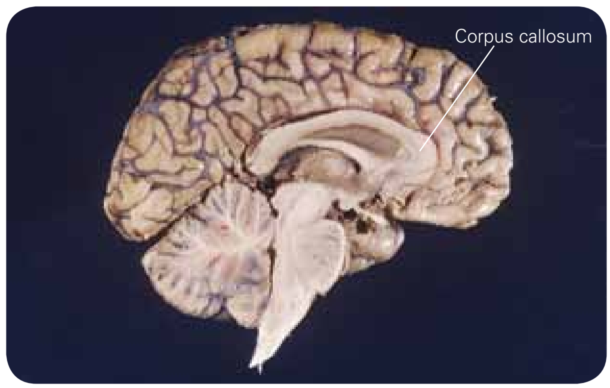


Figure 4.6 Deep in the brain, the corpus callosum, which measures about 10 cm in length and 0.75 cm in thickness, is a bundle of nerve tissue (comprising about 200 million nerve fibres) that connects the two hemispheres.

Figure 4.7 Corpus callosum

Learning Activity 4.2

Review questions

1. a What is a cerebral hemisphere?
   b Briefly describe three key characteristics that the cerebral hemispheres have in common.
2. a What is the corpus callosum?
   b Where is the corpus callosum located?
   c What key function is performed by the corpus callosum?
3. Suggest the possible impact on mental processes and behaviour if the corpus callosum were to be cut in two and it was no longer an intact 'bridge'. Explain your answer.

Four lobes of the cerebral cortex

The cerebral cortex of each hemisphere can be divided into four anatomical regions called cortical lobes. **Cortical lobes** are areas of the brain associated with different structures and functions. The four lobes are named after the bones of the skull that cover them: the *frontal lobe*, the *parietal lobe*, the *occipital lobe* and the *temporal lobe* (see figure 4.8).

The lobes contain areas of cortex that have specialised *sensory* or *motor* functions, as well as areas of cortex generally referred to as association cortex. Within the **association cortex** are different areas commonly called association areas. Each association area has one or more functions that typically involve integrating information from sensory, motor and other brain areas or structures to enable us to think, feel and behave as we do.

The **sensory areas** of the lobes receive and process information from sensory receptors in the body. Sensory receptors are specialised neurons that detect and respond to a specific type of sensory information. For example, there are specialised sensory receptors for detecting and responding to each type of sensory information from the environment (such as for vision and for hearing) and sensory receptors for sensory information from the body (such as touch, temperature and muscle movement). Sensory receptors also convert the 'raw' sensory information into neural ('nerve') impulses and transmit it to the sensory areas in the brain via neural pathways (nerves) where it is processed. Different sensory areas are located in different lobes of the brain. The sensory area that receives and processes visual information is called the *primary visual cortex*. The primary visual cortex is located in the occipital lobe. Auditory information, processed in the *primary auditory cortex*, is located in the temporal lobe. Sensory information from the skin (about pressure and temperature) and from skeletal muscles (about movement) is processed in the *primary somatosensory cortex*, located in the parietal lobe. Sensory information is transmitted initially to the primary sensory area specific to that sense.

The **motor areas** receive and process information about voluntary bodily movements; that is, intentional movements such as when you scratch your nose or pick up a pen and write. There is only one primary motor area in the brain. This is called the *primary motor cortex* and it is located in the frontal lobe. The primary motor cortex controls our movements by sending neural messages to various parts of the body to make them move in the required way.

The **association areas** of each lobe integrate information from different brain areas and are mainly involved in complex cognitive (mental) processes such as perceiving, thinking, learning, remembering, reasoning and so on. Unlike the sensory and motor areas, association areas do not

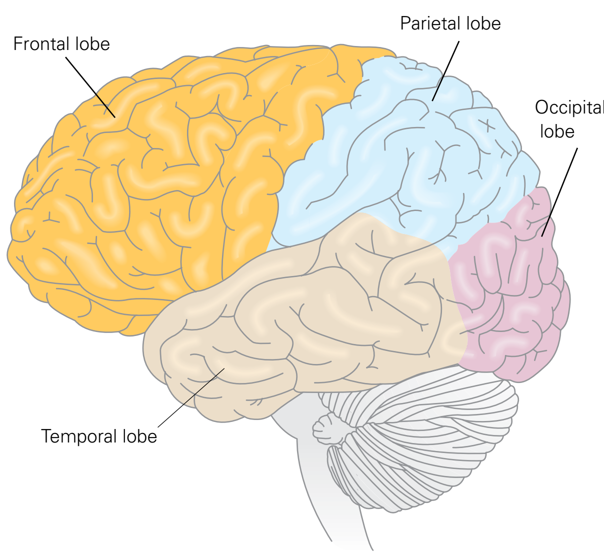


Figure 4.8 The lobes of each cerebral hemisphere

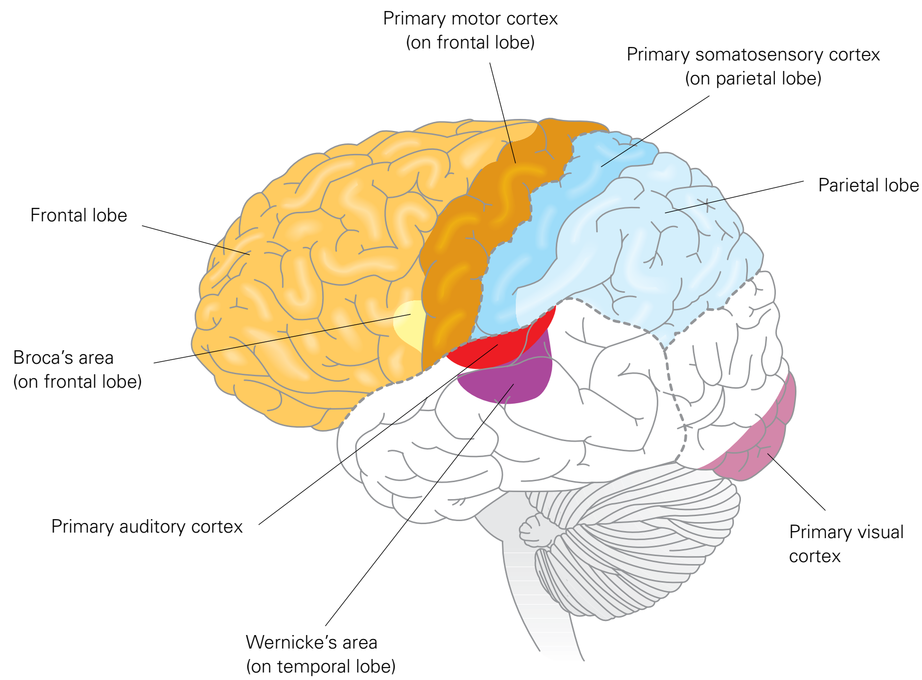


Figure 4.9 Each cortical lobe has areas that specialise in receiving and processing sensory or motor information. There are also association areas that integrate sensory, motor and other information for complex mental processes.

have any specialised sensory or motor function. Association areas are located in all four lobes of each hemisphere and may receive and process information from sensory and/or motor areas, as well as from other structures or other association areas of the brain in other lobes.

The frontal lobe

The **frontal lobe** is the largest of the four lobes and occupies the upper forward half of each cerebral hemisphere, right behind your forehead (see figures 4.8 and 4.10).

Located at the rear of each frontal lobe and running roughly across the top of your head is a strip of neural tissue called the primary motor cortex (see figures 4.9 and 4.11). The **primary motor cortex** is specifically involved in controlling voluntary bodily movements through its control of skeletal muscles. Skeletal muscles are attached directly to bones and include the hand, arm, leg, back and facial muscles. Your skeletal muscles are involved when you smile, wiggle your toes, nod your head and bend to sit in a chair.

The primary motor cortex in the *left* frontal lobe controls voluntary movements on the *right* side of the body. Likewise, the primary motor cortex in the *right* frontal lobe controls voluntary movements on the *left* side of the body. As shown in figure 4.12, a different area along the primary motor cortex is involved with the movement of each specific body part. For example, a specific area of the cortex in the left frontal lobe controls movement of the thumb on the right hand. Similarly, a specific area of the cortex in the right frontal lobe controls movement of the left leg, and so on. The amount of cortex devoted to a particular body part corresponds to the complexity, or 'fineness', of its movements. For example, parts that we are able to move with the greatest precision (such as the fingers and tongue) take up more cortical space than parts over which we have less control (such as the shoulder and thigh).

In the forward section of each frontal lobe are association areas that receive information from other lobes to enable us to perform complex mental functions. These association areas are involved when you plan to go out with your friends, when you estimate whether you have enough time to shower and change before someone arrives, when you have to decide which of two items of clothing is the best value for money and when you have to consider the meaning of a term such as ‘justice’ or ‘globalisation’ for an essay. The frontal lobes are also involved with attention, personality, the control of emotions and expression of emotional behaviour. Some psychologists refer to the frontal lobe as having an ‘executive’ role in our thinking, feeling and behaving. This is because it is the end point for a lot of the sensory information received and processed in the other lobes. Furthermore, the frontal lobe coordinates many of the functions of the other lobes, and determines many behavioural responses.

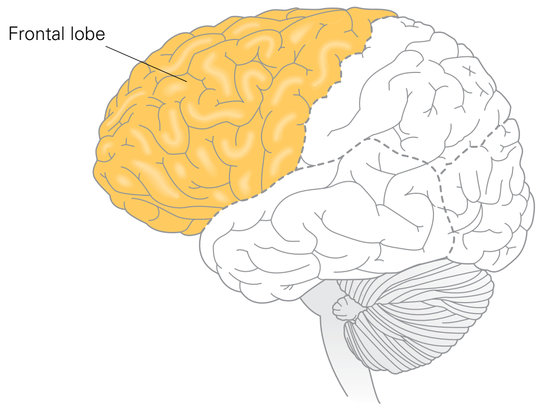


Figure 4.10 The frontal lobe

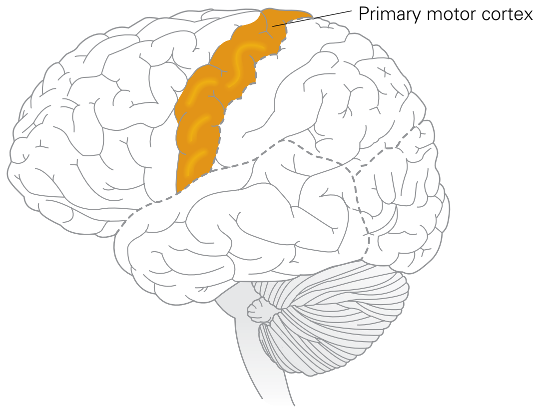


Figure 4.11 The primary motor cortex

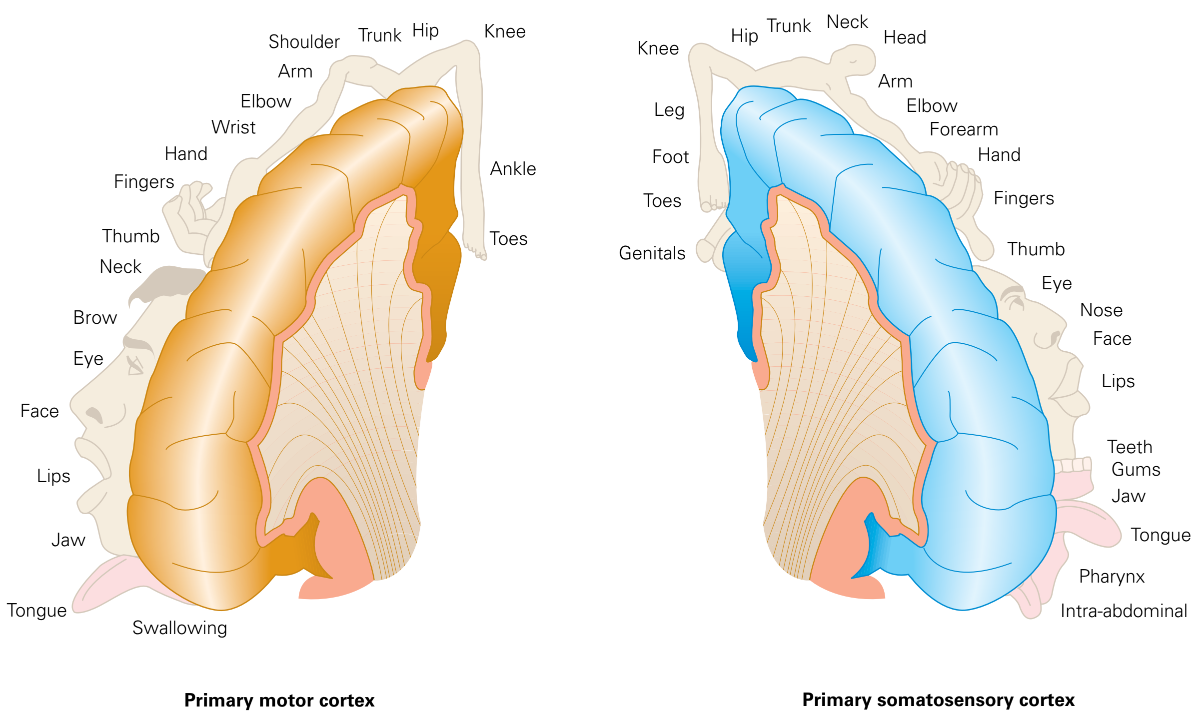


Figure 4.12 This diagram shows the organisation of the primary motor cortex and the primary somatosensory cortex. The primary motor cortex sends information to control voluntary movements of skeletal muscles. The primary somatosensory cortex receives and processes information from the body senses. Both cortices have areas associated with specific body parts and proportionally more cortical area is devoted to the more finely tuned and sensitive body parts than to other parts. Furthermore, the lowermost parts of the body are located on the uppermost areas of each cortex, and vice versa.

Learning Activity 4.3

Mapping the primary motor cortices

Make a copy of the left primary motor cortex in figure 4.12 using transparent paper. Use this traced copy to make a copy of the left primary motor cortex in your workbook and next to it, a copy of the right primary motor cortex (by using the reverse side of the traced copy).

Use arrows to identify the specific area(s) of the left and right primary motor cortices that would initiate each of the following voluntary movements:

- bending your right arm
- wriggling the toes on your left foot
- opening your mouth for the dentist
- sucking on your thumb
- winking with your right eye
- clenching your left fist
- kissing
- crossing your legs
- bending your right knee to walk up a step
- talking.

Learning Activity 4.4

Applying your knowledge of the primary motor cortex

Suppose you mapped the primary motor cortex of an orangutan. What would you expect to find with regard to the distribution of body parts in this cortical area? Explain your answer with reference to the proportion of the primary motor cortex likely to be occupied by four different body parts, including the arms and legs.

Broca's area

A specific cortical area located in the *left* frontal lobe next to the motor cortex areas that control the muscles of the face, tongue, jaw and throat is an area called Broca's area (see figure 4.14). It is roughly in front of, and slightly above, the left ear.

Broca's area has a crucial role in the production of articulate speech; that is, speech that is clear and fluent. In particular, Broca's area is involved with coordinating movements of the muscles required for speech and supplying this information to the appropriate motor cortex areas. If you were to read this section of text aloud, Broca's area would have an important role in coordinating

Figure 4.13 Broca's area is named after Paul Broca (1824–1880), a French doctor whose study of brain-damaged patients led him to identify in 1861 a relatively small area in the frontal lobe of the left cerebral hemisphere that is involved in the production of fluent speech. Broca's research enabled a better understanding of the role of the brain when we speak.

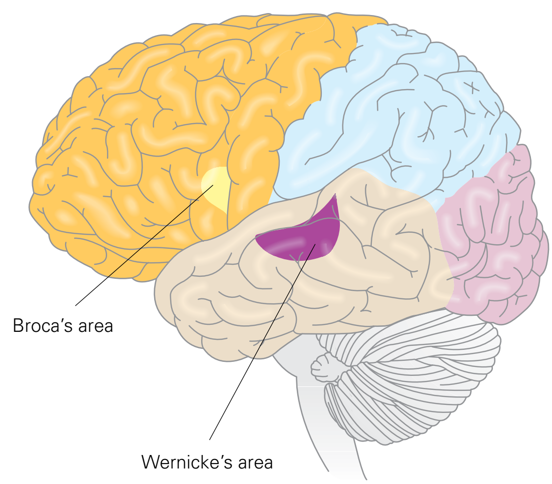


Figure 4.14 Broca's area (speech production) and Wernicke's area (speech comprehension) are both located only in the left cerebral hemisphere. They interact in performing their speech functions, and this is made possible through neural pathways connecting them.

messages to your lips, jaws, tongue and vocal cords to enable you to produce ('say') the words clearly and fluently.

Broca's area is also linked to and interacts with areas of the cerebral cortex that are involved with the meaning of words and the structure of sentences, as well as the specific parts of speech such as adjectives, prepositions and conjunctions. Research indicates that Broca's area is also involved with understanding the grammatical structure of a sentence that is heard or read in order to extract aspects of meaning that depend on that grammatical structure (Gazzaniga & Heatherton, 2006; Thompson, 2000). This becomes apparent with speech impairments that result when Broca's area is damaged.

Box 4.1

Case study: damage to the frontal lobes of Phineas Gage

Phineas Gage, a construction foreman working on a new railway line in the US state of Vermont, was only 25 years old when he suffered a massive head injury that seriously damaged the frontal lobes of his brain. Gage was supervising a crew of workmen in September 1848. In order to remove a large rock in the way of the track, Gage poured gunpowder into a deep, narrow hole drilled into the rock. The gunpowder was packed in tightly with an iron rod before a fuse was lit to ignite it. The rod was more than a metre long, 3.5 cm in diameter and weighed 6 kg. As Gage was packing down the gunpowder, a spark from the rod ignited the gunpowder and blew the rod into Gage's cheek and out through the top of his skull (see figure 4.15). After going through his skull, the rod is said to have landed somewhere between 20 and 50 metres away, depending on which report is read. Gage was pushed backwards and fell to the ground. His body began to shake uncontrollably, but he was still alive. Within minutes of the accident he is reported as sitting up and talking to people near him (Blakemore, 1977). The doctor attending him was able to stop the bleeding, and cleaned out loose bits of brain tissue and bone before dressing the wound.

There was no indication that Gage's mental capabilities had been affected by the accident, despite the frontal lobe damage. However, the once friendly, considerate and quietly spoken Phineas Gage is reported as having become impatient, crudely spoken, aggressive, irresponsible, uncontrollable and hard to get along with. His friends and acquaintances said that he had changed so much he was no longer the person they had known. Twelve years later, at the age of 37, Phineas Gage died.

Gage's doctor, John Harlow (1848), wrote a detailed account of the accident as well as of Gage's condition and symptoms. Years later, when he learned of Gage's death, he petitioned Gage's family to exhume the body and allow him to keep Gage's skull and the rod as a 'medical record'. These are on display in a museum at Harvard University in America.

Nearly 150 years later, American psychologists Hanna Damasio and her colleagues (1994) examined the metal rod and damage to Gage's skull. Using skull measurements and computer imaging techniques, they reconstructed the pathway of the rod to more accurately pinpoint the brain damage (see figure 4.15). Then they searched for case studies of patients with known brain damage in the same area as that of Gage's probable injury. They examined these isolated case study reports and found that Gage's symptoms were consistent with those reported by other patients.

Common among patients with damage to the forward part of the frontal lobes is an unusual collection of emotional, motor and cognitive changes. Emotional changes include a persistent apathy (lack of concern about anything) and lack of emotional responsiveness, including reduced responsiveness to pain and lack of concern for the past or present. However, the patients experience episodes in which this apathy is dramatically broken by bouts of euphoria (extreme excitement), impulsive behaviour, disregard for social conventions, boastfulness, silliness and, sometimes, unrestrained sexual activity. Patients with frontal lobe damage also reveal a range of problems with motor activities. In particular, their overall level of motor activity, especially ordinary, spontaneous movements, is markedly reduced. For example, facial expression becomes blank, and head and eye movements are minimal. Furthermore, some reflexes that are evident only during early infancy, such as the grasping reflex of the hand, reappear. In relation to cognitive abilities, general intelligence—as measured by IQ test performance—shows only slight changes, but forgetfulness is shown in many tasks requiring continual attention. Many case study reports of patients with frontal lobe damage have also emphasised problems with goal-directed behaviour, especially an inability to plan activities and use foresight. Daily activities of these patients seem disorganised and without a clear direction of where these activities are leading or why they are being undertaken (Breedlove, Rosenzweig & Watson, 2007).

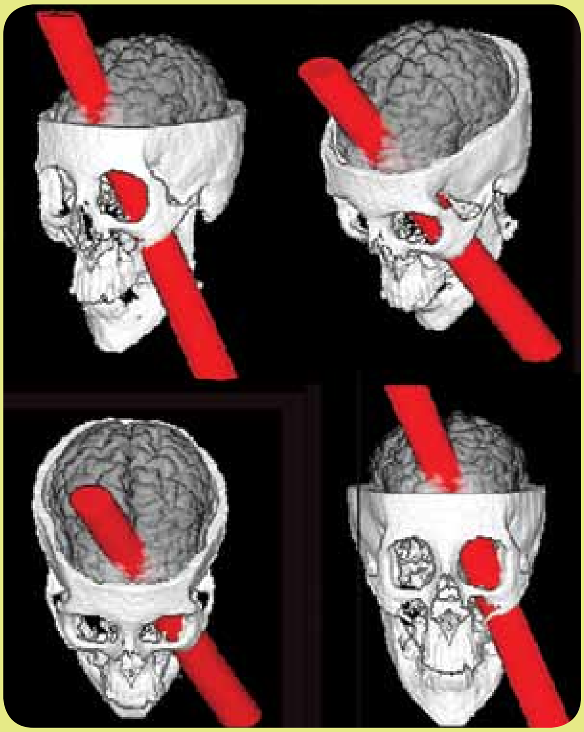


Figure 4.15 This computer reconstruction, based on measurements of Phineas Gage's skull, shows from several different perspectives the brain areas that are most likely to have been damaged in his accident. The red cylinder shows the path of the iron rod, which entered the skull below the left eye and exited through the top of the head, severely damaging both frontal lobes.

Parietal lobe

The parietal lobe is located behind the frontal lobe and occupies the upper back half of the brain, but not the rearmost area (see figure 4.16). The **parietal lobe** in each hemisphere receives and processes sensory information from the body and skin senses (called *somatosensory* information) and other sensory areas in the brain. It also sends information to other areas of the brain.

Located at the front of each parietal lobe, just behind and parallel to the primary motor cortex in the frontal lobe (but separated by a fissure, or 'groove') is a strip of cortex called the primary somatosensory cortex (see figure 4.17). The **primary somatosensory cortex** (also called the *primary sensory area* and *primary sensory cortex*) receives and processes sensory information from the skin and body, enabling us to perceive bodily sensations. This sensory information includes touch, pressure and temperature from sensory receptors in the skin, and information about muscle movement and the position of limbs from sensory receptors in the muscles, tendons and joints.

The primary somatosensory cortex in the *left* parietal lobe receives and processes sensory information from the *right* side of the body. Likewise, the primary somatosensory cortex in the *right* parietal lobe receives and processes sensory information from the *left* side of the body. As shown in figure 4.12 on page 184, different areas of the primary somatosensory cortex are involved with sensations of touch received from specific body parts. Furthermore, the amount of cortex

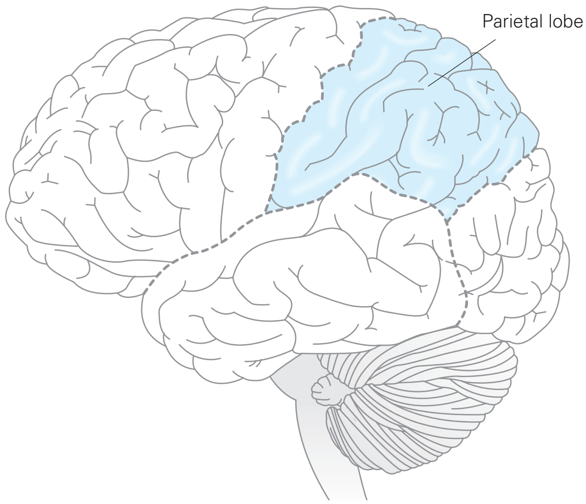


Figure 4.16 The parietal lobe

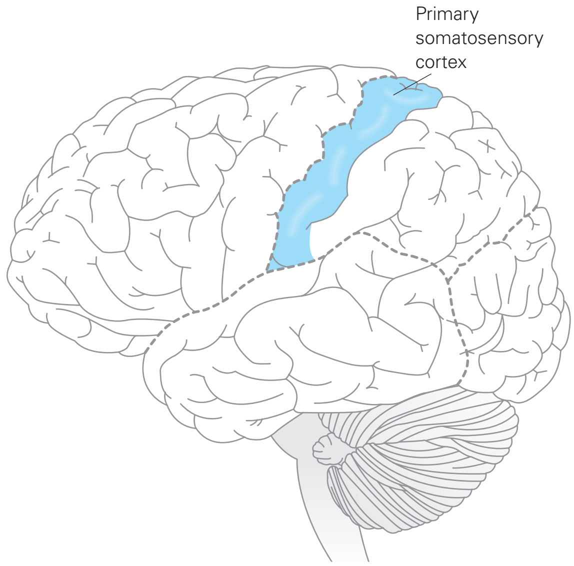


Figure 4.17 The primary somatosensory cortex

devoted to a particular body part corresponds to the sensitivity and amount of use of the body part (Gazzaniga & Heatherton, 2006; Thompson, 2000). For example, your lips, fingers and tongue, which are very sensitive to touch and frequently used in everyday behaviour, have more cortical space than parts that are less sensitive and used less frequently, such as the back of your legs and your hips. The misshapen appearance of the person called *homunculus* shown in figure 4.18 is used to represent the disproportionate areas of primary somatosensory cortex devoted to different parts of the body.

Figure 4.18 This misshapen person (called *homunculus*) represents the body parts in terms of the relative size of the area each body part occupies along the primary somatosensory cortex. Note the disproportionate size of the hands and face.

The parietal lobe also has association areas that receive and integrate information from within the lobe and other structures and areas of the brain. For example, one of the functions of the parietal lobe is to enable us to sense the position of our body in space. In order for this to occur, association areas integrate information about the body's limb positions and movements with information about vision transmitted from the primary visual cortex in the occipital lobe, and sound from the primary auditory cortex in the temporal lobe. Other functions of cortical association areas in the parietal lobe include attention and spatial reasoning; for example, determining where an object is located in the environment. These functions primarily occur in the parietal lobe in the right hemisphere of the brain. Evidence of these functions includes studies of patients with brain damage in the right parietal lobe resulting in 'spatial neglect', as described later in this chapter (Gazzaniga & Heatherton, 2006; Thompson 2000).

Learning Activity 4.5

Demonstration—primary motor cortex and primary somatosensory cortex

The following two activities provide quick ways of helping you understand the sensitivity of your primary motor cortex and your primary somatosensory cortex.

1. *Primary motor cortex.* Try wiggling each of your fingers one at a time. Now try wiggling each of your toes. Note how in figure 4.12 on page 184 the area of your primary motor cortex is much larger for your fingers than for your toes, which relates to the greater sensitivity and more precise control in your fingers.
2. *Primary somatosensory cortex.* Ask a friend to close their eyes. Using a random number of fingers (one to four), press down on the skin of your friend's back for one or two seconds and ask your friend to report how many fingers you are using. Now repeat the same procedure on the palm or back of your friend's hand. Your friend should be much better at guessing the number of fingers used when you're pressing their hand than when you're pressing their back. As in figure 4.12, the area of the primary somatosensory cortex is much larger for the hands than for the back, which is reflected in more sensitivity and greater accuracy of detection for finger pressure on the hand.

Source: adapted from Huffman, K. (2004). *Psychology in action* (7th ed.). New York: John Wiley & Sons.

Box 4.2

Phantom limb syndrome

Many people who have had a limb amputated continue to experience sensations from where their missing limb was originally located. This phenomenon is called *phantom limb syndrome*. Many people report that their limb feels as if still exists and some even report feeling pain in their missing limb. In some cases, phantom limbs are experienced as moving normally or gesturing during conservations as if they really existed, whereas others feel as if they are frozen in position. Such experiences have long intrigued psychologists and a number of explanations have been proposed to account for the phenomenon. Psychologist Vilayanur Ramachandran, a leading researcher on phantom limb syndrome, has proposed that phantom limb syndrome can be attributed to the brain's plasticity—the ability of the brain to change as a result of experience.

Ramachandran stimulated the skin surface in various regions around the face, arms and torso (upper body) while using a neuroimaging device to monitor brain activity in volunteer participants with an amputated limb and a control group of participants who did not have an amputated body part. The brain scans showed somatosensory cortical areas in the brain that were activated when different areas of the body were stimulated by touch.

In one experiment, Ramachandran found that participants with an amputated hand reported that stimulation of their cheek through touch (with a cotton swab) was perceived as if the stimulation was on their now-missing hand. In some cases, this sensation was quite precise. When specific areas of the face were stimulated, participants reported sensations in a particular area, such as just one finger, of the phantom hand.

Furthermore, the scans revealed that stimulating the cheek activated an area in the somatosensory cortex that previously would have been activated by their hand. Both the cheek and hand are represented next to each other in the somatosensory cortex. Following loss of the hand, the adjacent cortical area had both taken over the unused cortex previously representing the hand and also assumed its function. The new face and arm representations were now connected with each other, filling in the space occupied by the hand representation. Through its plasticity, the brain had reorganised itself to compensate for the loss of sensation from the missing hand.

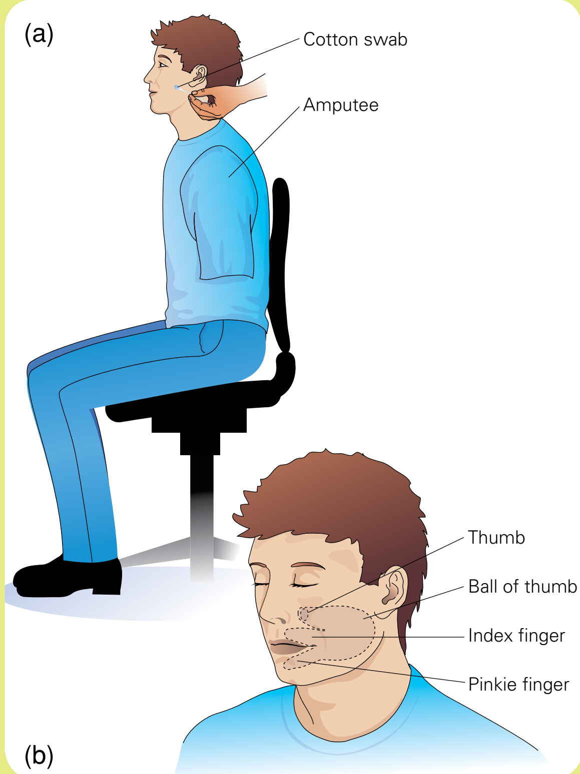


Figure 4.19 Mapping sensations in phantom limbs: (a) the researcher lightly touches the cheek of a participant's face with a cotton swab, thereby eliciting sensations in their now-missing hand; (b) stimulating specific parts of the face can result in sensations in a particular area of the missing hand.

Source: adapted from Schacter, D.L., Gilbert, D.T., & Wegner, D.M. (2009) *Psychology*. New York: Worth, p. 100.

Box 4.3

The sensory world of the platypus

The platypus is an egg-laying mammal that lives in and around streams in eastern Australia (including Tasmania). Because of its ducklike bill and webbed feet, some scientists thought it might be a hoax when the first carcasses were brought to Europe at the beginning of the 19th century.

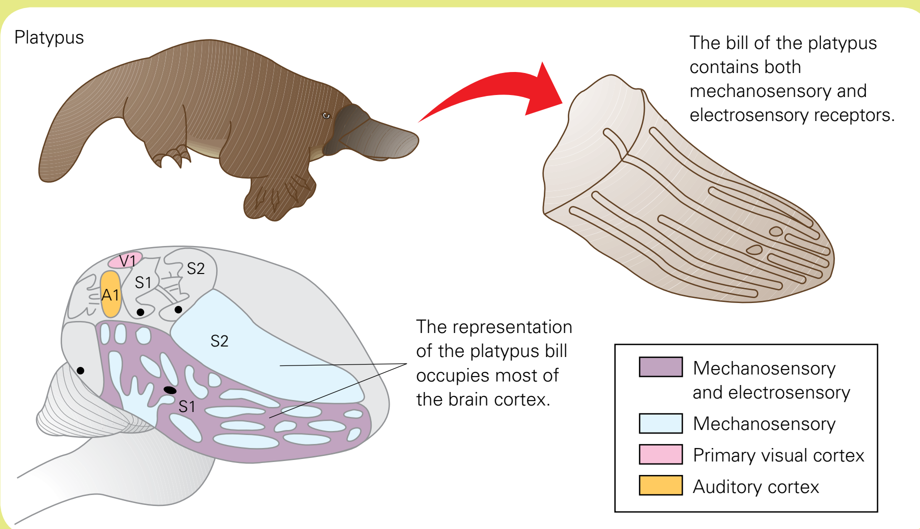


Figure 4.20 The platypus' bill

The platypus is largely nocturnal and dives into murky waters, closing its eyes, ears and nostrils as it hunts for invertebrates including insects, shrimp and crayfish. How it senses its prey remained a mystery until the 1980s, when researchers found that the main sensory organ of the platypus is its bill, which is about 7 cm long in an adult that is 160 cm long. The bill has about 16 longitudinal stripes of receptors: stripes of touch receptors alternating with touch-electrical receptors (see figure 4.20). As the platypus moves its bill underwater, it can detect prey by both the mechanical ripples and the changes in electrical fields they cause. In keeping with the importance of the bill in locating prey, almost all of the primary somatosensory cortex of the platypus is devoted to the bill, and the primary visual area and primary auditory area are small.

Source: adapted from Breedlove, S.M., Rosenzweig, M.R., & Watson, N.V. (2007). *Biological psychology: An introduction to behavioral, cognitive, and clinical neuroscience* (5th ed.). Sunderland, Massachusetts: Sinauer Associates, p. 159.

Box 4.4

Oliver Sacks' case studies on brain-damaged patients

Well-known neurologist Oliver Sacks (1970) has reported many case studies that describe the effects of various types of brain damage in his book and films, such as *Awakenings* (1973) and *The Man Who Mistook His Wife for a Hat* (1985). In one case study, Sacks (1970) described the plight of a man who had damage to an association area of the occipital lobe. The man could still see the basic features of objects, such as colour, edges and movement, and was able to recognise basic geometric shapes such as complex shapes in our everyday world. When the man was shown a rose and asked by Sacks to identify the object, the man responded: 'About six inches in length. A convoluted red form with a linear green attachment. It lacks the simple symmetry of the Platonic solids, although it may have a higher symmetry of its own …' After some time spent continuing to reason about its parts, the man finally guessed that it might be some sort of flower. Sacks then held it under his nose and asked him to smell it. 'Beautiful!' the man exclaimed. 'An early rose. What a heavenly smell!' The man could easily identify the rose by smell but not by sight, even though he could see every feature and describe most of them in considerable detail. According to Sacks, the man was unable to integrate the information because of damage to an association area that would have helped him make the connection between the visual and olfactory (smell) parts of his memory.

In another case study, Sacks (1985) described the case of 'Christina', who had lost the ability to feel the position of her own body. She reported feeling disembodied, like a ghost. For example, on one occasion when she was a patient in a hospital, she became annoyed at a visitor whom she thought was tapping her fingers on a tabletop. But it was actually Christina, not the visitor who was doing it. It was as if her hands were acting on their own and her body was doing things of which she was unaware. Sacks diagnosed Christina as having lost all her sensory feedback about joints, muscles and positions of her limbs. For unknown reasons, the sensory receptors that would normally carry this information to the somatosensory cortex in the parietal lobe were malfunctioning. This case study provided important insights into *kinesthesia*, the sense of knowing where our body parts are in space.

Temporal lobe

The temporal lobe is located in the lower, central area of the brain, above and around the top of each ear (see figure 4.21).

The **temporal lobe** in each hemisphere is primarily involved with auditory perception, but also plays an important role in memory (each lobe contains a *hippocampus*), in aspects of visual perception such as our ability to identify objects and recognise faces, and in our emotional responses to sensory information and memories.

The **primary auditory cortex** in each temporal lobe receives and processes sounds from both ears (see figure 4.22). Each primary auditory cortex has specialised areas that receive and process different *features* of sound and therefore play vital roles in the identification of sounds. The two main features of sound are *frequency* (which we perceive as pitch) and *amplitude* or *intensity* (which we perceive as loudness). If you were listening to classical music, notes with different frequencies (for example, low pitch or high pitch) and amplitudes (for example, loud or soft) would be processed in different areas of the primary auditory cortex. For example, the deep low-frequency sound of a bass drum would be received in a different location on the cortex from the high-frequency sound produced by a flute. Each primary auditory cortex is also specialised to process different *types* of sound. Verbal sounds (such as words) are mainly processed in the primary auditory cortex of the left hemisphere and non-verbal sounds (such as music) are mainly processed in the primary auditory cortex of the right hemisphere. However, this does not mean verbal and non-verbal information is processed exclusively by one hemisphere or the other—there is some overlap.

As with the other lobes, each temporal lobe also has association areas. Different association areas appear to be involved in memory, including linking emotions with memory and determining appropriate emotional responses to sensory information and memories. People with *amnesia* (partial or complete loss of memory) are often found to have damage in either or both temporal lobes. For example, areas of the temporal lobes appear to be responsible for receiving, processing and storing memories of facts (semantic memories), how to do things (procedural memories) and personal experiences such as birthdays and holidays (episodic memories). They are also involved in object identification (that is, determining what an object is) and face recognition. Therefore, the temporal lobes play an important role when we make decisions about those features of our environment that we perceive and remember. Damage to a temporal lobe area as a result of a stroke or severe blow to the head can leave a person with the ability to describe someone's facial features, to identify their sex and to judge their approximate age, but without the ability to recognise the person as someone they know, even if it is their mother.

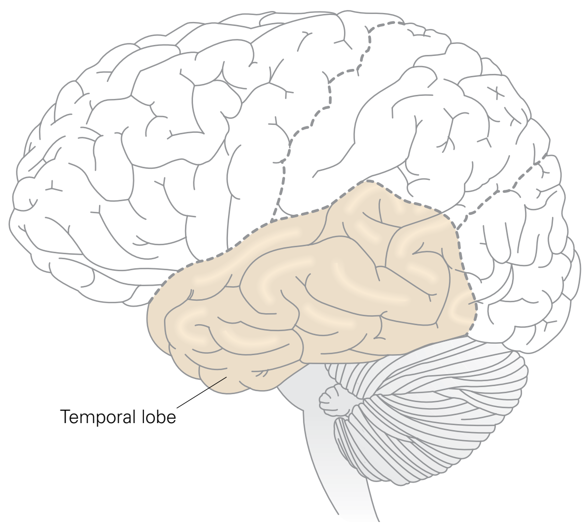


Figure 4.21 Temporal lobe

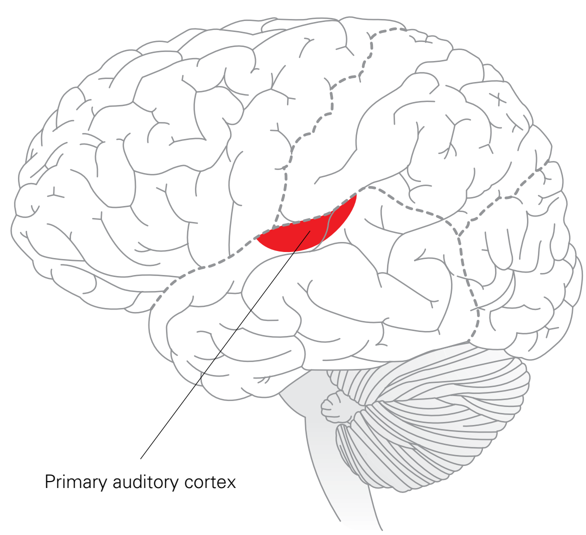


Figure 4.22 Primary auditory cortex

Conversely, damage to another area (such as where the temporal and occipital lobes intersect) can cause specific impairments in recognising people, but not in recognising objects such as houses or cars (Gazzaniga & Heatherton, 2006). This indicates that complex mental functions such as perception and memory are not entirely located in any one specific area, but are represented in many interconnected areas of the entire brain. Face recognition appears to require the temporal lobes (and information from the occipital lobes), but other memory-dependent abilities, such as determining someone's sex or age, do not.

Wernicke's area

A specific cortical area towards the rear of the temporal lobe of the *left* hemisphere only, next to the primary auditory cortex and connected to Broca's area by a bundle of nerves, is called Wernicke's area (see figure 4.24). **Wernicke's area** is also involved in speech production but has a crucial role in the comprehension of speech; more specifically, with interpreting the sounds of human speech. When a word is heard, the auditory sensation is processed by the primary auditory cortex of the left temporal lobe, but the word cannot be understood until the information has been processed by Wernicke's area.

It is thought that Wernicke's area is vital not just for understanding words, but also for locating appropriate words from memory to express intended meanings when we speak or write (Stirling, 2002; Thompson, 2000; Geschwind, 1972). Furthermore, when a word is to be spoken, a 'representation' of it is transmitted to Broca's area in the frontal lobe, which coordinates the muscles needed to produce the sound of the word and supplies this information to the face area located where the temporal and occipital lobes intersect (Gazzaniga & Heatherton, 2006; Thompson, 2000).

Damage to Wernicke's area causes impairment in understanding speech and to speaking.

Figure 4.23 In 1874, German doctor Carl Wernicke (1848–1904) identified an area in the temporal lobe of the left hemisphere that is involved with speech comprehension and speaking in a meaningful way. This observation was based on a post-mortem of one of his patients with a speech comprehension and production problem.

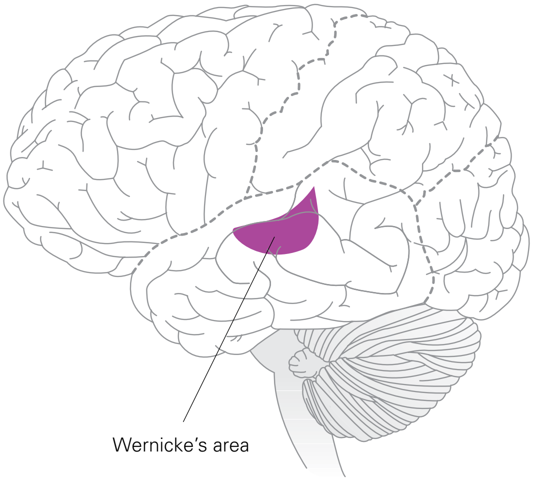


Figure 4.24 Wernicke's area

Box 4.5

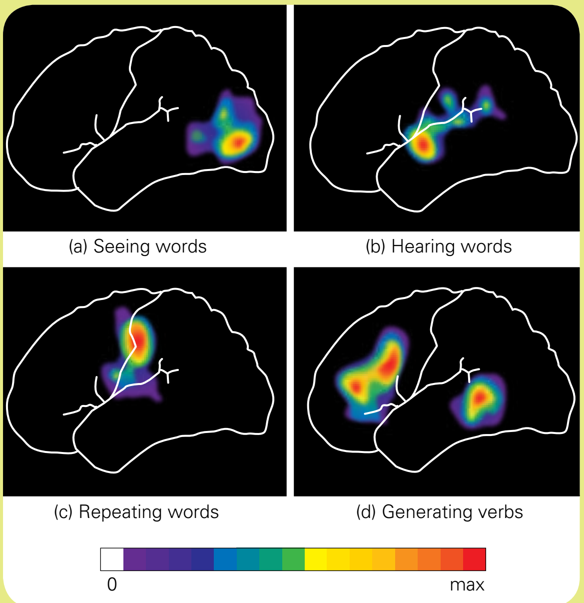
The brain and language

Language is a complex mental ability that involves intricate coordination of many brain areas. An example of the complexity of language is the finding that impairments in language often result from damage to several different cortical areas. Depending on where the damage occurs, a person may be able to speak fluently but be unable to read; or may be able to comprehend what they read but be unable to speak. Others can write but not read, read but not write, read numbers but not letters, or sing but not speak.

We tend to think of speaking and reading, or writing and reading, or singing and speaking simply as variations of the same general ability, but studies of patients with brain damage suggest otherwise.

In 1861, Paul Broca found that damage to part of the left frontal lobe seemed to have caused one of his patients severe problems in being able to form words, although they were quite capable of singing and understanding speech and writing. However, *Broca's area* is just one of the brain areas involved in language. Even in reading this text aloud, there are other areas of the cerebral cortex involved. For example, years after Broca's discovery, it was found that the *angular gyrus*, located towards the bottom of the left parietal lobe, is needed to receive visual information from the visual cortex and to recode it into an auditory form from which *Wernicke's area* (in the left temporal lobe) derives its meaning.

It seems that a number of different areas of the cerebral cortex are activated when language is spoken, seen or heard (see figure 4.25).



Source: Gray, P. (2007). *Psychology* (5th ed.). New York: Worth, p. 164.

Figure 4.25 Brain activity when hearing, seeing and speaking words. This series of side-view PET scans of left-facing patients shows levels of increased brain activity in specific areas: (a) when seeing words—visual cortex and angular gyrus; (b) when hearing words—auditory cortex and Wernicke's area; (c) when repeating words—Broca's area and the motor cortex; and (d) when generating verbs—a more complex language task, activating the most amount of brain. The colours violet, blue, green, yellow and red, in that order, represent increasing amounts of activity.

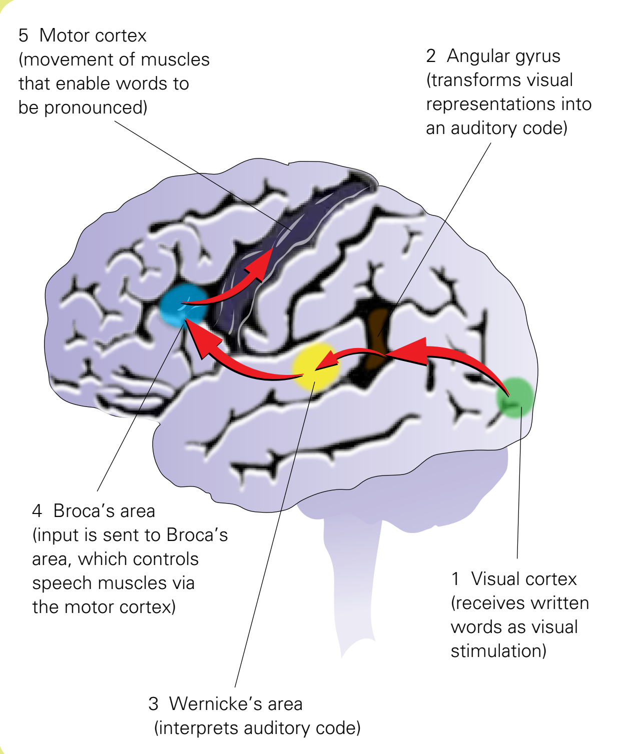


Figure 4.26 Five steps appear to be involved in reading aloud.

Different areas of the cerebral cortex are even activated when we use specific forms of grammar or concepts. For example, in 1985, two women who had strokes both suffered damage to language-related parts of their association cortex. Neither had difficulty with nouns but both had difficulty with verbs. Their respective problems, however, were opposite. One woman could speak verbs but had difficulty writing them, whereas the other woman could write verbs but could not say them. Interestingly, the woman who could speak verbs was able to say 'I watch TV' (where 'watch' is used as a verb), but was unable to say 'my watch is slow' (where 'watch' is a noun). Yet another patient with damage to a different language-related brain area lost the ability to say a particular group of nouns—specifically, the names of any fruit. He could say any noun from *abattoir* to *zoo*, but when it came to the name of a fruit he was 'lost' for words (Hart, Berndt & Caramazza, 1985).

Prominent American neurologist Norman Geschwind (1972) combined many findings from research and formed the following explanation of how we use language. When you read aloud, the words (1) register in the visual cortex; (2) are then relayed to the angular gyrus, which then transforms the words into an auditory code that is (3) received and understood in the neighbouring Wernicke's area, and (4) sent to Broca's area, which (5) directs the action of the motor cortex to create the pronounced word. This pathway from written to spoken word is illustrated in figure 4.26.

Occipital lobe

The occipital lobe is located at the rearmost area of each cerebral hemisphere; that is, at the back of your head (see figure 4.27).

The **occipital lobe** is almost exclusively devoted to the sense of vision. Damage to the occipital lobe can produce blindness, even if the eyes and their neural connections to the brain are normal. Although the occipital lobe is primarily involved in vision, some areas in the other three lobes also have important visual functions (Gazzaniga & Heatherton, 2006; Thompson, 2000).

The occipital lobe is divided into a multitude of different visual areas of which by far the largest is the primary visual cortex. The **primary visual cortex** is located at the base of each occipital lobe and this is the major destination of visual information from the two eyes. The information comes to the primary visual cortex from visual sensory receptors (called photoreceptors) located on the retina at the back of each eye. Each hemisphere receives and processes half of the visual information. The left half of *each* eye (which receives visual sensory information from the right half of the visual field) sends information only to the visual cortex in the left occipital lobe, and the right half of each eye (which receives visual sensory information from the left half of the visual field) sends information only to the visual cortex in the right occipital lobe (see box 4.12).

Neurons in the primary visual cortex and surrounding 'secondary' visual areas are specialised to respond to different features of visual information arriving there; for example, such features as orientation ('direction') of a line, and edges, shape ('forms'), motion and colour. Some neurons respond to specific features (for example, shape *or* colour), while other neurons respond to two or more features (for example, shape *and* colour) (Gazzaniga & Heatherton, 2006).

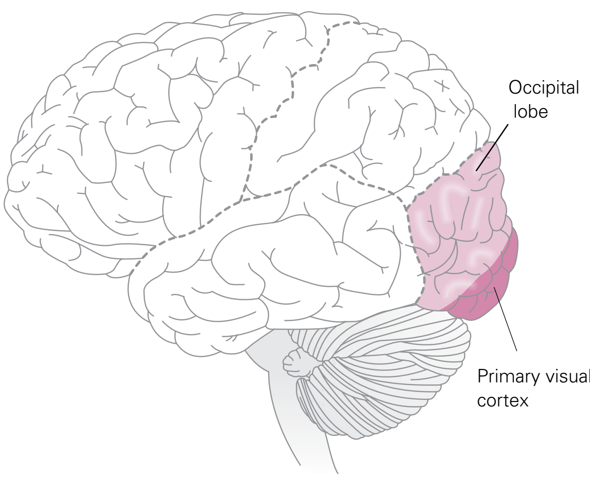


Figure 4.27 Occipital lobe, showing the primary visual cortex

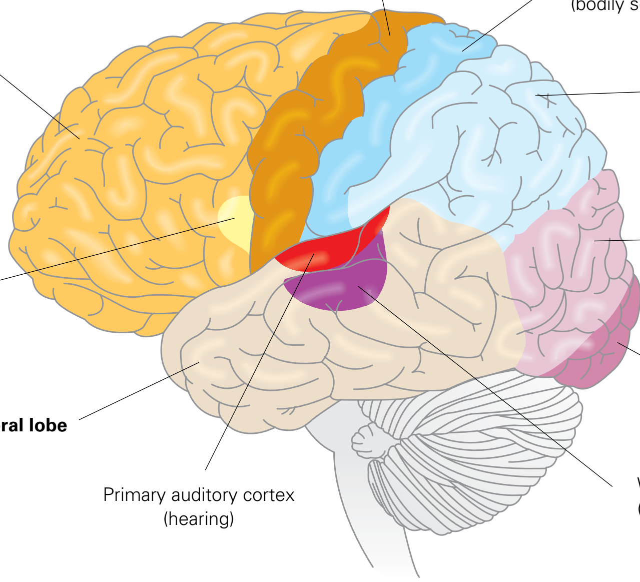


Figure 4.28 The locations of the four lobes, the sensory and motor areas, and areas of the brain involved in speech production and comprehension.

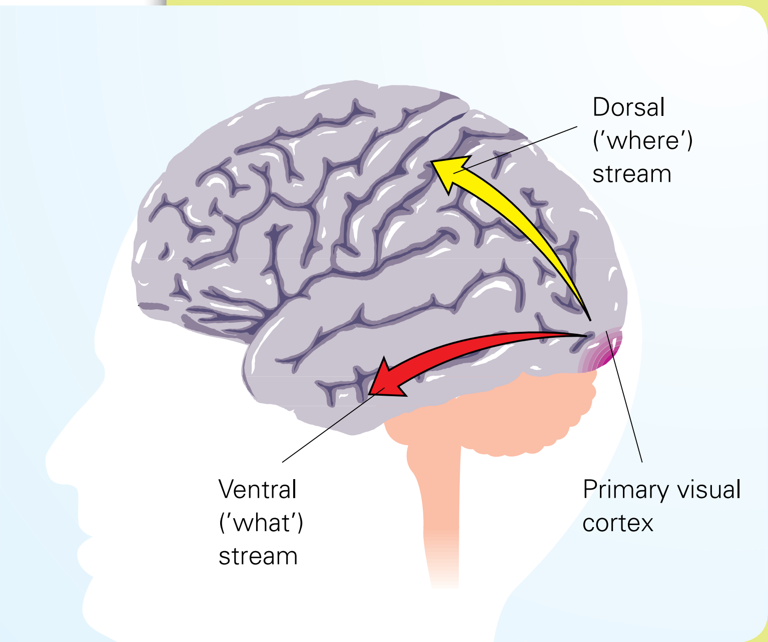
Association areas in the occipital lobes also have important roles in vision. These association areas interact with the primary visual cortex in each occipital lobe to select, organise and integrate visual information. They also interact with association areas in the frontal, parietal and temporal lobes to integrate visual information with other information such as memory, language and sounds. This enables visual information to be organised and interpreted in a meaningful way. For example, the frontal lobe (together with the parietal lobe) is involved in spatial reasoning, such as when you try to work out whether a specific piece of a jigsaw puzzle will fit into a particular place in the puzzle. Furthermore, the parietal lobe is believed to be involved in visual attention and in determining *where* objects are, and the temporal lobe is involved in determining *what* objects are (see box 4.6).

Box 4.6

Pathways to where and what

Psychologists believe that areas other than the visual cortex are also involved in the processing of visual information to enable visual perception. Considerable research evidence suggests that there are two major pathways from the visual cortex in the occipital lobe to areas of the parietal and temporal lobes. The pathways are called the dorsal stream and the ventral stream. The dorsal ('upper') stream includes areas of the occipital lobe and leads to the parietal lobe. The ventral ('lower') stream includes areas of the occipital lobe and leads to the temporal lobe.

Researchers who have investigated these pathways have found that the *ventral stream* (or *pathway*) appears to be specialised for object perception and recognition (that is, identifying objects), and the *dorsal stream* (or *pathway*) appears to be specialised for locating objects,



or spatial perception (that is, determining where an object is and relating it to other objects in a scene). These two processing streams have become known as the *what pathway* and the *where pathway* (Mishkin, 1986). Recent studies using brain-imaging techniques have confirmed that brain areas in the dorsal stream are active when participants perform tasks that require decisions about spatial relationships between objects, whereas areas in the ventral stream are active when participants perform tasks that require identification of objects (Gazzaniga & Heatherton, 2006).

Figure 4.29 Information about particular characteristics of a visual stimulus flow out of the primary visual cortex along numerous pathways. These can be grouped into two general streams: the dorsal stream (or the *where* stream) and the ventral stream (or the *what* stream). The dorsal stream flows to the parietal lobe and the ventral stream flows to the temporal lobe.

Case studies of patients with brain damage to specific areas of the visual cortex provide evidence in support of the differing roles of the ventral and dorsal streams. For example, a patient referred to as D.F. suffered carbon monoxide poisoning at the age of 34 years. The poisoning damaged brain areas involved in the 'what' pathway. D.F. is no longer able to recognise the faces of her friends and family, common objects or even a drawing of a square or circle. Her condition was diagnosed as *object agnosia*, which is the inability to recognise objects. D.F. can recognise people by their voices and, if you place objects in her hands, she can usually say what they are. She does this from memory of voices and her past experience with objects using touch and other senses. Similarly, when presented with a drawing of an apple, D.F. cannot identify or redraw it. But if asked to draw an apple, she can do so from memory.

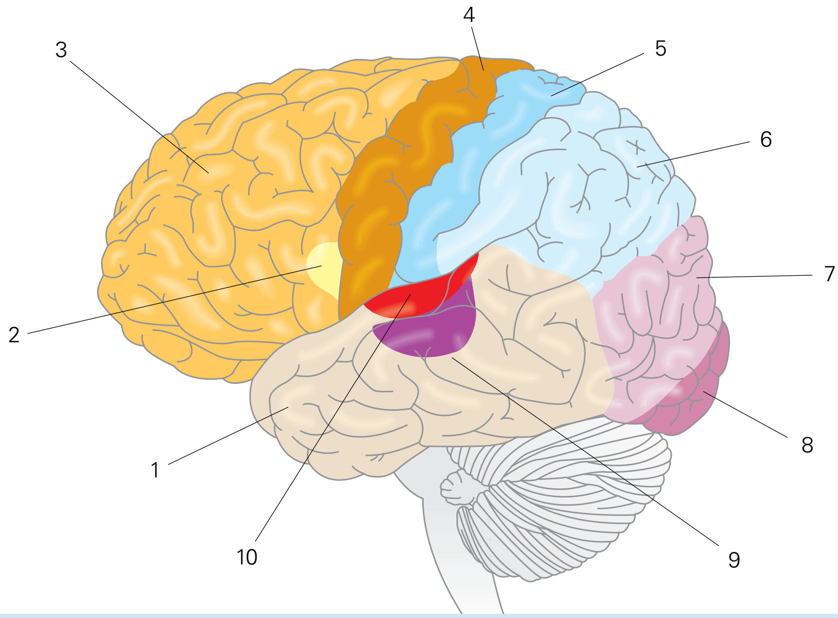
Despite major problems with object perception, D.F. can use visual information about the size, shape and orientation of objects to control visually guided movements. This suggests that her 'where' pathway has not been damaged. For instance, D.F. can walk across a room and step around things without any difficulty. She can also reach out and shake hands as easily as we all do.

Other tests and experiments conducted by neuropsychologists found that D.F. can reach out and grasp a block, with the exact correct distance between her fingers. However, she cannot tell you what she is going to pick up or how big it is. Thus, her conscious perception of objects is impaired; that is, D.F. has no awareness that she is taking in any visual information about objects she sees. However, other aspects of her visual processing are unaffected. The non-damaged parts of D.F.'s visual cortex allow her to use information about the size and location of objects despite her lack of awareness (Gazzaniga & Heatherton, 2006).

Learning Activity 4.6

Brain mapping exercise

Without referring to figure 4.28, correctly label the following key structures and areas of the cerebral cortex by number.



Learning Activity 4.7

Review questions

1 Construct a table that summarises the major functions of each lobe. Ensure that you name the main structures and areas, and include key functions of relevant sensory, motor, association and language areas.

2 Draw a half-page diagram of the brain and divide the brain into four lobes.

- **a** Within each lobe, write three or four key words to summarise key roles of the lobe.
- **b** Most mental processes and behaviours do not exclusively involve any one of the lobes. Demonstrate interaction between the lobes by using arrows on a diagram of the brain to link the lobes in three different roles.

3 Following a head injury sustained in a car accident, Sofia is unable to feel any sensation of touch or temperature in the area of her face between her cheeks and her lower jaw. Fortunately, Sofia did not damage her spine.

- **a** Which brain area is likely to be affected?
- **b** Explain your answer to part (a).
- **c** In which lobe is this area located?

Learning Activity 4.8

An alternative way of localising and summarising brain areas

Inflate a balloon and use a texta to mark the two cerebral hemispheres, the four cortical lobes in each hemisphere, the primary motor and sensory areas, and Broca's and Wernicke's areas.

Hemispheric specialisation

In general, the two cerebral hemispheres appear to be replicas of each other in terms of size, shape and function. While the functions performed by the sensory and motor areas of the left and right cerebral hemispheres are generally the same, each hemisphere also has some specialised functions that are not duplicated in the other hemisphere.

The idea that one hemisphere has specialised functions, or exerts greater control over a particular function, is often described as **hemispheric specialisation**. The terms *hemispheric dominance* and *hemispheric lateralisation* are also sometimes used. Although each hemisphere can specialise or exert greater control in various clearly distinguishable functions, both the left and right hemispheres are actually involved in nearly all functions, usually acting together in a coordinated and interactive way.

The earliest evidence for hemispheric specialisation came from observations of people who had suffered a stroke or an injury affecting one hemisphere but not the other. It was observed that damage to the left hemisphere often resulted in difficulties with language-related activities such as understanding speech, talking fluently, reading and writing. Damage to the right hemisphere often resulted in difficulties with visual and spatial tasks; that is, tasks not dependent on language, such as reading a map and interpreting geometric shapes. Visual and spatial skills generally involve the ability to mentally picture the way that shapes or objects are related to one another in the environment.

Left hemisphere specialisations

The left hemisphere specialises in verbal and analytical functions. *Verbal functions* involve the use or recognition of words; for example, reading, writing, speaking and understanding speech, all of which are important in our use of language. *Analytical functions* essentially involve breaking a task down into its key parts and approaching it in a sequential 'step-by-step' way, as is required when using logical reasoning to interpret and apply a formula to solve a mathematics problem, to critically evaluate an experimental design in psychology, or to bake a cake or cook a roast dinner. Analytical functions are also involved when developing an argument to use in a debate, formulating a plan to save up enough money to buy a car, or organising sufficient time to complete your homework for all your different subjects.

In terms of behaviour, the left hemisphere has exclusive functions that involve sensory information and bodily movements. As described previously, the left hemisphere generally receives and processes sensory information from the right side of the body and controls voluntary bodily movements on the right side of the body.

Right hemisphere specialisations

The right hemisphere specialises in *non-verbal functions* that do not depend on language skills. Its non-verbal functions include spatial and visual thinking, such as completing a jigsaw puzzle, reading a map or visualising the location of objects of places; recognising faces, patterns and tunes; appreciating music and artworks (but not necessarily producing them); creative thinking; and daydreaming. The right hemisphere is also more involved in recognising emotions from facial cues (signals), such as a raised eyebrow or trembling lips, and in non-verbal emotional expression.

Like the left hemisphere, the right hemisphere also has exclusive functions that involve sensory information and bodily movements. As described previously, the right hemisphere generally receives and processes sensory information from the left side of the body and controls voluntary bodily movements on the left side of the body.

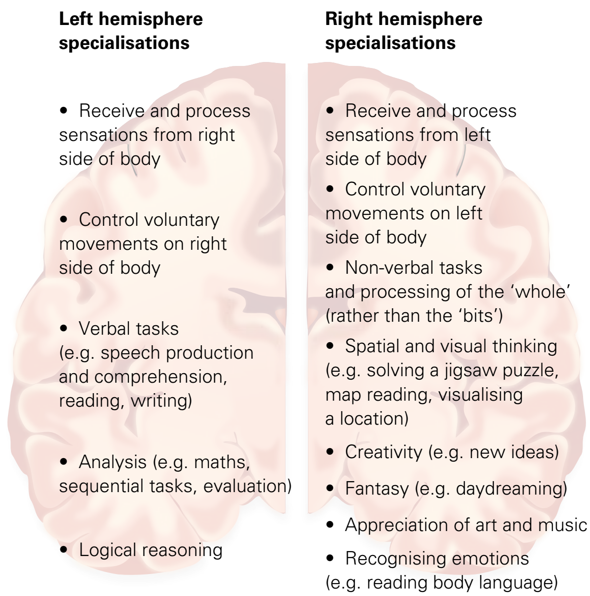


Figure 4.30 The specialised functions of the left and right cerebral hemispheres

Learning Activity 4.9

Left and right hemisphere functions

1. Explain the meaning of the term hemispheric specialisation.
2. Construct a table that summarises specialised functions of the left and right cerebral hemispheres. Organise the functions under subheadings that include cognitive functions, behavioural functions, non-verbal functions, verbal functions and analytical functions. A specific function may be included more than once.

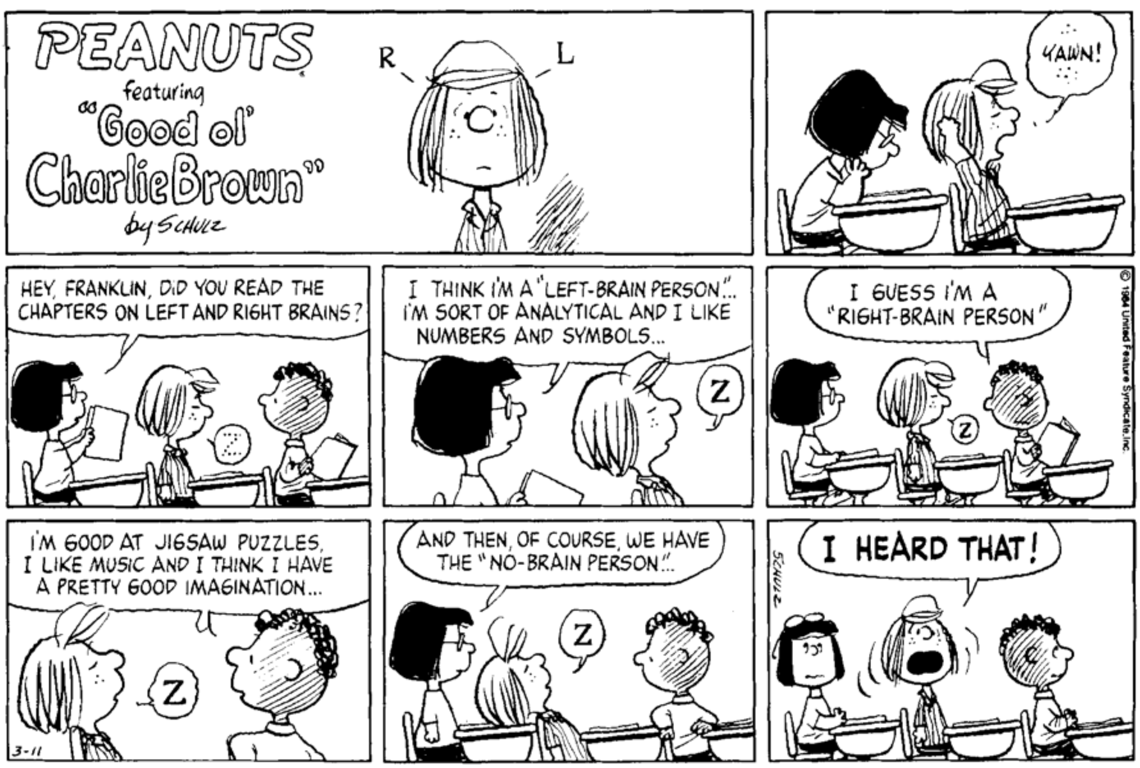
3 Identify the cerebral hemisphere (left or right) that specialises in these cognitive and behavioural functions:
   - **a** appreciating the beauty of a forest
   - **b** judging whether a car will fit into a parking space
   - **c** kicking a football with the left foot
   - **d** listening to someone speak
   - **e** applying logic in an argument
   - **f** working out if you have enough money for a holiday
   - **g** daydreaming about being rich and famous
   - **h** finding your way around a maze
   - **i** speaking on the telephone
   - **j** playing a simulated golf game on a computer
   - **k** working out the meaning of a grin on someone's face
   - **l** arranging a bouquet of flowers
   - **m** giving someone the correct change for their purchases
   - **n** recognising classmates from an old class photo
   - **o** working out when you have to get up in the morning to get to school on time.

4 A friend tells you about an internet test that determines hemispheric dominance of the test-taker. The test seems very formal and involves a mixture of verbal and non-verbal tasks. Your friend has performed the test and one of the results indicated that they have no musical ability because of their dominant left hemisphere. List three key arguments that could be used to dispute this result.

Learning Activity 4.10

Media response

Explain how accurately the cartoon represents hemispheric specialisation.



Learning Activity 4.11

Research investigation: eye gaze as an indicator of hemispheric specialisation

Research findings indicate that when we think, we shift our eyes from one side to the other (called lateral eye movement). Whether we shift our eyes to the left or right seems to depend on the kind of thinking we are doing at the time. The findings suggest that eye gaze (movement) to the right indicates that the left hemisphere is activated and that eye gaze to the left indicates that the right hemisphere is activated.

For most people (males and females), the left hemisphere tends to specialise in verbal (e.g. speech) and analytical (e.g. arithmetic) functions. People performing language and arithmetic tasks should therefore gaze to the right. Spatial abilities tend to be a specialised function of the right hemisphere; therefore, participants performing spatial tasks should gaze to the left. This investigation enables you to test this theory. All relevant ethical guidelines should be followed.

Procedure

Working with a partner, conduct the investigation working in the role of the experimenter with one participant and in the role of an observer with another participant. The experimenter presents the tasks and records the direction of eye gaze in response to each task. The observer also records the direction of eye gaze for each task, thereby providing a second set of observations.

Select two right-handed students to be participants in the experiment. The participants can be of any age, as long as each is old enough to solve problems or perform the tasks required by the procedure. Although participants should give consent to their involvement, it is best to use participants who are not aware of the purpose or procedures of this activity. Either way, participants should be debriefed at the conclusion of the experiment.

Step 1: Find a quiet place to carry out this step. Even a slight noise can affect the participant's performance on the required tasks. Seat your participant at a small desk or table, so that you can clearly see their eyes at all times. Sit down in front of, but slightly to the left or right of, the participant so that they do not have to stare directly at you. The experimenter should give the following standardised instructions to the participant.

I am going to give you a set of short, simple tasks. Perform each one as I give it to you. If you are unable to do the task immediately, take your time and keep trying to think about the solution. Time is not important. However, it is important that you hold your head up, don't move your head and keep your eyes open.

Step 2: Read the 12 tasks listed below, one at a time, to the participant. Do not state the name of the task; for example, 'spatial'. Give the participant plenty of time to perform each task. The participant should not feel rushed. As the participant completes each task, carefully observe their eyes.

Note the direction in which their eyes move off-centre; that is, to the left or right. Remember that if you are sitting in front of the participant, your left will be the participant's right. You should keep an accurate record of the number of times the participant looks off-centre, and of whether the eyes are off-centre to the left or to the right.

Spatial	1	On which Australian coin is there a platypus?
Verbal	2	Please state your name and your country of birth.
Spatial	3	Which way does the queen face on a 20-cent piece: left or right?
Arithmetic	4	Please add up the following numbers in your head: 1, 2, 3, 4, 5.
Spatial	5	Without closing your eyes, describe where the power point is located in your bedroom (if the participant states that there is more than one power point, ask for the power point used most often).
Verbal	6	Recite the first two lines of 'Advance Australia Fair'.
Spatial	7	Who is pictured on the front of a $5 note?

Arithmetic	8	Multiply the following numbers in your head: 6, 2, 2.
Spatial	9	Without closing your eyes, describe the front entrance outside the place where you live.
Verbal	10	What do the letters in ANZAC stand for?
Arithmetic	11	How many 50-cent stamps can you buy for $7.50?
Spatial	12	In America, on which side is the steering wheel of a car?

The observer should sit opposite the participant and keep a record of the participant's eye movements. Later, compare both sets of results and use the mean of the two records if there is any difference. There is no need to write down the participant's actual answers to questions.

Step 3: Combine your data on eye gaze for the different tasks. Copy the table at the end of this learning activity and enter the data in the appropriate columns. Then add the frequencies of left and right eye gaze, and write the results in the 'total' row.

Interpretation

1. Compare the frequency of left and right eye gaze for the verbal and arithmetic (analytical) tasks. Do the data indicate support for the theory? That is, did the participants tend to look more often to the right during the verbal tasks or during the arithmetic tasks? If so, in which activities?
2. Compare the totals for both the analytical tasks with the total for the spatial task. Did the participants look more to the left or to the right during left-hemisphere specialised tasks? What about the right-hemisphere specialised tasks?
3. Do the results support or not support the theory of eye gaze and hemispheric specialisation (and your hypothesis, if you are required to write one)? Explain your answer with reference to the results and to the theory of eye gaze and hemispheric specialisation. Ensure you consider research evidence of left- and right-handedness and hemispheric specialisation.
4. If your findings do not support the theory (or your hypothesis), what extraneous variables might have influenced your results?
5. Informed consent in research is one ethical issue relevant to this investigation. What justification is there for *not* obtaining informed consent? What other ethical issues are relevant to the experiment?

Tasks	**Number of times looked to:**	
	left	**right**
Left hemisphere • verbal • arithmetic		
Total		
Right hemisphere • spatial		
Total		

Source: adapted from Grivas, J., & Lawrie, P. (1991). *Psychology experiments and activities*. Marrickville, NSW: Harcourt Brace Jovanovich.

The reticular activating system

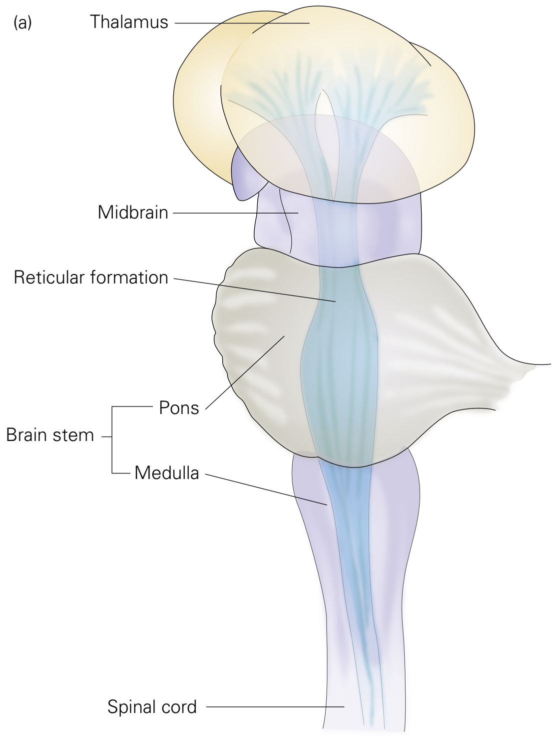
If you follow the spinal cord from your lower vertebrae to where it enters your skull, you'll find it difficult to determine where your spinal cord ends and your brain begins. This is because the spinal cord is a continuation of the **brain stem** (also called *hindbrain)*. The brain stem looks like its name; that is, like a 'stem' on which the rest of the brain sits. Three anatomical structures make up the brain stem: the medulla, the cerebellum and the pons (see figure 4.31). Running through the centre of the brain stem and upward through the midbrain to the forebrain (the area under the cerebral cortex) is a structure called the **reticular formation**. When viewed through a microscope, it resembles white netting or lacing, which is why it is called reticular—reticular means 'like a network'.

In one early experiment, Italian neuroscientist Guiseppe Moruzzi and his American colleague Horace Magoun (1949) electrically stimulated the reticular formation of sleeping cats. This caused the animals to awaken suddenly and remain alert. Conversely, severing the connections between the reticular formation and the rest of the brain caused the cats to fall into a prolonged coma resembling sleep. They remained in this state until they died. As a result of their experiment, Moruzzi and Magoun proposed that the function of the reticular formation is to control sleeping and waking. Through the influence of these findings, the reticular formation gradually came to be known as the reticular activating system. It is now recognised that there is more to the reticular activating system than identified by Moruzzi and Magoun, that the brain stem serves many functions other than sleeping and waking, and that other areas of the brain are also involved in regulating wakefulness. However, exactly what the reticular activating system does, and how it does so, remains unclear (Kolb & Whishaw, 1996).

The **reticular activating system (RAS)** is a network of neurons that extends in many directions from the reticular formation to different parts of the brain and to the spinal cord. The RAS may be considered as looking something like a bicycle wheel hub, with spokes running in all directions. Its *ascending tracts* (upward nerve pathways) extend to the cerebral cortex and its *descending tracts* (downward nerve pathways) extend to the spinal cord (see figure 4.31b). Generally, the major functions of the RAS are to regulate cortical arousal ('alertness'), either increasing arousal or dampening arousal in response to feedback from upper and lower brain areas. It influences whether we are awake, drowsy, asleep or in some state in between. When our RAS is less active, we go to sleep. Many general anaesthetics work by reducing the activity of the RAS, making the patient unconscious. Damage to the RAS will profoundly disrupt the sleep–waking cycle and can result in coma or a chronic vegetative state (Stirling, 2002; Levie, 1996).

In maintaining and regulating cortical arousal, the RAS also influences *attention* and to what we choose to attend; that is, *selective attention*. Neurons of the RAS send out a steady stream of impulses that keep the cerebral cortex active and alert, taking account of the incoming flow of sensory and motor information. The RAS can 'highlight' neural information of potential importance, directing attention and consciousness towards potentially significant events. When something happens that demands attention, the RAS will bombard the cortex with stimulation to arouse specific cortical areas. For example, the sleepy driver in outback Australia who snaps to attention when a kangaroo appears in the middle of the road can thank the RAS for arousing the rest of their brain. Neurons within the RAS network can also detect and filter out weak or familiar incoming sensory information, allowing the brain to concentrate on a particular stimulus. Research findings indicate that when there is incoming information from two different sensory sources (such as sounds and associated images), the RAS appears to call attention to both and help direct areas in the cerebral cortex to focus on the more relevant information (Kowalski & Westen, 2005; Huffman, 2004; Andrewes, 2001).

The RAS is one way in which sensory information can be routed to the cerebral cortex. Another way is via the thalamus. However, they do not necessarily work independently of one another. The ascending RAS tracts connect to central areas in the thalamus and appears to influence arousal and attention through the thalamus.



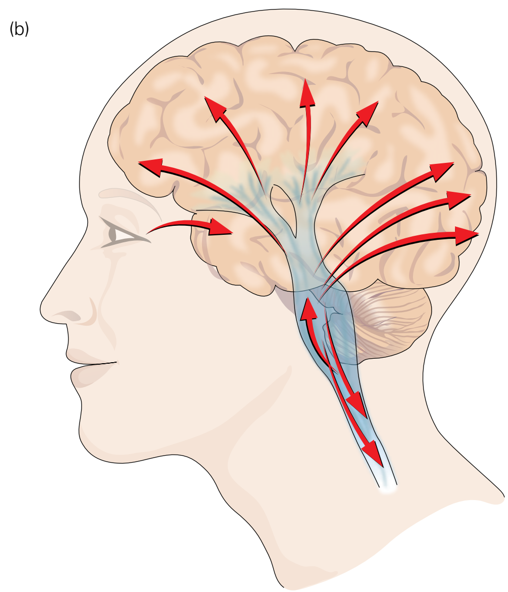


Figure 4.31 (a) The thalamus is located at the top of the brain stem. It receives incoming sensory information (except smell) and relays it to the cortex. It also receives information about our state of arousal from the reticular formation. (b) The reticular activating system (RAS) radiates from the reticular formation within the brain stem. The RAS has both ascending and descending tracts and therefore receives and sends information from the reticular formation in regulating arousal.

The thalamus

Imagine sticking an index finger in each of your ears and pushing inward until they touch. That is about where you'd find the thalamus. As shown in figure 4.31a, it is located in the middle of the brain, right on top of the brain stem. In appearance, the thalamus is about 3 cm in length and consists of two ovoids, which look like two little footballs or a fist. Each ovoid is within a different cerebral hemisphere. Given its location, the thalamus is often described as the 'gateway' from the lower part of the brain to the cortex in the upper part.

The **thalamus** is a brain structure that filters information from the senses and transmits ('relays') the information to the cerebral cortex. It receives inputs from all the major senses, with the exception of smell, which has a direct route to the cortex, bypassing the thalamus. This means that almost all incoming sensory information—including information from the eyes, ears, tastebuds and skin receptors sensitive to itching, pain or heat—must pass through the thalamus before reaching the cortex. For example, while you're reading this page, your thalamus sends incoming visual information to the visual cortex, and when your ears receive sound, the information is transferred to the auditory cortex. In addition to incoming sensory information, the thalamus receives information about our state of arousal from the reticular formation. Streams or bursts of neural messages from the reticular formation appear to be channelled through the thalamus. Therefore, the thalamus also has a crucial role in influencing our wakefulness and level of alertness.

A considerable amount of information from the cerebral cortex also passes through the thalamus to lower brain structures, the spinal cord and out to the peripheral nervous system. For example, the thalamus has neurons that relay messages between motor cortex areas and movement control centres in the brain stem (such as the cerebellum). Evidence from case studies of patients with a damaged or abnormal thalamus suggests that some analysis or processing of sensory information is likely to occur there. Injury to the thalamus can cause blindness, deafness or loss of any other sense (except smell). Furthermore, because the thalamus is the major sensory relay area to the cerebral cortex, damage or abnormalities also might cause the cortex to misinterpret or not receive vital sensory information. For example, research using brain-imaging techniques has linked abnormalities in the thalamus to schizophrenia and other mental disorders (Gazzaniga & Heatherton 2006; Huffman, 2004).

The thalamus appears to play a role in attention as well. Its function is not just to route messages to the appropriate brain areas and structures. The thalamus actively filters the vast amounts of incoming to-be-attended-to sensory information, highlighting and giving more weight to some inputs and de-emphasising or giving less weight to others. One study providing evidence for the role of the thalamus in filtering and directing attention to sensory input was conducted by American psychologist David LaBerge and psychiatrist Monte Buchsbaum (1990). In one condition, participants had to attend to the presence or absence of a single letter. In a second condition, participants had to 'look out' for the same letter embedded among other letters. The second task required more 'attention' than the first because there was now a requirement to filter or sift through the assortment of letters to find the target letter. A brain-imaging PET scanner was used to observe areas of the brain's activity as participants completed the tasks. Analysis of the scans showed that the second condition brought about greater activation of a specific area of the thalamus than the first condition, even when stimulus complexity was accounted for. Additional evidence comes from studies of patients with damage to this area of the thalamus who have attentional difficulties involving the ability to filter stimuli; that is, attending to one input and ignoring others (Coull & others, 2004; Stirling, 2002).

Areas of the thalamus also have a crucial role in regulating arousal through their connection to the reticular formation and nerve pathways that form the reticular activation system. Damage to these areas results in lowered arousal, ranging from lethargy to coma. Research studies have also found that the thalamus closes the pathways of incoming

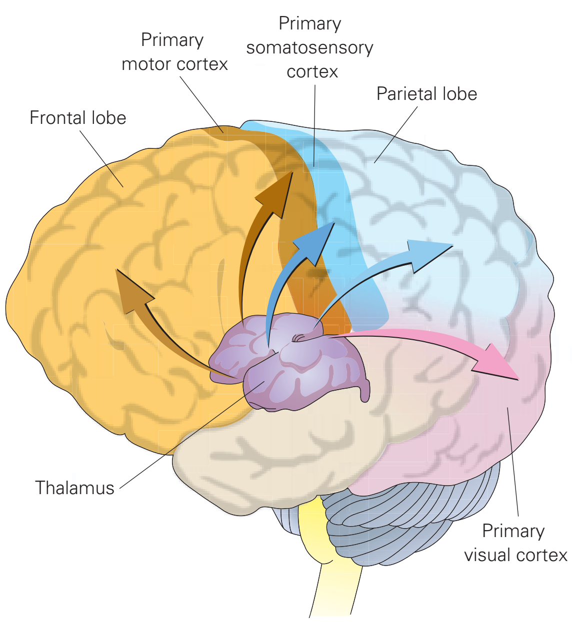


Figure 4.32 The thalamus: almost all sensory and motor information going to and from the cerebral cortex is processed through the thalamus. This diagram shows some of the neural pathways from different regions of the thalamus to specific lobes of the cerebral cortex.

Figure 4.33 Circuits of neurons in the brain stem, including the reticular formation and thalamus, regulate our level of sleep and wakefulness.

Box 4.7

Case study: the thalamus and fatal familial insomnia

A 53-year-old industrial manager consulted Italian psychologist Elio Lugaresi and his colleagues, complaining of increasing difficulty in falling asleep. The insomnia was associated with other symptoms such as constipation, increasing activity of the autonomic nervous system in the form of sweating and higher heart rate, blood pressure and body temperature. Some months after the initial appearance of these symptoms, insomnia had become almost total, and the manager's waking hours were interspersed with vivid dreamlike episodes. Gradually the patient lost contact with the people around him, and he died nine months after the onset of his symptoms. His father and two sisters died in the same manner. The inability to sleep culminating in total insomnia was dramatic, justifying the name given to the rare disease *fatal familial insomnia*.

In all four cases, post-mortem brain examination revealed severe degeneration of the anterior (front) part of the thalamus. Since in two of the patients the damage was almost exclusively limited to the thalamus, Lugaresi and his colleagues concluded that the anterior part of the thalamus plays a major role in sleep regulation. Later studies have shown that fatal familial insomnia is an inherited disease and is always fatal. Lugaresi's clinical observations agreed with research evidence. Numerous experiments using EEG recordings have found that brain waves that indicate sleep onset originate in the thalamus.

Source: adapted from Lavie, P. (1996). *The enchanted world of sleep*. New York: Yale University Press.

Learning Activity 4.12

Review questions

1. a What is the reticular formation?
   b Where is it located?
2. a What is the reticular activating system?
   b Explain its role in:
      i selective attention
      ii wakefulness.
3. a What is the thalamus?
   b Where is it located?
   c Explain its role in:
      i directing attention
      ii switching sensory input on and off.
4. Describe the relationship between the reticular activating system and the thalamus.
5. Consider the experiment conducted by LaBerge & Buchsbaum (1990).
   a Identify the IV and DV.
   b What do the results suggest?

sensations during sleep, providing the valuable function of *not* allowing information to pass to the brain while the brain rests (Schacter, Gilbert & Wegner, 2007; Gazzaniga & Heatherton, 2006; Stirling, 2002).

The spinal cord

Imagine that you are picking up an ice cube. As the sensory receptors in your skin become highly stimulated by the detection of a sudden change in temperature, they transmit sensory information (in the form of neural impulses) to your brain. This sensory information will be registered initially in your somatosensory cortex. The somatosensory cortex will then relay the information to the motor cortex after a very brief period of analysis and interpretation. During this short time, you will probably decide to release the ice cube, since the temperature of the skin holding it is interpreted by your brain as unpleasant, perhaps painful. The motor cortex is then activated and transmits a message down to the fingers holding the ice cube, causing them to move in a way that releases it. This relatively simple sequence of activity involves an important two-way communication link between the brain and the body—the spinal cord.

The brain and the spinal cord make up the central nervous system. The **spinal cord** is the cable-like column of nerve fibres that extends from the base of the brain to the lower back. It is encased in a series of bones called the *vertebrae* that extend further than the actual cord.

The major functions of the spinal cord are to receive sensory information from the body (via the peripheral nervous system) and transmit them to the brain, and to receive information from the brain and relay it to the body (via the peripheral nervous system) to control muscles, glands and internal organs.

When the spinal cord is damaged, the brain loses both sensory input from and control over the body. The severity of feeling loss and paralysis depends on where the spinal cord is damaged. The higher up on the spine the damage is, the greater the number of nerve connections between the brain and the body that are severed (Gazzaniga & Heatherton, 2006).

The spinal cord appears to be an extension of the brain, although in evolutionary terms, the reverse could be argued since the spinal cord was present before the brain evolved. The spinal cord carries messages from the body's sensory system to the brain for processing. For example, an itch on your big toe, the sensation of heat as you step into a hot bath and the pain of a sprained wrist are all carried to the somatosensory cortex via the spinal cord. It also carries messages from the brain to parts of the body that are required to perform certain actions. For example, in order to lift your textbook from the desk, millions of neural impulses are transmitted from the motor cortex to the muscles in your shoulder, upper arm, forearm, wrist and fingers. These occur in a highly coordinated series of individual movements that are carried out in one smooth action.

The spinal cord has two major components: white matter and grey matter. The *white matter* is made solely of axons that run the length of the spinal cord uninterrupted and are bundled together. An **axon** is the part of a neuron that *sends* information away from its soma (cell body) to other neurons or to the cells in muscles or glands. Axons are covered with a white protective coating called *myelin* and are located mainly in the outer layers of the spinal cord. Myelin is the white matter that is involved in transmitting messages to and from the brain, up and down the spinal cord. Interconnected axons in the central nervous system are referred to as *tracts*, *circuits* or *pathways*. The spinal cord contains *ascending tracts* for *somatosensory information*, which comes in from various parts of the body through the spinal nerves and travels up to the brain, and *descending tracts* for *motor information*, which leaves the brain and travels down the spinal cord to exit via the spinal nerves to their destination in the muscles, organs and glands.

The *grey matter* contains cell bodies, together with their axons and dendrites, and is mainly located near the centre of the spinal cord. **Dendrites** are thin extensions of a neuron that receive information from other neurons and transmit it to the cell body.

The bones of the vertebrae, which encase the spinal cord, extend considerably further down the back than the spinal cord itself. An adult's spinal cord is only about 43 to 45 cm long, whereas the vertebrae extend for about 60 cm. As shown in figure 4.34, the spinal cord is divided into four sections that are named by groups of spinal nerves: the cervical nerves, the thoracic nerves, the lumbar nerves and the sacral nerves. These are described in box 4.8.

In sum, the spinal cord is the linking conduit or 'pipeline' that integrates the central nervous system and peripheral nervous system, which work together to transmit information around the body. The central nervous system is the central processing system while the peripheral nervous system consists of nerve fibres that extend from the central nervous system to all parts of the body. The nerve fibres in the peripheral nervous system carry sensory information to the central nervous system and motor information from the central nervous system to the skeletal muscles, internal organs and glands.

Box 4.8

The spinal cord nerves

At the top of the spinal cord, nearest the brain, the *cervical nerves* are divided into eight levels (see figure 4.34). Each of these levels contributes to different motor functions in the neck, shoulders and arms. Similarly, sensations from the neck, shoulders and arms use the sensory nerves in these eight levels as their neural pathway to the brain.

Below the cervical region, the 12 pairs of nerves in the *thoracic* region of the spinal cord radiate to muscles in the chest, known as the pectoral muscles. Besides the pectoral muscles, they also link to the visceral muscles, which are those connected to the large internal organs in the chest cavity, such as the lungs. Visceral muscles are therefore involved with actions such as breathing and coughing. Messages from the internal organs as well as those sent from sensory receptors in the chest area enter via the thoracic nerves.

The lower two sections (*lumbar* and *sacral*) are referred to jointly as the lumbosacral spinal cord. This area has ten pairs of nerves: five pairs from the lumber and five pairs from the sacral sections. These nerves send nerve impulses to move the pelvis, legs, feet, bladder and bowel. Sensory messages from the same parts and the lower abdomen enter the spinal cord here on their way to the brain.

The spinal cord only extends down to the last bone of the thoracic vertebrae. Nerves radiate laterally (sideways) from the spinal cord in the cervical and thoracic sections of the vertebrae, but not in the lumbar and sacral sections. Instead, nerves below the thoracic section form a bundle that runs vertically inside the vertebrae. This large collection of nerves is known as the *cauda equina*, which means 'horse tail'.

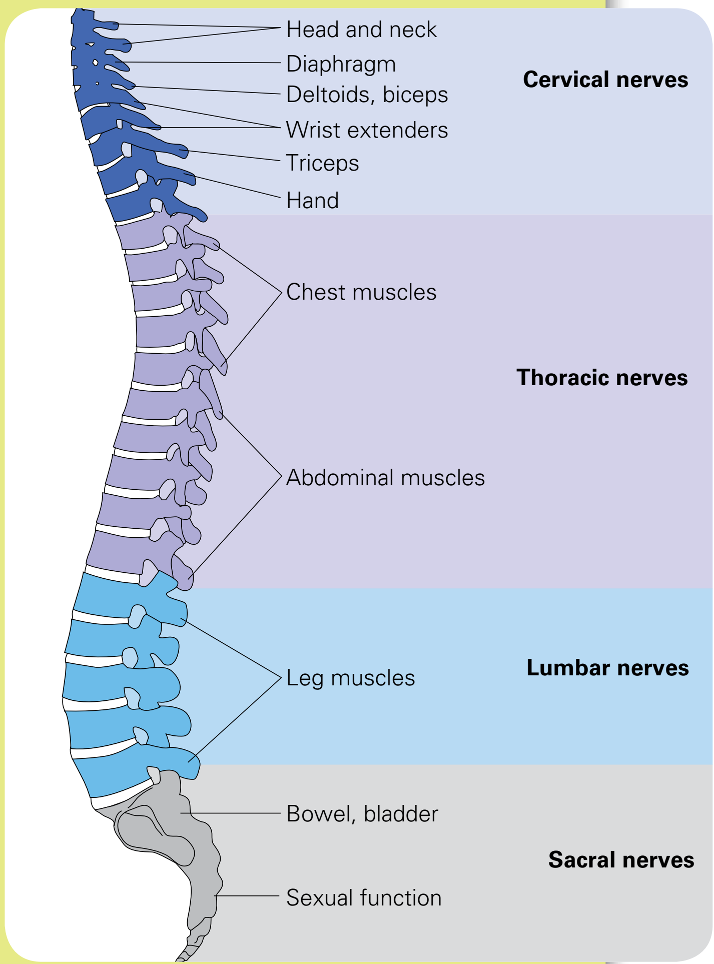


Figure 4.34 The four sections of the spinal cord. Note that the spinal cord ends at the last vertebrae in the thoracic section.

Transmission of sensory information from the peripheral nervous system

Sensory information is transmitted from sensory receptor cells in the peripheral nervous system via *sensory neurons* to the central nervous system. These types of neurons specialise in detecting and responding to specific types of sensory information. Sensory information is also known as *afferent* information—'afferent' means 'coming towards', and in this instance it refers to coming towards the central nervous system. Information such as the change in skin temperature when you hold an ice cube, the sound of a kettle whistling, the visual image of a bird in flight, and the smell of toast cooking are all examples of sensory information. Afferent messages travel along nerve tracts (pathways) consisting of bundles of axons in the spinal cord. These nerve tracts carry only *somatosensory* information. The sensory neurons are quite different in structure from the motor neurons and they do not share the same tracts to and from the brain. Rather, they are like an underground train-line network that provides separate tunnels for each line. There are 31 afferent tracts and 31 efferent tracts in the spinal cord.

Imagine stepping on a sharp object, such as a nail or a staple, while walking barefoot. Initially, the millions of sensory receptor cells in your foot fire off neural impulses in response to being stimulated by the object. These nerve impulses will travel from the sensory receptors along the dendrites to which they connect. The dendrites connect to axons that take the nerve impulse towards the spinal cord. The axons connect with interneurons ('connector neurons') near the base of the spinal cord, which take the nerve impulses up to the brain. An *interneuron* is a nerve cell that relays messages from sensory (afferent) neurons to other interneurons or to motor (efferent) neurons within the central nervous system.

Transmission of motor information from the brain

Once information about sensory stimuli reaches the brain, there is often a response that requires movement. The 'launching pad' for most bodily movements, whether voluntary or involuntary, is the motor cortex. The exception to this is movement initiated in a spinal reflex (see box 4.9). The neurons that carry messages of movement are called motor neurons. They leave the motor cortex (located at the rear of the frontal lobes) and travel down the spinal cord to the skeletal muscles and glands where they connect to effector cells. These *effector cells* control the action of muscles by causing them to contract, thereby causing movement. Effector cells located in glands cause the secretion (release) of hormones to occur when they are activated by messages carried by motor neurons. Motor messages are also known as efferent messages. *Efferent* means 'leading out from'; in this instance, it refers to leading out from the central nervous system.

For example, the sensory information that lets you know that your shower is too hot will probably result in you adjusting the temperature of the water to something more comfortable. The messages required to physically turn the taps in the shower are transmitted from the motor cortex, down through the spinal cord and out to the effector cells located in the muscles in your arms, hands and fingers.

There is ongoing interaction in the cerebral cortex between sensory information coming *to* the brain and motor information going *from* the brain because much of the sensory information requires action to be taken in the form of movement. It has been suggested that the close proximity of the somatosensory and motor cortices is an adaptive evolutionary feature of the brain.

Sensory and motor neuron activity

Neurons are cells that are specialised to receive, process and/or transmit information to other cells within the body. Sometimes referred to as *nerve cells*, neurons are the basic unit of the nervous system. There are many types of neurons in the human body, and about 200 different types in the central nervous system alone. However, neurons can be categorised into three types, based on the primary function they perform. The three types are sensory neurons, interneurons and motor neurons.

Sensory neurons, also called *afferent neurons*, are specialised nerve cells that carry messages from sensory organs through nerves in the peripheral nervous system, up the tracts in the spinal cord to the brain. Sensory neurons receive information from both the external and the internal environment. Information is received externally from the environment through the senses and internally from the muscles, organs and glands. Some sensory neurons transmit information to the brain via the spinal cord. Other sensory neurons transmit information directly to the brain via the

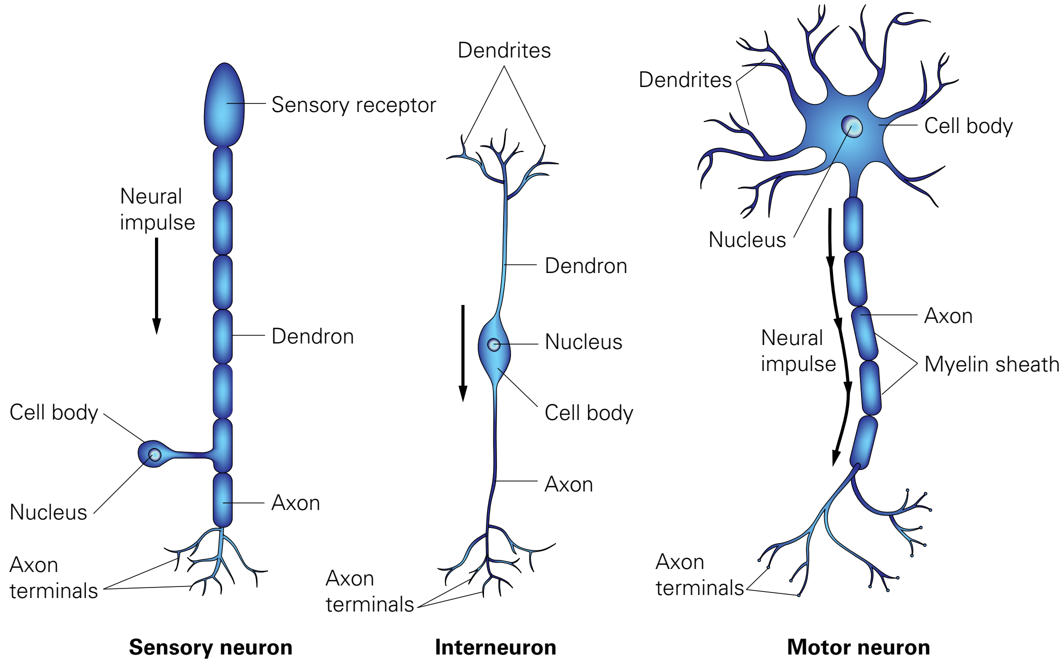


Figure 4.35 This diagram compares a sensory neuron, an interneuron and a motor neuron. While each has a *soma*, or cell body, a *nucleus* and an *axon*, there is great variation in structure.

cranial nerves in the face; for example, from the forehead or cheek. Sensory neurons generally respond only to a particular type of stimulation. For example, sensory neurons in the nose that detect odours respond only to stimulation by chemical energy, but not to other forms of energy such as light (electromagnetic energy) or sound (mechanical energy).

Interneurons, also called *connecting neurons*, perform the important function of making the connection between sensory and motor neurons, which rarely ever connect directly. Interneurons relay messages from one type of neuron to another type of neuron. They exist only in the central nervous system (brain and spinal cord) where they are the most numerous type of neuron. Interneurons can have a long axon and short dendrites or long dendrites and a short axon.

Motor neurons, also called *efferent neurons*, are specialised nerve cells that carry messages away from the central nervous system towards the muscles, organs and glands, thereby enabling bodily movements, internal organs to be activated and glandular secretions to occur. Motor neurons receive and act on messages received from interneurons.

The main distinction between sensory and motor neuron activity is the direction of the nerve (neural) impulses and what happens at their respective destinations.

Sensory neuron activity refers to activity that begins with the excitation of receptor cells at sensory receptor sites. *Sensory receptor sites* are locations where cells for different senses detect stimuli to which they specialise in responding. The reaction of the receptor cells involves the firing of tiny electrical charges (neural impulses) that are transmitted towards the brain via the spinal or cranial nerves, depending on the sense organ's location. When they reach the brain the neural impulses are sent to a specific area of the cerebral cortex. For example, visual messages are sent to the visual cortex located in the occipital lobe, whereas auditory messages are sent to the auditory cortex located in the temporal lobe. There is also specific cortex for other sensory information and very specific locations along the somatosensory cortex provide destinations for a range of touch sensations arriving from all over the body.

Motor neuron activity begins at the motor cortex, and follows a nerve pathway to the skeletal muscles, internal organs and glands to initiate body movement of some kind. Neural impulses are fired at the particular point on the motor cortex responsible for a given body part. These neural impulses travel down one of the 31 motor nerve tracts in the spinal cord. Which tract is followed depends on the destination of the message; that is, the body part to be moved. If the message needs to go to a muscle in the forearm, for example, then it will exit via one of the cervical nerves.

Interneuron activity often involves messages being relayed from sensory neurons to motor neurons because sensory and motor neurons rarely make a direct connection. Interneurons bring messages from various sources, organising and integrating information.

Box 4.9

The spinal reflex

In 1730, English scientist Stephen Hales demonstrated that the spinal cord is responsible for limb reflex movements. He decapitated a frog (to ensure that there would be no input from the brain) and then pinched one of its legs. When the frog's leg pulled away, Hales concluded that the sensory receptors in its leg had transmitted a message to the spinal cord and, in turn, a message had looped to the motor neurons to stimulate certain muscles, causing them to contract and pull away from the stimulus. Of course, pain had not been registered since this occurs in the brain. Interneuron cells in the spinal cord make the connection between the sensory neurons and the motor neurons, forming a loop of signals that return to the site of the stimulus-producing movement.

People also experience some reflex behaviour that relies solely on the neural circuitry of the spinal cord. This spinal reflex response serves an adaptive purpose to protect you from harm and enhance survival. For example, if you were to prick your finger on a rose thorn, you would automatically withdraw your hand before any intervention by the brain. The sensory receptors in the finger would send messages to the central nervous system, but the first point of contact in the central nervous system is the spinal cord. It responds with a motor neuron message to the muscles in the finger and arm to withdraw. Although sensory messages will also be sent to the brain (where the actual experience is interpreted), a stimulus such as that from a rose thorn will produce an immediate spinal reflex response.

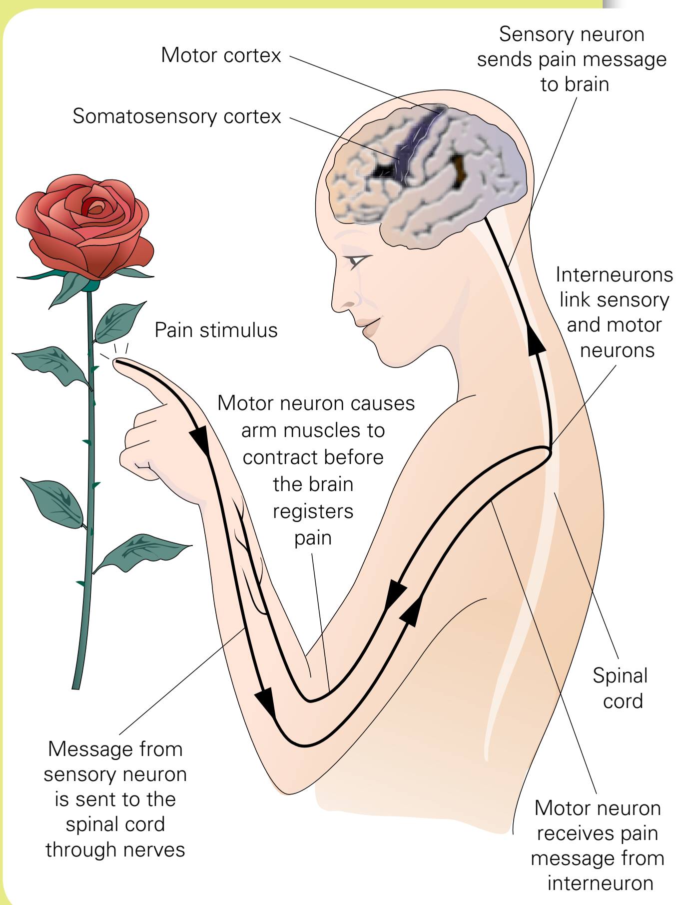


Figure 4.36 Touching the rose thorn stimulates sensory receptors in the skin of the finger. The receptors transmit the information to sensory neurons that connect to interneurons in the spinal cord. The interneurons send the message to the motor neurons that connect to effector cells in the muscles in the finger. This causes the finger to contract and pull away from the stimulus.

Box 4.10

Within-neuron transmission of information: the neural impulse

Neurons do not actually transmit raw sensory information (for example, light for vision or mechanical energy for hearing) to the CNS. Neurons are capable only of transmitting information in a specific form, as neural impulses. Neural impulses develop as a result of stimulation of the neurons. The stimulus can occur in the external environment (for example, when a noise is detected); from within the body (for example, when food reaches the stomach); or from within the CNS (for example, to deliver a message to a muscle to contract). A **neural impulse** (or *action potential* as it is also called) is a combination of electrical and chemical energy (electrochemical energy) that contains the neural information that travels along the axon. A neural impulse travels only the length of the neuron. Once the neural information reaches an axon terminal at the end of the axon, a different process occurs for the neural information to be transmitted to the next neuron.

The neuron sends information along the axon in a way similar to the movement of a coordinated 'Mexican wave' through a large crowd of people at the MCG or the Rod Laver arena. Groups of people in one section of the crowd stand up, raise their arms, then sit down again. As the first group sits down, people in the next section rise, wave their arms and sit down and so on, giving the appearance of a wave travelling around the stadium.

Neural impulses do not travel continuously along the axon. When an impulse is triggered, one section of the axon opens up, which then triggers the next section to open up and so on, passing the impulse along the axon.

Neurons are surrounded by a membrane (casing). Between the neuron and the membrane is a small amount of fluid that contains particles called *ions*. Ions are either positively charged or negatively charged. There are different quantities of positively and negatively charged ions within a neuron and in the fluid that surrounds each neuron. This difference in the charges between the neuron and the surrounding fluid results in an electrical charge across the cell membrane. When the neuron is in its resting state (that is, when it is not involved in transmitting a neural impulse), there is a very small difference in the electrical charge inside and outside the neuron. The difference in the electrical charge inside and outside the neuron is called its *resting potential*.

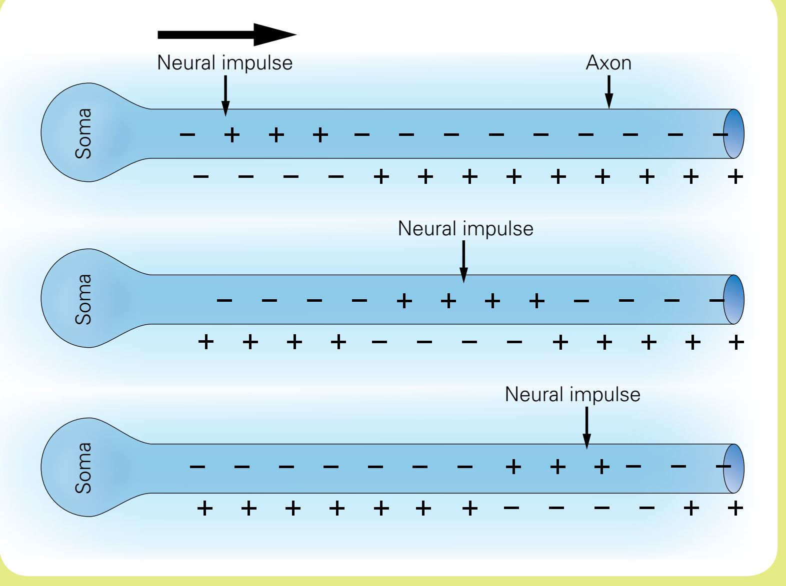


Figure 4.37 Inside the axon is usually negatively charged, while the fluid that surrounds the axon is usually positively charged. As a neural impulse travels down the axon, these charges reverse: inside the axon becomes positively charged while the surrounding fluid becomes negatively charged.

Each neuron requires a minimum level of stimulation in order to be activated from its resting potential and therefore for a neural impulse to begin. This minimum level of stimulation required to activate a neuron is called the neuron's *threshold*. When messages arrive from other neurons, the resting potential (electrical charge) of a neuron changes. If the electrical charge reaches the threshold, a neural impulse is activated and begins its movement down the axon (figure 4.37). This movement occurs in sections. At the end of each section of the axon there are ion channels. The *ion channels* are like gates that open and close to allow ions to flow along the axon. As the impulse moves down the first section of the axon from the soma, the 'gate' opens, enabling the impulse to move into the second section. The 'gate' then closes after the impulse has passed into the next section. The closure of the 'gate' after the impulse has moved onto the next section of the axon prevents the impulse from reversing its direction. Thus, the impulse can only move in one direction—from the soma, down the axon to the axon terminals.

Once a neural impulse has been triggered, it is self-sustaining; that is, it will continue to the end of the axon without further stimulation. As long as the neuron is stimulated to its threshold, a neural impulse will occur. Regardless of the amount of stimulation above the threshold, the same response will occur. There is no difference in magnitude (intensity) of a neural impulse: there is either a neural impulse or there is no neural impulse; that is, a neuron either 'fires' or does not 'fire'. There is no such thing as a partial impulse. This principle, or 'rule', is called the *all-or-none principle*.

The speed at which a neural impulse travels down the axon varies. The fastest impulses can travel at around 430 km/h. The slowest impulses travel at around 3.5 km/h. The speed of transmission depends mainly on two factors: the diameter (width) of the axon and whether the axon has a myelin sheath. The larger the diameter of the axon, the faster the impulse is transmitted. In addition, most of the axons with larger diameters are myelinated and this covering enables the axons to transmit the impulse at a faster speed.

Learning Activity 4.13

Review questions

1. Describe the two main functions of the spinal cord in terms of the types of messages that travel up and down its length, and the branch of the nervous system to which it connects.
2. Explain how sensory information is transmitted from the peripheral nervous system to the central nervous system using an example different from that provided in the text.
3. Explain how motor information is transmitted from the central nervous system to the peripheral nervous system using an example different from that provided in the text.
4. Explain what sensory neurons, motor neurons and interneurons are in terms of their respective functions.
5. Explain why damage to the spinal cord results in loss of brain–body control.

Studies on cognitive processes of the brain

The human brain is an extremely complex structure. Many mental and physical processes that seem relatively simple usually involve simultaneous activity within numerous areas of the brain, both in the cortex and lower regions. Although much is known about our brain's biochemistry, structures and functioning, probably more remains unclear or unknown. There is, however, little doubt that our brain is inextricably linked with consciousness and our level of awareness at any point in time. It is also known that consciousness is intertwined with the processes through which we pay attention, although there may be little difference in certain circumstances between 'paying attention' to something and becoming aware of it. Nor do we necessarily have to pay attention to something in order to become consciously aware of it. It is also clear that our brain is primarily responsible for cognitive functions such as learning, memory, thinking, language and so on. Despite its 'split-halves', which were once thought to be and function as two separate brains, it is now clear that they function as an integrated whole, even when one hemisphere has specialised in certain functions or when the two hemispheres are surgically separated.

At most times, our brain serves us well. When intact and undamaged, it usually enables us to successfully adapt to our environment and effectively meet the demands of everyday life. Many people with brain damage can also function quite effectively in everyday life, but this depends on the location, extent and severity of their brain damage.

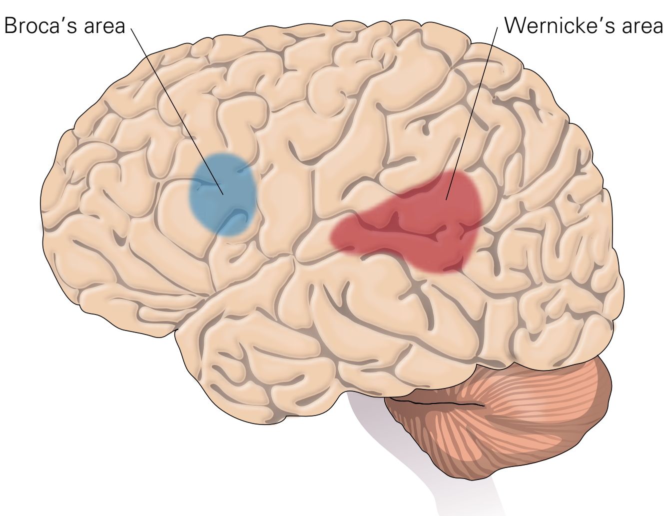
However, our brain is not always 'perfect', as evidenced by perceptual anomalies, or 'irregularities', such as when we perceive motion that doesn't actually occur (*motion after-effect*), when we fail to notice a large change that actually takes place even when we are expecting the change (*change blindness*) and when we involuntarily experience sensations that do not have a physical basis at that time (*synesthesia*).

In this section, we examine each of these anomalies, all of which are experienced by people with intact, undamaged brains. Of course, many people with brain damage experience the world differently to those without brain damage, sometimes in very debilitating ways. We will also examine studies of individuals with damage to particular areas of their brain, how this affects their everyday conscious experiences and what their brain damage has revealed about brain structures and functions. For instance, we consider individuals with a damaged hemisphere who neglect and are therefore unaware of one side of their world (*spatial neglect*) and individuals who have had their cerebral hemispheres surgically disconnected (*split-brain studies*).

We start with *studies of aphasia* associated with damage to Broca's area or Wernicke's area.

Studies of aphasia

The word 'aphasia' is a general term used for clinical purposes to describe individuals with a language disorder. Neuropsychologists



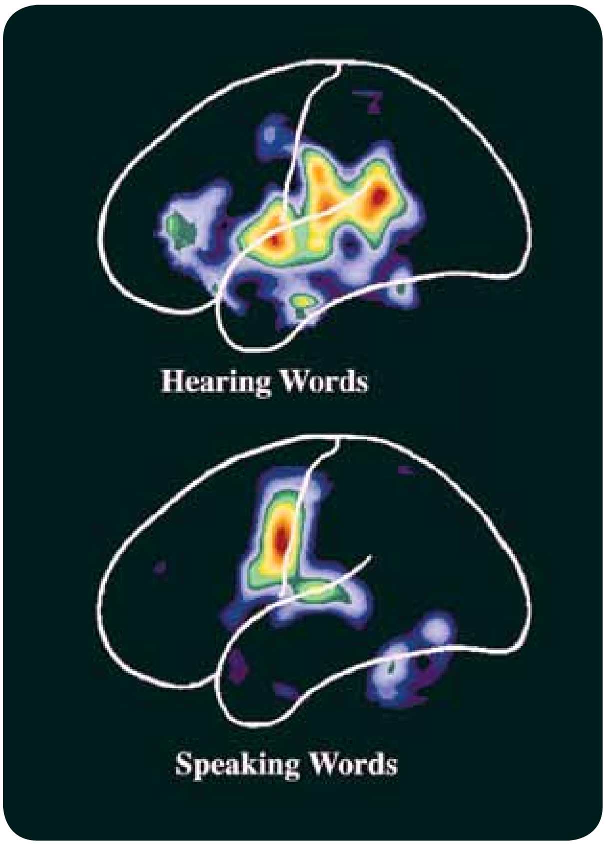


Figure 4.38 The PET scans show activity in Wernicke's area (top) and Broca's area (bottom).

commonly define **aphasia** more specifically to refer to a language disorder apparent in speech (comprehension or production), writing or reading produced by injury to brain areas specialised for these functions. Thus, disturbances of language due to severe intellectual impairment, loss of sensory input (especially vision or hearing), paralysis or impairment in the coordination of muscles involved in mouth movement or the hand (for writing) are not considered to be aphasic disorders. However, these disorders may accompany aphasia, thereby complicating its diagnosis or study.

Aphasias are often classified into three general categories: *fluent aphasias*, in which there is fluent speech but there are difficulties in either auditory verbal comprehension (understanding spoken words) or in the repetition of words, phrases or sentences spoken by others; *nonfluent aphasias*, in which there are difficulties in articulating (speaking clearly) but auditory verbal comprehension is relatively good; and *pure aphasias*, in which there are specific impairments in reading, writing or the recognition of words. Within each of these broad categories, numerous subtypes of aphasia are distinguished, including *Broca's aphasia* and *Wernicke's aphasia*. The most common cause of the various subtypes of aphasia is a stroke, causing loss of blood supply to areas of the brain involved in language (Kolb & Whishaw, 1996).

Broca's aphasia

Damage to Broca's area, which is located in the left frontal lobe next to motor cortex areas that control muscles involved in speech, often produces speech that is very deliberate, consisting of a few words with a very simple grammatical structure. However, damage rarely results in the total loss of speech. Other language abilities that are not dependent on speech, such as reading and writing, also tend to be unaffected when Broca's area is damaged. The speech impairment is one type of aphasia.

In **Broca's aphasia**, also called *nonfluent aphasia*, *expressive aphasia* or *motor aphasia*, a person has difficulty in speaking, although they continue to understand speech. Speech consists of very short sentences, typically three or four words, and these words are mainly verbs and nouns. The small parts of speech, such as *to* and *the*, are omitted, as are proper grammatical endings of words, such as -*ing* and -*ed*. For example, if you were to ask someone with Broca's aphasia what they did today, they might answer: 'Went house visit cousin'.

There is also evidence that comprehension of speech can be impaired by damage to Broca's area. Someone with Broca's aphasia can easily become confused when the usual order of words is changed, especially if the meaning cannot be inferred from individual word meanings alone. For example, the sentence *The boy hugged the girl* would probably be understood. But the sentence *The girl was hugged by the boy* would be confusing to someone with Broca's aphasia as the meaning cannot be inferred from individual word meanings or by context alone. This occurs because either the boy or the girl might reasonably have been the person initiating the hugging action. A similar sentence structure such as *The football was kicked by the boy* would not create such difficulty because the meaning attached to individual words in the content assists with comprehension; that is, footballs do not kick boys.

Most people with Broca's aphasia are usually aware of their own language difficulties and have a relatively clear understanding of their condition. Interestingly, deaf people with brain damage to Broca's area have difficulty producing sign language (Stirling, 2002).

Studies of individuals with Broca's aphasia have revealed that damage to any part of the area can result in the typical speech production problems. However, many studies have also failed to show a clear and consistent relationship between location of damage and the area originally described by Broca. Nonetheless, the damage is always found in left frontal lobe areas, indicating the role of the left frontal lobe in speech production. Furthermore, more recent studies using brain-imaging technology indicate that Broca's area and nearby areas in the left frontal lobe play an important role in the spontaneous expression of speech (Andrewes, 2001).

Box 4.11

Illustration of speech of a Broca's aphasia patient

Cinderella's story

'a mother/ … three kids/ … bad mother/one kid beautiful/ … rich/Italian/ … stepmother/ … talk about Cinderella/Cinderella/clean my house/ … you Cinderella/close the door/ … Cinderella like jail/ … mother … three kids/ … I love mother/ … Cinderella walk ball/ … people ball/ … rich rich people/ … man and Cinderella dance dance dance party/ … one/ … dance dance dance/ … dance every time/ … ball beautiful people/ … people watched Cinderella/ … Cinderella … beautiful clothes … and garments/ … twelve o'clock night/Cinderella/oh no/oh no/ I'm sorry/I'm sorry people/I love you baby/ … walk walk/tumble/ … one shoe bye-bye/ … Cinderella … pumpkin cab/ … oh shoe/oh please/oh well/ walk/walk pumpkin car/.'

Source: Saffran, E.M., Berndt, R.S., & Schwartz, M.F. (1989). The quantitative analysis of agrammatic production: procedure and data. *Brain and Language*, *37*, 440–479. In D.G. Andrewes (2001). *Neuropsychology: From theory to practice*. New York: Psychology Press, p. 303.

Wernicke's aphasia

Wernicke's aphasia (also called *fluent aphasia*, *sensory aphasia* or *receptive aphasia*) is a type of aphasia in which a person has considerable difficulty comprehending speech and speaking in a meaningful way. Unlike someone with Broca's aphasia, speech is often fluent and grammatically correct, but what is said is nonsense. For example, someone with Wernicke's aphasia can produce, or 'string together', a clearly spoken sequence of words or even proper phrases (fluent speech), but what they say is generally nonsense and therefore not considered to be understandable language. Their speech often has the correct rhythm and general sound of normal speech, but the content is odd, conveys little information and sounds like a word salad (Thompson, 2000). For example, someone with Wernicke's aphasia might say something like *I feel very well. In other words, I used to be able to work cigarettes. I don't know how. Things I couldn't hear from are here* (Schacter, Gilbert & Wegner, 2009).

Unlike people with Broca's aphasia, most people with Wernicke's aphasia have little or no conscious awareness or understanding of their condition. They talk nonsense without realising it, being unaware that other people cannot understand them (Stirling, 2002).

Wernicke's aphasia is associated with damage to Wernicke's area, which is located in the temporal lobe of the left hemisphere. Its identification in 1874 by Carl Wernicke provided evidence of a second major language centre in another lobe of the left hemisphere. Like Broca's aphasia, Wernicke's aphasia is most commonly caused by a stroke. Subsequent research has repeatedly confirmed the link between speech comprehension and production problems associated with Wernicke's aphasia and damage to Wernicke's area. However, more research has also identified left hemisphere areas in addition to Broca's area and Wernicke's area that are involved in language. These have been found elsewhere in the left hemisphere and sub-cortically; that is, beneath the cerebral cortex (see box 4.5). Furthermore, it has been found that the right hemisphere also has a role in language. For example, some patients with major destruction to the left hemisphere are capable of swearing and using other emotionally charged words, or singing and producing well-learnt phrases. In some cases, these aphasic patients can sing sentences they are unable to say, thereby making use of the right hemisphere's musical function. In relation to comprehension, some frequently used concrete words, such as *car, television* and *food*, are understood by the right hemisphere, even if the patient is unaware that they have been shown the word. The right hemisphere also appears to have the ability to comprehend the overall context or theme that is present in a sentence (Andrewes, 2001).

Learning Activity 4.14

Review questions

1. How is aphasia defined?
2. Distinguish between fluent and nonfluent aphasia, with reference to examples of speech not used in the text.
3. Construct a table that compares and contrasts Broca's aphasia and Wernicke's aphasia in terms of their specific characteristics. The table should include information about links to specific brain areas, lobes, language problems and patient awareness of problems.
4. What do studies of people with aphasia indicate about the roles of the different hemispheres in language?
5. Olivia has recently suffered serious head injuries as a result of a car accident. Apparent effects of her injury are in her use of speech and her comprehension of speech. While she strings lengthy sentences together, they make little sense. Likewise, she seems to have great difficulty making sense of what others say.
   a. Identify the brain area likely to be damaged and therefore the probable cause of Olivia's speech problems. In which brain lobe is this area located?
   b. Explain the role this area plays in people whose brains are *not* affected by stroke, injury or disease.
6. Following a stroke, Carlo's speech consisted of very short sentences that were incoherent. For example, the sentences were often made up of a few nouns and verbs that weren't linked properly.
   a. Identify the brain area that is most likely linked to Carlo's speech problems. In which brain lobe is this area located?
   b. Explain the role this area plays in people whose brains are not affected by brain damage.

Spatial neglect

A patient in a rehabilitation hospital wakes up in the morning and proceeds to shave his face. When he puts the shaver down to go to breakfast, it is apparent that he shaved only the right side of his face. While eating breakfast, the patient starts to look for his coffee cup until someone points out that it is just slightly to the left of his dish. At lunch or dinner, he may leave the food on the left half of his plate untouched while asking for more, only to be reminded that there is still food on the plate. If asked to read compound words such as *football* or *birthday*, the patient will read *ball* and *day*, overlooking the first half of the word. If questioned, the patient states that he read the words correctly. If asked to draw a clock, the patient will draw a circle correctly but then crowd all the numbers into the right half. If asked to draw a person, he will draw only the right side of the body, leaving out the left arm and leg. If questioned, the patient states that the drawings look all right to him (Springer & Deutsch, 1998).

This unusual behaviour is associated with a disorder given various names in psychology, including *spatial neglect*, *hemineglect*, *hemispatial neglect*, *neglect syndrome*, *contralateral neglect* and *unilateral neglect*. Although some of the terms refer to subtypes of the disorder, all refer to a cluster of attentional and behavioural symptoms associated with a disorder involving problems with attention. Generally, **spatial neglect** is an attentional disorder in which individuals fail to notice anything either on their left or right side. They tend to behave as if that one side of their world does not exist (Stirling, 2002; Andrewes, 2001; Thompson, 2000). Figure 4.39 shows the type of drawings made by patients with spatial neglect. The disorder is most commonly observed in stroke or accident victims who have fairly extensive damage to the rear area of the parietal lobe of the right hemisphere. Consequently, they mostly neglect the left side of their world. Spatial neglect of the right side sometimes occurs after similar damage to the left hemisphere, but much less frequently and in a milder form. In either case, the side of the world opposite to (*contralateral*) the damaged hemisphere tends to be neglected, rather than the same side (*unilateral*) (Springer & Deutsch, 1998; Kolb & Whishaw, 1996).

Spatial neglect is a complex disorder with many different types and subtypes. Although neglect is mostly experienced with the visual sense, it may occur for other senses, such as hearing or touch, or with movement. Furthermore, it may be isolated to one or a combination of these senses. When tested, some patients acknowledge the presence of a stimulus on the neglected side and mistakenly report its presence as if it appeared on the non-neglected side. Thus, for example, a patient may be given an auditory stimulation on their left neglected side and claim that the sound came from the right. Or, in the case of neglect involving movement, the patient may be asked to raise their left hand and, if they respond at all, they may raise their right hand. However, if their left hand is held or stimulated in some way, this extra cue directing their attention to their left hand may be enough for the patient to respond with the correct hand. Similarly, in the case of neglect involving vision, extra visual cues may attract the patient's attention towards the neglected side so they may notice something they had not attended to before. However, the most common and consistently occurring feature of the spatial neglect disorder is an apparent lack of awareness of the presence of an anything on their left side. This means that half of their world is missing. They cannot attend to anything in their left side nor locate anything in their left side. Consequently, there is no spatial perception on the left side of their world (Andrewes, 2001).

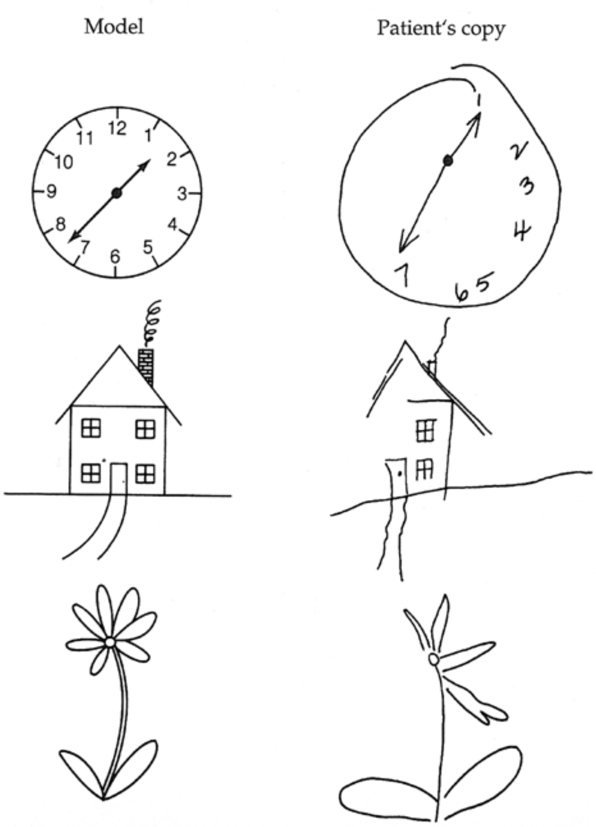


Figure 4.39 When asked to copy drawings of common symmetrical objects, patients suffering from spatial neglect syndrome ignore the left side of the model they are copying.

Experimental research indicates that the neglect experienced by people with spatial neglect can include their inside world as well as their outside world. For example, when neglect patients are asked to imagine a well-known scene, they overlook details on one side of the visual image they create in their 'mind's eye'. This was demonstrated in a simple experiment conducted by Italian neurologists Eduardo Bisiach and Claudio Luzzatti (1978). They asked two neglect patients with right parietal lobe damage to close their eyes and imagine themselves standing at one end of a famous landmark in Milan. The landmark was very well-known to the patients as they had lived in Milan for many years before their strokes. When asked to describe the landmark, both patients described it in great detail, but almost all the identified details were on the right-hand side of their imagined direction of gaze. Control group participants, who were required to perform the same task, recalled about the same number of details from both sides of the landmark and made a similar number of errors. The findings of this study suggest that spatial neglect can affect the recall of images from memory; however, it does not involve memory impairment (Stirling, 2002).

The extent of neglect among different patients varies and depends on the severity and location of brain damage. It may range from indifference towards objects on one side to denial of the very existence of that side of the body. For example, one patient called a nurse in the middle of the night to ask her to help him throw his own left leg out of bed, thinking that 'the alien leg' had been put there as a cruel joke by other patients. Less severely affected patients may simply ignore things in their left or right visual field and not necessarily all parts of their body on that side (Stirling, 2002).

Spatial neglect is widely considered to be a disorder involving failure of attention, and not a disorder due to impairment of memory processes, the visual system or any other sensory system. However, psychologists are unclear about why it occurs following damage to the parietal lobe. Nor is there any widely accepted explanation of the disorder. Its much greater occurrence with damage to the right rather than left parietal lobe demonstrates the importance of the right parietal lobe and right hemisphere in attention and in conscious awareness of objects, both internally and externally. However, like many other mental processes, other brain areas are also involved in attention and consciousness. For example, the frontal lobe plays an important role in attentional processes and consciousness, as do the reticular activating system and thalamus. In fact, one explanation of spatial neglect proposes that it may be caused by failure of cortical arousal associated with the activities of the thalamus and the reticular activating system. Nor is consciousness exclusively associated with the right hemisphere. Interestingly, many spatial neglect patients insist that there is nothing wrong with how they perceive and act in the world. As shown in figure 4.40, some people with spatial neglect make a gradual recovery from the disorder (Bloom, Nelson & Lazerson, 2001; Heilman & Watson, 1977).

2 months after the stroke

3½ months after the stroke

6 months after the stroke

9 months after the stroke

Figure 4.40 Whether or not a patient recovers from spatial neglect, how well they recover and the speed of recovery depends on the severity of the stroke and brain damage. German artist Anton Raderscheidt suffered a stroke that damaged the cerebral cortex of the right parietal lobe. Note his gradual recovery from spatial neglect, as evidenced by the progressive addition of details in the left side of his self-portraits.

Learning Activity 4.15

Review questions

1 Explain what spatial neglect is with reference to examples of mental processes and behaviour associated with the disorder.

2 **a** Which brain area is most commonly associated with spatial neglect?

b What does your answer to part (a) suggest about the role of this brain area in attention, consciousness and spatial perception?

3 In what way does spatial neglect affect conscious experiences of people with the disorder?

4 Why is spatial neglect considered to be a ‘complex disorder’?

5 **a** Identify the IV and DV in the experiment conducted by Bisiach and Luzzatti (1978).

b In what way do the researchers’ results suggest that spatial neglect does not involve memory impairment?

Learning Activity 4.16

Media response

Explain how accurately the cartoon represents spatial neglect, including its prevalence.

Split-brain studies

During an epileptic seizure, abnormal and progressively erratic electrical activity spreads from its source somewhere in the brain to other brain areas. Sometimes the electrical activity starts in one hemisphere and passes through the corpus callosum to the opposite hemisphere, spreading out like ink on a blotter. When this happens, the entire brain can become involved in the seizure. The effects can be dramatic, resulting in massive spasms and loss of consciousness. If breathing stops, the seizure can be life-threatening. In the 1940s, anti-epilepsy medications were not as effective as those available today, and for some people even the highest safe levels of medication could not prevent regular seizures. As these could occur ten or 15 times per day, normal life could be severely disrupted. Doctors were also beginning to understand that the seizures themselves could cause progressive damage to the brain so there was an urgent need for new treatments (Stirling, 2002).

Having tried all other treatments, American neurosurgeon William Van Wagenen decided to try to contain seizure activity to just one hemisphere by cutting the corpus callosum of his patients. This operation has come to be known as split-brain surgery. **Split-brain surgery**, or *commissurotomy*, involves surgically cutting the corpus callosum (and sometimes also other nerves connecting the two hemispheres), thereby disconnecting one hemisphere of the brain from the other (see figure 4.41). The effect is that the two hemispheres do not directly receive information from each other. Van Wagenen knew from the results of animal studies that monkeys given this surgical procedure appeared to suffer no lasting side effects. In the early 1940s, he performed the first of several split-brain operations. Post-surgical testing showed little evidence of impairments in perceptual and motor abilities or effects on everyday behavior. His patients could walk and talk normally, think clearly and interact socially. However, some of his patients showed little or no improvement in their epileptic conditions. Split-brain surgery to treat epilepsy was subsequently abandoned until a decade later when research findings with cats that had undergone split-brain surgery led to a reconsideration of the procedure (Springer & Deutsch, 1998; Kolb & Whishaw, 1996).

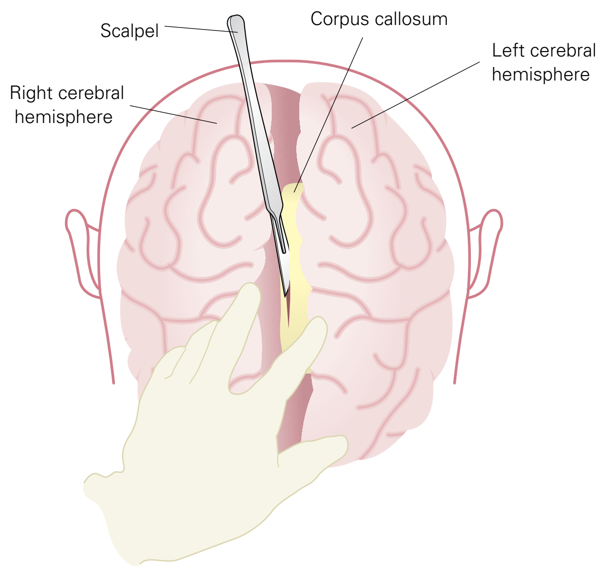


Figure 4.41 'Split-brain' surgery involves completely severing the corpus callosum and other nerve tissue, which connect the two cerebral hemispheres.

In the 1950s, American neuropsychologist Roger Sperry and one of his students Ronald Myers conducted split-brain studies with cats. In most mammals, the visual system is arranged so that each eye normally sends visual information to both hemispheres via the optic nerve and optic chiasm (see box 4.12 on page 224). By cutting into the optic nerve where it crosses the optic chiasm, however, the brain areas to which each eye sends its information can be restricted. The remaining nerve fibres in the optic nerve carry information to the hemisphere on the same side—visual information to the left eye is sent only to the left hemisphere, and information to the right eye is sent only to the right hemisphere.

Myers and Sperry performed this operation on cats and then conducted an experiment. They taught each cat a visual discrimination task; for example, pressing a lever when it sees a circle but not pressing the lever when it sees a square. When this training is done with one eye covered, a 'normal' cat or a cat with a severed optic chiasm can later perform the task using either eye. When both the corpus callosum and the optic chiasm were cut, however, Myers and Sperry found that the results were dramatically different. The cat trained with one eye patched would learn to do a task well, but when the patch was switched to the other eye, the cat was totally unable to do the task. In fact, it had to be taught over again, taking just as long to learn the task as it had the first time.

Myers and Sperry (1958) concluded that cutting the corpus callosum prevented the information going into one hemisphere from reaching the other hemisphere. They had, in effect, trained only one-half of a brain (Springer & Deutsch, 1998).

These findings led two American neurosurgeons, Joseph Bogen and Phillip Vogel, to reconsider split-brain surgery as a treatment for severe cases of human epilepsy. They reasoned that some of the earlier work with human patients had failed because the surgical disconnection between the cerebral hemispheres was not complete.

Bogen and Vogel performed split-brain surgery on 11 patients with serious epileptic conditions, each time completely cutting the corpus callosum and some of the other nerves connecting the two hemispheres. The procedure was successful and very effective, leaving some patients virtually seizure-free afterward and with minimal side effects on their everyday behaviour. More extensive psychological testing and research by Roger Sperry and his colleagues, however, demonstrated that split-brain surgery had left these patients with a unique condition (Springer & Deutsch, 1998; Kolb & Whishaw, 1996).

Drawing on the findings of his split-brain studies with cats, Sperry and his student, Michael Gazzaniga, designed a series of experiments to test Bogen and Vogel's split-brain patients. According to Sperry (1968), all 11 patients had undergone

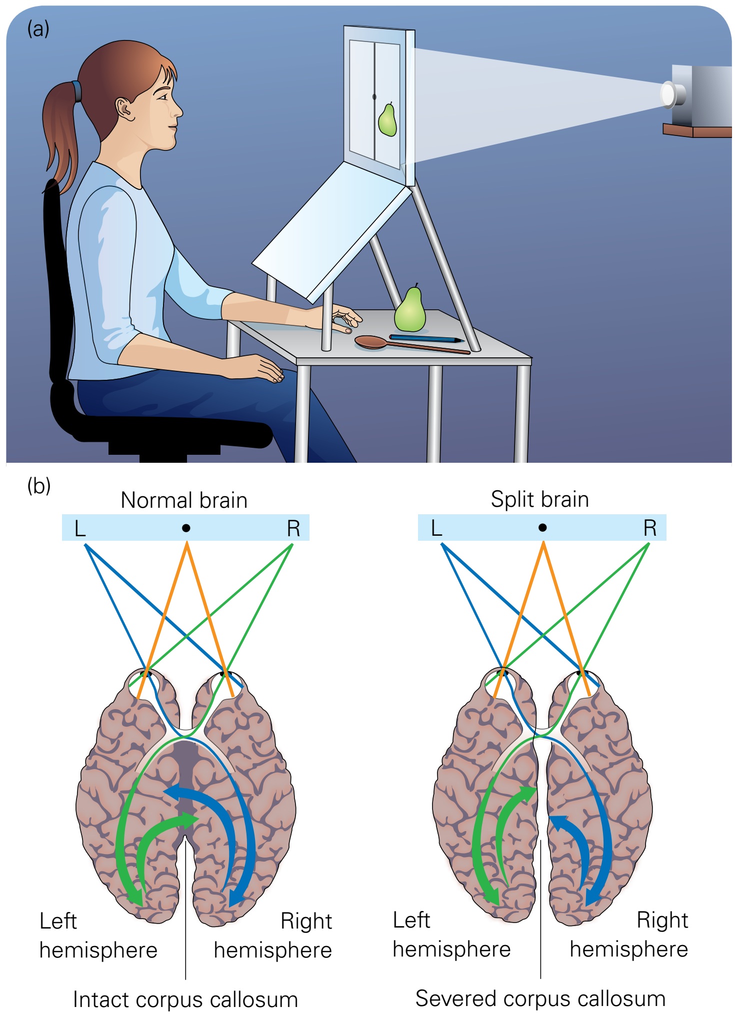


Figure 4.42 (a) The participant in this experiment (a split brain patient) focuses on the black dot in the middle of the screen while the experimenter flashes an image of a familiar object to the left or right of the midpoint. The participant is required to name the object and to reach under the screen with her left hand to locate and identify the object, which is hidden from view. (b) How information from the left and right visual fields is transmitted in patients with and without the split-brain condition.

'the most radical disconnection of the cerebral hemispheres thus far in human history' and the surgery was seen as a 'last resort'. Sperry's aim was to pinpoint the effects of hemispheric disconnection and thereby to address the question of how the hemispheres work in a 'normal' brain.

Under controlled laboratory conditions, Sperry used the apparatus shown in figure 4.42a to test the abilities of split-brain patients and compare their responses with those of participants with no hemisphere disconnection. Tested one at a time, each participant is seated behind a screen. The screen is used to flash a word or picture for a fraction of a second while the participant focuses on a black dot in the middle of the screen. This is done using a tachistoscope, which is a type of projector that allows the researcher to precisely control how long an image stays on the screen. The word or picture is flashed either to the left or right of the black dot.

In this procedure, visual information flashed to the left of the black dot is in the participant's left visual field and would therefore be sent to the participant's *right* hemisphere, while visual information flashed to the right of the black dot is in the right visual field and would therefore be sent to the participant's *left* hemisphere.

Behind the screen and hidden from the participant are several objects such as an apple, a spoon and a pencil. Although the participant cannot see the objects, they are able to reach through a partition below the screen to touch them and therefore respond to tactile sensations, if these are experienced.

Sperry reported the specific responses of an adult female participant, N.G., which exemplified the responses of other split-brain patients. N.G. was asked to focus on the black dot when it appeared on the screen in front of her. As she did so, Sperry flashed a picture of an object such as a pencil or spoon to either the left or right of the black dot. Each time an image was flashed onto the screen, Sperry asked her 'What did you see?' In response to the images flashed in the right visual field (and therefore sent to the left hemisphere), N.G. named the objects. But to images flashed in the left visual field (and sent to the right hemisphere), N.G. could not *say* what she saw and often denied that anything had been flashed on the screen other than 'just a flash of light'.

Why was N.G. unable to identify images flashed to the left visual field? If the visual information sent to the right hemisphere cannot cross back to the left hemisphere (because the corpus callosum has been cut), then the person is unable to *say* what they saw. This occurs despite the fact that they still actually see the image, because the control of speech is located in the left hemisphere. In order to check that N.G. *did* actually see an object when it was presented in the left visual field, Sperry asked N.G. to use her left hand to reach under the partition for the object. N.G. could correctly locate the object shown in the image because her left hand was controlled by the right hemisphere that also saw the image of the object. The message from the primary motor cortex in the right hemisphere that directs the left hand to move does not use the corpus callosum.

It was evident that the right hemisphere had processed information about each object because N.G. could correctly select them by feeling for each one with her left hand. However, she could not say what each object was, because language is controlled by the left hemisphere and only the left hemisphere could convert the information into the spoken words. Other split-brain participants responded in the same ways.

Sperry's results not only provided research evidence that indicated specialised functions of the different hemispheres, but his research also determined the role of the corpus callosum in enabling the exchange of information between the two hemispheres of the brain. In 1981, Sperry was awarded the Nobel Prize in Physiology or Medicine for his research findings (Gazzaniga & Heatherton, 2006).

According to Sperry (1974), splitting the brain had produced two half-brains, each with its own independent thoughts and consciousness. He noted:

> *Each hemisphere ... has its own ... private sensations, perceptions, thoughts, and ideas, all of which are cut off from the corresponding experiences in the opposite hemisphere. Each left and right hemisphere has its own private chain of memories and learning experiences that are inaccessible to recall by the other hemisphere. In many respects each disconnected hemisphere appears to have a separate 'mind of its own'.*

This does not mean that Sperry believed that split-brain surgery caused patients to actually have 'split-consciousness' or 'split-minds'. Sperry also argued that consciousness was the *combined* result of both hemispheres in the intact brain. What keeps the separate hemispheres acting as an integrated unit during the everyday activities of split-brain patients? Why aren't the hemispheres in continuous conflict, with each providing a different conscious experience of the world?

The two hemispheres can compensate for the absence of the corpus callosum and coordinate their activities. This has been explained in terms of a number of different factors. One reason is that the two hemispheres are involved in many tasks. Although one hemisphere may specialise in a task, this does not necessarily mean that the task is exclusively performed in that hemisphere and the other hemisphere does not make any contribution. Another reason is that not all nerve fibres connecting the two hemispheres are cut during split-brain surgery. Lower areas remain intact and some motor and sensory information can be exchanged by the hemispheres via these nerve fibres. Furthermore, eye movements, as well as the fact that each eye projects to both hemispheres, play an important role in establishing unity of the visual world. The eye movements initiated by one hemisphere to bring an object into direct view serve to make that information available to the other hemisphere as well. Much of the conflict that would result from having the two hemispheres view different halves of the visual field is thus avoided. In addition, information from the touch sense provides another means by which each hemisphere is made aware of stimulation from both sides of the body. Finally, each hemisphere apparently learns to communicate with the other by observing and responding to the mental processes and behaviour the other produces. This process has been described as *cross-cueing* or *implicit transfer*. For example, the right hemisphere may perceive something unpleasant and trigger a frown, which the left hemisphere may feel and say 'I'm displeased'. There is, however, variability among split-brain patients as to what can be transferred, and considerable research on the process still remains to be done. It is also important to note that split-brain studies have been based on patients with serious epileptic conditions. The factors that produced the epilepsy in the first place and the epilepsy itself may have produced changes in the patient's brain, making their brain fundamentally different from those of people without epilepsy (Gray, 2007; Springer & Deutsch, 1998).

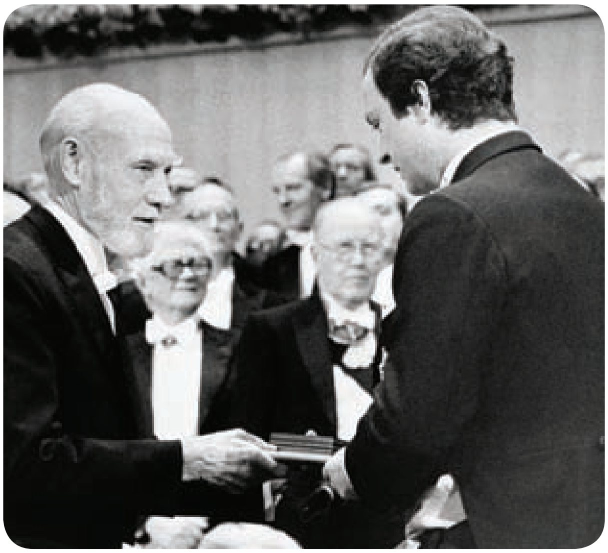


Figure 4.43 Roger Sperry (1913–1994) (at left) received the 1981 Nobel Prize in Physiology or Medicine for his pioneering research on the relationship between the brain and behaviour.

Box 4.12

The neural pathway of visual information

Unlike the crossover of sensory information sent to the primary somatosensory cortex, only some visual information sent to the primary visual cortex crosses over from one side of the body to the other side of the brain. The images formed on the retina of each eye are divided into *left* and *right* halves. The neural pathway that transmits information from the right visual field that reaches the left half of the retina of each eye can be traced in figure 4.44. The pathway starts on the left side of each retina, which is the area shaded blue. This occurs because the retinal image of the object is inverted (turned upside-down) and reversed (right becomes left and vice versa) as it passes through the convex-shaped lens of each eye. The opposite is true for information from the left visual field that reaches the right half of the retina of each eye.

Neurons leaving each eye via their respective *optic nerves* come together at the *optic chiasm*. From here, the optic nerves from the halves of each retina closest to the nose cross over and go to the *visual cortex* on the opposite side from which they began. The visual information from the 'outer' half of each retina does not cross over. Thus, information from the left visual field ends up in the visual cortex in the right hemisphere and information from the right visual field goes to the visual cortex in the left hemisphere.

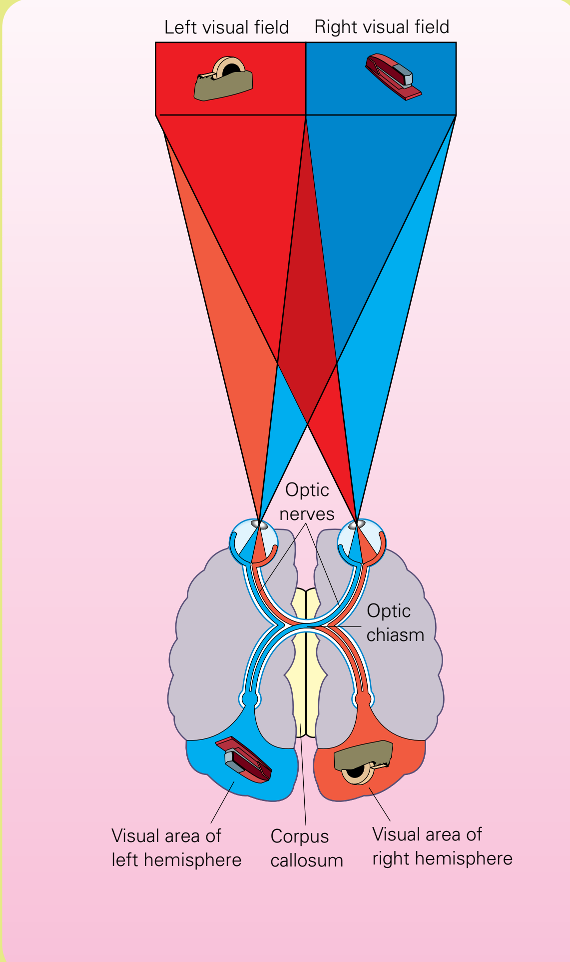


Figure 4.44 The neural pathway of visual information

Learning Activity 4.17

Review questions

1. What is split-brain surgery and why is it performed?
2. What is a split-brain study and why is it conducted?
3. Why would Sperry prefer to study a patient with a damaged brain rather than someone with an intact brain in order to address the question of how the hemispheres work in a 'normal' brain?
4. Why did Sperry use a control group in his experiments?
5. Draw a flow chart to briefly summarise Sperry's experimental design for his split-brain studies.
6. Why is each participant required to focus on a dot in the middle of the screen before the picture appears on the screen?

7 Describe what happens when a split-brain patient is flashed pictures of objects to the right hemisphere and asked to name them. Your response should identify
   a which visual field the image is in (i.e. left or right)
   b on which side of the retina the image will be received (i.e. left or right)
   c which occipital lobe will process the image (i.e. left or right)
   d the expected outcome for a split-brain patient who predominantly processes language in the left hemisphere and the reason for your answer.

8 What conclusion(s) did Sperry draw about how the hemispheres work in a 'normal' brain?

9 Why are demand characteristics and experimenter effects unlikely to have influenced the results in an unwanted way?

10 What do split-brain studies indicate about
   a cognitive processes of the brain?
   b consciousness?

11 a Consider the split-brain studies by Sperry and Myers using cats. Do you believe these experiments would be ethically permissible according to guidelines for animal research. Explain your answer.
   b Would Sperry's experiments with his student Gazzaniga be ethically permissible today according to guidelines in the *National Statement on Ethical Conduct in Human Research*? Explain your answer with reference to the guidelines (see pages 77–80).

12 a If a doctor injected a sedative drug into the artery leading to your left hemisphere just before a friend visits you in hospital, in what way(s) would you be able to greet your friend?
   b What abilities normally used to greet someone would you be unable to use?

13 Suppose you met a person whose corpus callosum had been cut. If you were to put a pencil in this person's left hand, would this person be able to tell you what was in their hand? If 'no', in what other way could the person communicate 'pencil' to you? What if the pencil were put in their right hand?

Perceptual anomalies

Perception occurs when sensory information reaching the brain is meaningfully interpreted. What we see, hear, smell, taste, and so on, is the result of brain activities that actively process and construct reliable representations of reality. This allows us to adapt to the environment and 'make sense' of a constantly changing world. Our perceptions are therefore also an important aspect of our conscious experience of the external world as well as our private internal worlds. Most of the time, our perception of the world closely matches the physical environment around us. However, this does not mean that perception is error-free. We sometimes experience perceptual anomalies.

The term **perceptual anomaly** is used generally to refer to an irregularity in perception. A perceptual anomaly usually involves an inconsistency, or 'mismatch', between the perceptual experience and physical reality. Visual illusions demonstrate cases in which reality is misperceived. For example, when driving along a highway you may have seen a puddle glistening on the road several hundred metres ahead. But as you continue driving, the road stays dry and the puddle continues to remain in the distance. In reality there is no puddle. The illusion has been caused by a layer of hot air beneath cooler air that casts a reflection from the sky onto the road. Similarly, baseball and softball players claim that some pitchers pitch a 'rising fast ball'. The laws of physics state that this is impossible, yet batters insist that they can see the fast ball actually rise as it gets closer to them. This is apparently an illusion that occurs when the batter underestimates speed of a fast pitch (Bahill & Karnavas, 1993).

Perceptual anomalies may also occur with all other senses too. For example, we can hear things that may not exist in reality and perceive taste in something that has no chemical basis for what is tasted. Pain can also persist long after the injury that caused it has healed. For example, amputees often continue to perceive chronic pain from a missing limb after loss of an arm or leg. Consider also examples of when you perceive movement that isn't real. Have you ever noticed how the moon appears to be moving across the sky as clouds pass in front of it on a cloudy, windy night? A similar effect can occur when you are sitting in a car at a stoplight and the vehicle next to you starts to move forward. For a moment you may feel that you are moving backwards. This is despite the fact that your vehicle has not actually moved and the adjacent vehicle is the source of real movement.

In this section we consider another example of an anomaly involving the perception of movement (*motion after-effect*). We also consider an example of our failure to see something that actually takes place or exists in physical reality (*change blindness*) and a relatively rare example of a perceptual anomaly that involves unusual experiences in one sense when another sense is stimulated (*synesthesia*).

Figure 4.45 The Falls of Foyers in Scotland where Addams experienced and described the waterfall illusion now referred to as a motion after-effect.

Motion after-effect

In 1834, philosopher Robert Addams was staring at the Falls of Foyers in Scotland, lost in meditation, when he observed that after watching the falling water for about a minute and then shifting his gaze to the surrounding rocks, the surrounding rocks appeared to move upwards. Naturally enough, Addams called this the *waterfall illusion*, but it is now referred to more generally as motion after-effect to include other examples of phenomena involving apparent motion.

Motion after-effect is the perceptual illusion of movement of a physically stationary visual stimulus following exposure to visual motion. The stationary stimulus appears to move in the opposite direction to the original (physically moving) stimulus. For example, if you were to stare for several minutes at a stationary point (such as a rock located in the middle of a waterfall) while a texture pattern drifts across the field of view and then shift your gaze to a stationary pattern (such as the riverbank), apparent movement is seen in the direction opposite to the previous real motion. You have possibly already experienced motion after-effect after watching a movie. Most movies finish with a moving list of credits to people involved with the production. The moving list scrolls up the screen. In order to read the names, you have to keep up with the list. Next time you see one of these lists, avoid reading the names and just keep your eyes fixed steadily on the centre of the screen until the list finishes. As soon as the scrolling finishes, you will experience illusory motion in a direction opposite to that of the scrolling—this is motion after-effect. An easy way to generate motion after-effect at home is to slowly rotate a patterned plate for about 30 seconds. After the plate is stopped suddenly, it will appear to rotate in the opposite direction for a few seconds (Mather, Verstraten & Anstis, 1998; Sekular & Blake, 1990).

Motion after-effect has been studied extensively by psychologists but the cause is still not fully understood. Research studies indicate that eye movements and neurons in the visual cortex specialised to detect and respond to motion are both involved in the illusory effect. For example, laboratory experiments on the waterfall illusion have found that when one group of participants is asked to track the movement with their eyes, they will report seeing the initial movement, but no motion after-effect. Another group who is asked to keep their eyes stationary will see both the initial movement *and* the motion after-effect. Studies have also found that there are neurons in the visual system that are sensitive to direction of movement. In humans, these are located in the retina and the visual cortex at the back of the brain. It has been suggested that prolonged exposure to a particular direction of motion (say, downwards) can 'fatigue' and therefore reduce the responsiveness of the neurons preferring downward movement, while neurons sensitive to upward motion maintain their normal level of activity, thereby producing the after-effect (Gazzaniga & Heatherton, 2006; Walker, Burnham & Borland, 1989; Anstis & Gregory, 1964).

Despite the potential confusion that can be created by the constant bombardment our senses receive from the different types of incoming stimuli, we consciously experience a seamless, organised, stable and coherent world. Perceptual processes play a critical role in this outcome. However, illusions such as motion after-effect indicate that perception, although reliable, may not always accurately reflect reality.

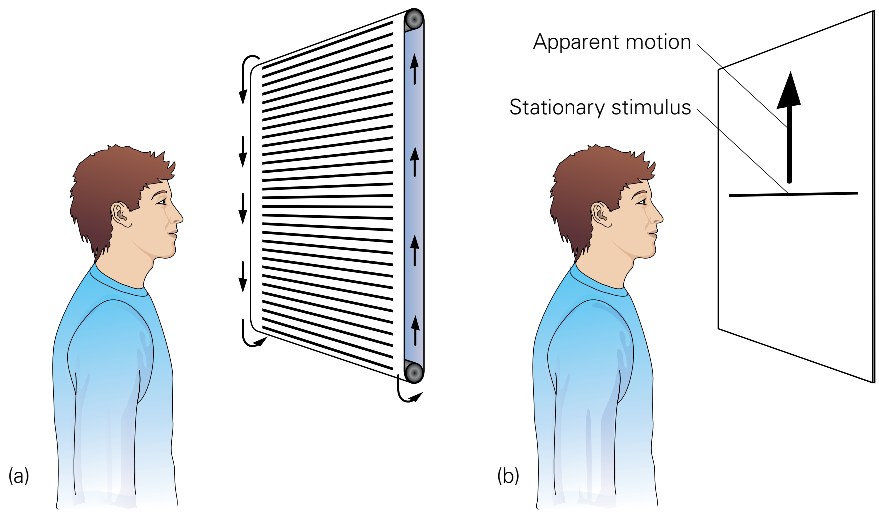


Figure 4.46 Procedure of an experiment on motion after-effect. (a) Objective motion: the research participant first looks at a band of downward moving lines for a minute or two; (b) Subjective motion: he then looks at a stationary horizontal line, which will now appear to be moving upward. Motion after-effect may be produced by eye movements and the adaptation of specialised neurons in the visual system that detect and respond to motion.

Box 4.13

Case study of akinetopsia—motion blindness

Akinetopsia, or motion blindness, is a rare disorder resulting from brain damage in which an individual is unable to perceive motion in many aspects of their visual world. One of the best-known case studies on this disorder is that of a German adult female referred to as L.M. She saw the world almost entirely as a series of 'snapshots', rather than consisting of moving images, especially if the movements involved were quite fast. Her perception was affected for movements in a spatial dimension (horizontal movements, vertical movements and movements towards or away from her), and the condition was very disabling.

Consequently, L.M. experienced difficulty crossing the road because she could no longer judge the movements of cars, yet she could spot a car far away without any difficulty. When pouring tea, L.M. would see the liquid as if were frozen in the air like a small glacier, and she did not know when to stop pouring because she could not see the level in the cup rising. In a room where people were moving about they would seem to L.M. to be first in one place and then suddenly in another place. She also complained of problems in following conversations because she could not see facial movements, especially mouth movements, which we tend to rely on to a significant extent in face-to-face conversations.

In laboratory tests, L.M. was able to locate and perceive stationary objects. Thus she was able to control her eye movements. However, her eye movements when tracking moving objects were abnormal, more so when an object was moving fast. Her eyes jumped from one point to another instead of tracking the moving target slowly.

L.M. also had trouble moving parts of her body under visual control. She could easily trace the path of a raised wire with her finger when she was blindfolded and had to rely on tactile (touch) sensory information. But when a sheet of glass was placed over the wire (to eliminate the tactile information) and the blindfold was removed, she could only follow the path if she moved her finger slowly. Other tests confirmed that L.M's disorder was confined to vision. Her visual perception of depth was poor and she did not experience motion after-effect. Her colour perception was excellent.

There is no effective treatment for akinetopsia (Ellis & Young, 1996).

Figure 4.47 People with akinetopsia (motion blindness) see the world as a series of snapshots rather than as a moving image. Even pouring a cup of tea becomes difficult because by the time they see the cup as full, it is overflowing.

Learning Activity 4.18

Review questions

1. Explain the meaning of the term perceptual anomaly.
2. Explain what motion after-effect is and why it is a perceptual anomaly.
3. What is a common explanation of motion after-effect?
4. Read the case study of akinetopsia (box 4.13) and answer the following questions:
   a. In what way(s) does the case study provide evidence in support of psychologists' explanation of motion after-effect?
   b. Which area(s) of L.M.'s brain may be damaged? Explain with reference to problems experienced by L.M. in cognitive processes, including consciousness.

Change blindness

Imagine that you are standing around and a stranger walks up to you and asks for directions. While you are giving directions, two 'workers' carrying a large board, pass between you and the stranger. You momentarily lose sight of the stranger asking for directions. During this brief period, the stranger to whom you are giving directions is replaced by another person. The new person then resumes the conversation with you as if nothing had happened. Do you think you would notice if the person standing in front of you was switched? When American psychologist Daniel Simons and his colleague Daniel Levin conducted this experiment on a university campus (see figure 4.48), only half the participants noticed the change (Simons & Levin, 1998). The failure to see large changes that should be noticed easily is referred to as change blindness.

Change blindness refers to the difficulty observers have in noticing large changes to visual scenes. Experimental research indicates that we can experience a remarkable lack of awareness of events that take place in our visual environment; for example, colours may change, the shape of a line-drawn object may change, the position of a handrail may change, a soft-drink bottle may disappear from a scene or two cowboys sitting on a bench may exchange heads during a brief visual disruption for the observer! Yet, more often than not, observers do not notice.

Change blindness occurs both when change is expected and unexpected. When change is expected, we may eventually detect the change but 'it can take an astonishingly long time to do so, even for large changes' (Simons & Rensink, 2005). For example, participants in an experiment may be shown two photos of real-world objects or scenes that are almost identical, except for one change (see figure 4.49). The original and modified scene are presented using a 'flicker' technique. This involves presenting the original and modified scene one after the other repeatedly, briefly separated (80 milliseconds) by a blank screen after presentation. The observers are told that something is changing in the picture every time the flicker occurs, and asked to search for it. Observers eventually find the change(s), but take a

Figure 4.48 While a man (wearing glasses) gives directions to a stranger, two 'workers' (research assistants) pass between them carrying a large board. During this disruption, the stranger switches places with a different person wearing different-coloured clothing. Most people, focused on giving directions, do not notice the switch.

Figure provided by Daniel Simons. Simons, D.J., & Levin, D.T. (1998). Failure to detect changes to people during a real-world interaction. *Psychonomic Bulletin and Review*, 5, 644–649.

very long time to do so. The change blindness effect is even stronger when the changes are unexpected. For example, if the main actor in a scene is changed during a shift in camera position, most observers do not notice, even if the actor is replaced by another person.

For change blindness to occur, the change in the scene has to occur during some kind of visual disruption, such as a brief obstruction or during an eye movement (which involves retinal disruption). This means that change blindness is different from 'inattentional blindness' with which it is sometimes confused. Inattentional blindness was demonstrated in an experiment in which participants were required to watch a videotaped basketball game and either count the passes made by one of the teams or to count bounce passes and aerial passes. Half the participants were so focused on their assigned task that that they failed to notice a person wearing a full gorilla suit walk in front of the camera, beat their chest and then walk away (see figure 4.50) (Simons & Chabris, 1999). **Inattentional blindness** is a failure to notice something in a scene when the same scene continually remains in sight. There is no visual disruption or any reliance on memory. However, change blindness involves the presence of a visual disruption during which change detection

Figure 4.49 These two photos were used in a study of change blindness. They are almost identical. Can you see the difference? (The answer is supplied on page 823.)

Figure 4.50 'Gorilla' in the Simons and Chabris (1999) experiment. When attending to one task (counting basketball passes by one of the teams) about half the observers display inattentional blindness by failing to notice a clearly visible 'gorilla'.

Figure provided by Daniel Simons. Simons, D.J., & Chabris, C.F. (1999). Gorillas in our midst: Sustained inattentional blindness for dynamic events. *Perception*, 28, 1059–1074.

requires comparison of one image to another, both of which are held in short-term visual memory (Rensink, 2000).

Can an observer consciously sense that a change is occurring but still have no visual experience of it? In one experiment, American psychologist Ronald Rensink (1998) used the flicker technique. Forty observers were presented with a flicker sequence in which an image of a real-world scene alternated with a similar image that had been changed (see figure 4.51). Observers pressed a button first ($t1$) when they were *aware* that something was changing, and then again ($t2$) when they *visually experienced* the change; that is, when they believed they could describe the item that was changing. Fourteen of the 40 observers reported 'feeling' that something was changing in a large number of trials. According to Rensink, the results of this study suggest that some observers have a limited ability to detect a change in a scene even when they have no conscious experience of it. The results also show that some observers can have a conscious experience of change without an accompanying visual experience. Rensink (2000)

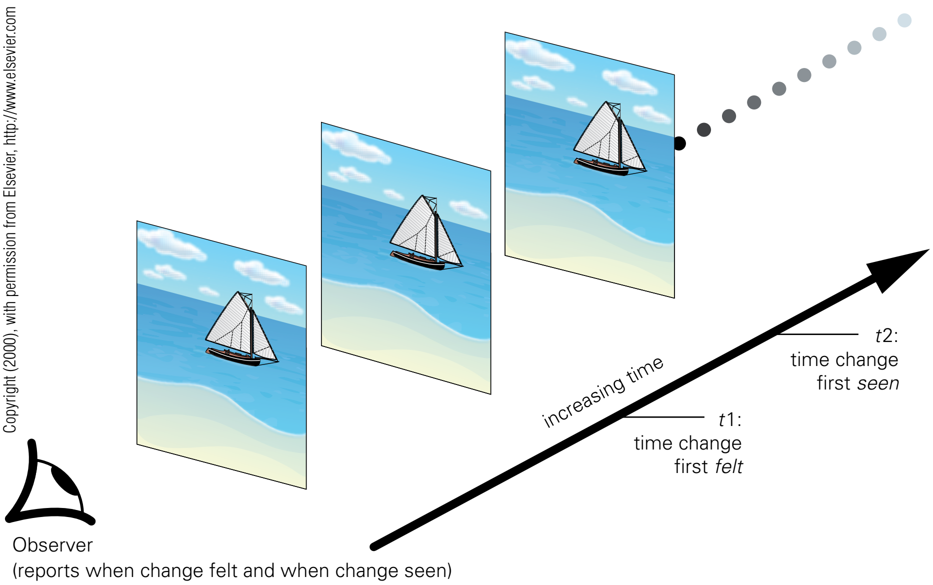


Figure 4.51 In the Rensink (1998) experiment using the flicker technique, observers viewed a flicker display showing a change in a real-world scene. They pressed a button first ($t1$) when they were *aware* that something was changing, and then again ($t2$) when they *visually experienced* the change. For many observers, $t2$ exceeded $t1$ by more than one second on about a quarter of all trials.

Source: from Rensink, R.A. (2000). Seeing, sensing, and scrutinizing. *Vision Research*, 40, 1480.

also believes that his study may provide some evidence for a phenomenon known as *mindsight*—the 'feeling of seeing' with no accompanying visual experience. He has proposed that mindsight may correspond to a 'sixth sense', which is sometimes believed to provide a warning to an observer in a dangerous situation.

Studies of change blindness are useful for exploring aspects of visual perception and consciousness. For example, when looking at most everyday scenes, we tend to believe that we can see everything in great detail and can immediately notice any changes in it. Change blindness studies indicate that this is not necessarily true, which raises questions about the limits of our conscious experience of our visual world. Despite the possibility of mindsight (which has yet to be substantiated), change blindness studies make it clear that focused attention is needed to detect change in any scene. However, focused attention does not guarantee that we will detect the change, even when the change is large, expected and should be noticed.

Although we must look in order to see, the findings of change blindness studies suggest that looking by itself is not enough. For example, a person who turns their eyes toward a bird singing in a tree will often fail to see it right away, 'latching onto' it only after some effort. This also applies to objects in plain view—a driver whose mind wanders during driving can often miss important road signs, even when these are highly visible. In both situations, the information needed for perception is available to the observer. Something, however, prevents the observer from using this information to see the new objects that have entered their field of vision (Rensink, O'Regan & Clark, 1997). One explanation is that simple focused attention might not be enough and that other cognitive processes must accompany attention. In order to perceive change in our visual world, we must focus our attention on a scene, form a visual mental representation of the scene as an image-like replica, or 'icon', and store this in 'visual memory' so that we can access the relevant information in order to compare the original and changed scenes. If attention is not given and mental effort not made, the contents of visual memory will simply be overwritten and replaced by new visual inputs. Therefore, the required information is no longer available and cannot be used to make comparisons for tasks such as change detection—it will simply be forgotten. This view of visual processing has been called 'inattentional amnesia'—the idea is that we see everything, but forget most of it immediately (Rensink, 2000; Simons & Levin, 1998).

Learning Activity 4.19

Review questions

1. Explain what change blindness is and why it is a perceptual anomaly.
2. Under what conditions is change blindness more likely to occur? Explain with reference to findings from experimental research.
3. What is the 'flicker technique' and why is it used in experimental research on change blindness?
4. Is it possible for someone to 'consciously sense that a change is occurring' without actually seeing the change? Explain with reference to Rensink's (1998) study. Ensure that you refer to the research procedures and results.
5. Give an example of when you or someone you know may have experienced 'mindsight'. In your opinion, is mindsight a possible 'sixth sense'? Explain your answer.
6. What does change blindness indicate about
   a. cognitive processes of the brain?
   b. consciousness?
7. To what extent do research studies on change blindness support the view that we can 'look but not see'? Explain your answer.
8. Distinguish between change blindness and 'inattentional blindness' with reference to an example.
9. Explain whether each of the following examples is best explained by change blindness, inattentional blindness or both.
   a. Harry is a magician but prefers to describe himself as an 'illusionist'. One of his best-known tricks is performed by using sudden movements to draw the audience's attention away from the actions that lie behind the trick.

b Mary is an interstate truck driver who managed to survive a serious accident without killing or seriously injuring anyone else. Mary crashed into the side of a train at a remote level crossing in the outback, which did not have any boom gates or flashing lights. The accident occurred in the middle of the day and the level crossing was on a long, straight stretch of track without any trees or buildings blocking Mary's view of the oncoming train. She reported that she was fully alert at the time and that she looked both ways as she approached the crossing, yet failed to see the train.

Learning Activity 4.20

Research investigation

Devise and conduct an experiment on change blindness using the flicker technique and images such as those in figure 4.49 or 4.51 (which were used in actual research by Rensink). PowerPoint software or a data projector can be used to create the flicker technique. Some studies have found age differences to be a factor so this variable could be tested. All relevant ethical guidelines should be followed.

Synesthesia

When Matthew Blakeslee shapes hamburger patties with his hands, he experiences a vivid bitter taste in his mouth. Esmeralda Jones sees blue when she listens to the note C sharp played on the piano; other notes produce different colours—so much so that the piano keys are actually colour-coded, making it easier for her to remember and play musical scales. And when Jeff Coleman looks at printed black numbers, he sees them in colour, each a different colour. Blakeslee, Jones and Coleman experience the ordinary world in extraordinary ways. For them, the senses get intertwined instead of remaining separate. They are among a few otherwise normal people who have synesthesia (Ramachandran & Hubbard, 2003).

Synesthesia (pronounced 'sin-ess-THEE-zhah') is a perceptual experience in which stimulation of one sense produces additional unusual experiences in another sense. The experience associated with the additional sense 'adds' to the overall perceptual experience without replacing the initial sense. Researchers have found that synesthesia is a real experience (rather than imagined) and can be distinguished by a number of characteristics. Synesthesia is involuntary and occurs automatically in response to the relevant sensory stimulation. It is extremely difficult to suppress. The experience is also vivid, highly memorable and consistent across time. For example, the synesthete always associates the same colour with the same number, letter of the alphabet or sound. Blue will always be experienced with the number three, or T's are always red to the individual synesthete. However, these specific cross-sensory experiences vary among individual synesthetes. For example, one synesthete may always experience blue with the number three, whereas another may always experience yellow with the number three. Finally, synesthesia also tends to be one-way rather than bidirectional. If a sound produces a taste, the taste will not necessarily produce the sound (Ward & Mattingly, 2006; Hubbard & Ramachandran, 2003).

Although synesthesia was first scientifically investigated around 1880, it was brushed aside as fakery or a mere curiosity for many years. More recently, many psychologists and neuroscientists have developed renewed interest in synesthesia and are now conducting research investigations on the phenomenon. Much research still needs to be done, but it has been found that there may be unusual brain processes associated with synesthesia and that there may be a genetic basis to its experience, as it tends to run in families. However, there is no strong evidence for sex differences in its experience (Hubbard & Ramachandran, 2003).

Synesthesia is relatively rare and there are substantial individual differences among people in how they experience it. Estimates of its prevalence vary from as much as 1 in 20 people to as few as 1 in 25 000 people. An estimate of about 1 in 2000 people seems to be widely accepted within psychology. Some forms of synesthesia are more common than others. For example, the experience of seeing colours produced by sounds, or seeing letters in specific colours, is more common among synesthetes

(a)

A B C D E

(b)

A B C D E

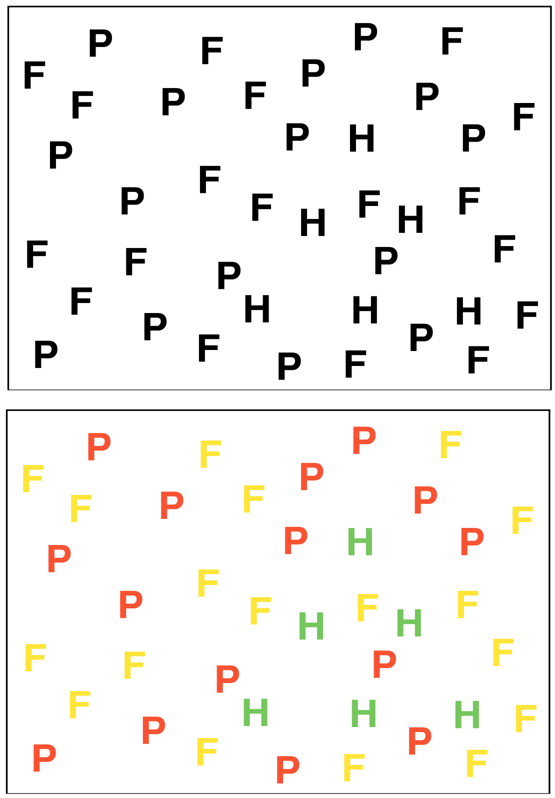
Figure 4.52 Synesthesia is a perceptual experience in which stimulation of one sense produces additional unusual experiences in another sense: (a) how letters usually appear; (b) how letters appear to a person with synesthesia.

than a smell produced by touching a particular shape or a taste produced by hearing words.

One of the most common and widely studied forms of synesthesia is called *grapheme-colour synesthesia*, in which viewing letters or numbers produces the experience of colours. Synesthetes who have this experience report that looking at a specific letter of the alphabet will evoke a specific colour or a 'coloured overlay'. Other synesthetes report that they do not actually see the colours but instead just 'know' that a particular letter is a particular colour. Still others report experiencing specific colours but say that the colour is experienced somewhere within their 'mind's eye' (Hubbard & Ramachandran, 2003).

Most of the research evidence on synesthesia has come from case studies using convenience samples and small-scale testing. The question of whether synesthetic experiences are automatic has typically been investigated using variations of the Stroop effect task. For example, participants are asked to name the actual colour of a visual stimulus (number, letter or word) and ignore the synesthetic colour it elicits. Given that the synesthetic colour is irrelevant to the task, interference arising from it is assumed to be due to automatic processing. Researchers often use a test–retest strategy to check for the consistency of synesthetic experiences. This strategy also enables a check of the authenticity of synesthesia. In one case study, the researchers asked a grapheme-colour synesthete to describe the colour that each of 100 words triggered. A year later, they repeated the test without warning and found that the associations between words and colours that their participant described were consistent with her initial responses more than 90% of the time. In contrast, people who had no experience of synesthesia and were asked to perform the same task, but with only a two-week interval between the two tests, were consistent only 20% of the time. Other researchers using the test–retest method have reported similar results (Ward & Mattingly, 2006; Carpenter, 2001; Baron-Cohen & Harrison, 1997).

The most commonly used strategy to test grapheme-colour synesthetes is to use a visual search task and compare their performance to a control group. For example, participants may be presented with a triangular pattern of H's, such as that in figure 4.53, then asked to detect



Source: Ramachandran, V.S., & Hubbard, E.M. (2003). The phenomenology of synaesthesia. *Journal of Consciousness Studies, 10*, 49–57.

Figure 4.53 When these stimulus materials are used in experimental research on synesthesia, most participants find it hard to detect the triangle of H's. Synesthetes detects it immediately because they see the H's as green, the F's as yellow and the P's as red.

the triangle. Most people with no experience of synesthesia find it difficult to detect the triangle. But grapheme-colour synesthetes are much more accurate and quicker than control group participants in picking out the target pattern. They see the target pattern in a different colour and can therefore more accurately locate it and do so quite quickly. American psychologist Edward Hubbard and his Indian colleague Vilayanur Ramachandran (2005) have conducted several experiments using this procedure. They have found that more than 80% of synesthetes tend to see the test items as shown in the simulation in figure 4.53. For example, the H's may be seen as green, the F's as yellow and the P's as red.

Researchers still know relatively little about synesthesia and why it is experienced. Many explanations have been proposed for its occurrence. Some researchers have suggested that synesthetes are unusually sensitive to external stimuli. Others have proposed that synesthesia may result from a breakdown in sensory and perceptual processes. It has also been suggested that synesthesia can be linked to the excess of neural connections formed during early development that are normally 'pruned' and refined as the brain matures over time. Therefore, synesthetes may be people who retain these neural connections. Many psychologists agree that it is likely that the brains of synesthetes possess unique structural and/or functional properties. Consequently, explanations often refer to the possibility of differences in the architecture of the synesthete's brain. For example, the brains of synesthetes may have abnormal nerve pathways or be 'wired' differently, so that neighbouring sensory areas in the brain cross-activate one another, thereby triggering additional sensations—the experience of seeing colour when looking at shapes might be due to cross-activation of the colour and shape recognition. Neuroimaging technology has been very useful for studying brain areas that are active during synesthesia, but the spatial resolution of images is not yet good enough to allow researchers to see whether the individual connections in the brain are cross-wired. When enough known synesthetes die and donate their brains to science, postmortem examinations may provide valuable information on what is different about their brains and what may therefore account for their extraordinary perceptual experiences. It is likely that something is 'going on' in the sensory areas of the brain but precisely what still remains unclear. It is, however, clear that synesthesia is not associated with any serious brain abnormality or problems with cognitive functioning. Nor is it some kind of 'sixth sense'.

Researchers usually study synesthesia not only because it is a perceptual anomaly, but also because it may shed new light on how the brain is organised and how we sense and perceive the world. It may offer new insights on brain areas and cognitive processes involved in perception and consciousness. For example, it raises questions on the role of attention in perception and conscious awareness; on cross-processing of sensory information and how the different senses interact in the brain; how we 'bind' all perceptions together into one complete whole; how different types of information are represented in the brain; and on the overlap between cognitive processes such as perception, imagery, language, memory and consciousness.

Box 4.14

Do you experience synesthesia?

You may be experiencing synesthesia if:

- black printed letters or numbers have colour, or a personality
- days, weeks or months of the year appear in shapes such as squares, circles and ovals
- sounds or words have a taste
- tastes have shapes
- faces have an aura
- sounds have smells or temperature
- music makes you see visual patterns.

A special few can 'taste' a word before they can say it

By J.R. Minkel

TASTE OF THE UNKNOWN: Words caught on the tip of the tongue elicit tastes in people with an unusual mixing of the senses called synesthesia.

Having a word stuck on the tip of the tongue is enough to activate an unusual condition in which some people perceive words as having different tastes, according to a new study. When people with the inherited condition called synesthesia looked at pictures of objects that come up infrequently in conversation, they perceived a taste before they could think of the word.

Some researchers believe synesthesia is an extreme version of what happens in everyone's mind. If so, the result suggests that all abstract thoughts are associated with specific perceptions, says neuropsychologist Julia Simner of the University of Edinburgh, co-author of the report. 'The extent to which abstract thought is truly abstract—that's really what the question is.'

Simner and her colleague Jamie Ward of University College London tested six synesthetes by showing them pictures of 96 uncommon objects such as a gazebo, sextant, catamaran, artichoke or castanets. Out of 550 trials in total, Simner and Ward induced 89 tip-of-the-tongue states. In 17 of these 'um, um' moments, the synesthete reported perceiving a taste while still trying to conjure the word. In short, the word's meaning alone elicited the taste.

To confirm that these reports were truthful the researchers called the participants out of the blue a year later and retested them. The synesthetes consistently associated the same tastes with the same words, the researchers report in the November 22 *Nature*.

'This looks pretty clever,' says neuroscientist David Eagleman of Baylor Medical College, who was not involved in the study. Synesthesia research has blossomed in the last five years, as researchers have gained confidence in the subjective reports of presumed synesthetes, especially those who perceive letters or numbers as being colored, he says. 'Essentially all the synesthesia literature is about color just because it's easier to study. This is stepping beyond that.' Some experts have estimated that there are more than 150 kinds of synesthesia, based on the possible combinations of subjective sensations, he says.

Prior experiments found that the word–taste associations are locked in during adolescence and have some definite patterns, Simner explains. These synesthetes tend to taste childhood things such as chocolate and lollipops, she says. 'Some of these tastes are really strong and some them of them are really unpleasant—some of the them taste of earwax and bodily fluids,' she notes. 'It starts with words like "mince" and "cabbage", and the taste experience spreads to similarly sounding words.' 'Prince' might also taste of mince, for example. Some of the associations have seemingly obvious roots—'newspaper' might taste like fish and chips, which traditionally comes wrapped in newsprint, she adds.

The brain wiring necessary for synesthesia seems to be present in everyone. Dropping acid or drifting to sleep can both cause synesthetic perceptions, and people who are blindfolded for extended periods may start seeing colors for different sounds, the experts note. 'It's possible that we all have that connection but the synesthetes have them to an extreme degree,' says Simner.

Some scientists have theorized that we are born synesthetic but lose or block most of the pathways that cause the unusual perceptions, Simner observes. Eagleman disagrees, saying that the condition may be the result of an imbalance in brain signals. He hopes to identify the gene for familial synesthesia in order to learn more, he says.

Source: Minkel, J.R. (2006, November 22). A special few can 'taste' a word before they can say it. *Scientific American*. Retrieved from http://www.scientificamerican.com/article.cfm?id=a-special-few-can-taste-a.

Learning Activity 4.21

Review questions

1 Explain what synesthesia is and why it is a perceptual anomaly.
2 List the key distinguishing characteristics of synesthesia.
3 Briefly describe two research methods used to investigate synesthesia and the findings that have been obtained from these types of studies.
4 Identify the possible IVs and DVs in an experiment testing synesthesia using a visual search task.
5 Give a possible explanation of synesthesia that is based on brain dysfunction.
6 What does synesthesia indicate about
   a cognitive processes in the brain?
   b consciousness?

Learning Activity 4.22

Media response

Read the article on synesthesia on page 236 and explain how accurately the article describes *and* explains synesthesia. Ensure you refer to four key points made in the article that can be checked against information in the text.

Learning Activity 4.23

Evaluation of an online test for synesthesia

American neurologist Richard Cytowik has conducted research on synesthesia since 1980 and has written several scientific and popular books on it. These include *The Man Who Tasted Shapes* (2003) and *Wednesday Is Indigo Blue: Discovering the Brain of Synesthesia* (2009), which he wrote with American neuroscientist and psychiatrist David Eagleman. Cytowik's website has a test for synesthesia.

Go to http://cytowic.net/____synesthesia.html. Then click 'Take the synesthesia test' and complete the short pre-test.

How well do the test items reflect the description of synesthesia in the text? Explain with reference to the test items and information in the text.

Brain research methods

A major problem confronting early researchers interested in studying the brain was the lack of technology to directly observe a normal intact human brain in action, primarily because the brain is entirely surrounded by bone (the skull). Consequently, early researchers (most of whom were medical doctors) often studied the brains of dead animals and those of dead people who had donated their bodies to medical science.

Living people and animals were also studied. Studies with animals often included experiments. Many animal experiments involved the destruction or surgical removal of a specific area of an animal's brain to study the effects on behaviour. Studies with people were often case studies. Case studies usually involved individuals who had experienced brain damage in an accident or as a result of an illness or disease.

Although early research provided useful information about the brain, this information was mainly limited to the *structure* of the brain. Relatively little was known about the *function* of the brain; for example, *how* and *when* different brain structures and areas 'work', their relationships to other brain structures and areas, and neural tracts or pathways linking them.

The development of new brain recording and imaging technologies during the 20th century helped advance understanding of the brain in significant ways. An important development in the first half of the 20th century was the *electroencephalograph (EEG)*, which enables detection and recording of the brain's electrical activity. This has provided valuable information on the brain during waking and altered states of consciousness. It has also been used for many studies of other brain functions, often in conjunction with other techniques. Another development was a technique called *direct brain stimulation*, using electrodes to transmit a weak electric current in specific brain areas. This technique enabled researchers to study the brain by opening the skull and activating or disrupting specific brain areas to observe any changes in behaviour. Often, patients who had already undergone surgery and therefore had an exposed brain were used. The technique, however, had limitations and raised many ethical issues despite the valuable information provided by studies that used it. For example, it was extremely *invasive* as it required researchers to expose and enter, or 'invade', the brain; hence the term 'invasive'. Many researchers avoided or abandoned its use but the publication of a study conducted in Britain in 1985 revised interest in the use of direct brain stimulation for psychological research purposes. The study reported the use of a new technique called *transcranial magnetic stimulation (TMS)* to directly stimulate the motor cortex using an electric current generated by a magnetic field. Unlike the earlier direct brain stimulation techniques, TMS is non-invasive. Although developed for medical purposes, it does not require any surgical incision, nor any anaesthetic or sedative. Using TMS, researchers can now manipulate the state of the brain and perform experiments that suggest cause–effect relationships.

The latter half of the 20th century also saw the development of various brain-imaging techniques for medical diagnostic purposes. These techniques included *computerised tomography (CT)*, *positron emission tomography (PET)*, *single photon emission computed tomography (SPECT)*, *magnetic resonance imaging (MRI)* and *functional magnetic resonance imaging (*f*MRI)*. **Neuroimaging** can capture detailed images of the living intact brain as people engage in different mental processes or make behavioural responses. The various brain-imaging techniques can be divided into two general categories: 'structural' and 'functional'. *Structural neuroimaging* refers to scanning techniques that show brain structure and anatomy, such as the CT and standard MRI. Scans produced by these techniques typically show cross-sections of the brain and may look as if someone has sliced through the brain and taken a picture. **Functional neuroimaging** refers to scanning techniques that provide views of some particular aspect of brain function by showing images of the brain 'at work'. They also provide information about brain structure. PET, SPECT and *f*MRI are examples of functional neuroimaging (Springer & Deutsch, 1998).

One important aspect of TMS and neuroimaging techniques is that they help overcome significant ethical issues in studying the live intact brain as well as the damaged brain. Neuroimaging techniques (and the EEG) are *non-invasive*; that is, they can be used by researchers without entering the brain. Therefore, the risk of harm to participants is minimal, if not negligible.

Direct brain stimulation

Electrical signals are generated continuously by the neurons throughout the brain (and nervous system). This type of activity continues as long as the brain is alive. **Direct brain stimulation** involves using a device that emits a weak electric current to activate or disrupt the normal activity of neurons in a specific brain area. This can be done using an electrode or with pulses of transcranial magnetic stimulation. It is assumed that if direct stimulation of a specific brain area initiates a response, then that area of the brain controls or is involved in that response. Direct stimulation may not just initiate a response; for example, stimulate a particular behavioural response such as the movement of a body part. It may also disrupt the functioning of a specific brain area, thereby impairing a response; for example, it may stop speech 'mid-sentence' while someone is talking. The disruptive effect of direct brain stimulation will only be apparent when a person is actively engaged in the behaviour that it impairs or prevents, and is most evident in complex functions such as language and memory (Kolb & Whishaw, 1996).

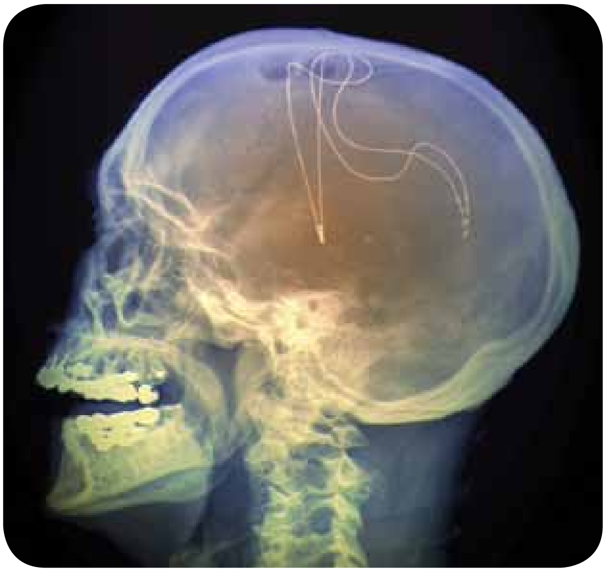


Figure 4.54 Electrodes are implanted in the brain of a person with Parkinson's disease, sending electrical impulses to the thalamic area.

Electrode stimulation

The best-known early studies using an electrode for direct brain stimulation were conducted in the 1940s to the 1960s by American neurosurgeon Wilder Penfield (1891–1976). An *electrode* is a small, electrified fine wire (or disc) that can be inserted into or placed onto a specific area of the brain. The electrode can be used to deliver a precisely regulated electric current to the brain, thereby directly stimulating a specific brain area. Penfield used the technique to locate and identify areas of the cerebral cortex responsible for different functions, thereby producing a 'map' of the cortex.

Penfield did this as a part of his pioneering use of surgery to treat epilepsy. His treatment specifically involved surgically removing the area of cortex that was believed to be the source of epileptic seizures, but only as a last resort for patients whose seizures were often causing violent life-threatening convulsions of the entire body. During the surgery, Penfield had to take considerable care to avoid damaging normally functioning areas of the cortex. In order to do this, it was important to first precisely identify the location of both the abnormal brain tissue as well as the areas of the brain that were functioning normally so that he knew specifically which areas of the brain to avoid damaging during surgery. The patient needed to be conscious during the procedure so that they could react to or report their experiences during the electrical stimulation. Previous research in the early 1900s had shown that, because the brain itself does not contain pain receptors, a patient can remain fully conscious and not experience pain during brain surgery while a neurosurgeon removes a section of skull under local anaesthesia.

When the cerebral cortex was exposed, Penfield was able to stimulate different areas of the brain using an electrode, and to ask his patients to report their experiences. He used this technique with hundreds of patients who had previously given their consent for him to undertake this exploratory procedure while their brains were exposed for surgery. During his research, Penfield used tiny numbered tags to mark the areas of the cortex that he electrically stimulated as he developed his brain 'map' (see figure 4.55). Then he recorded the responses of his awake and alert patients.

As Penfield touched one cortical area after another with the tip of the electrode, the conscious patient reacted in various ways. For example, when Penfield stimulated areas of the occipital lobe, patients reported seeing flickering lights, spots, colours, stars and other visual images. In this instance, Penfield was stimulating parts of the visual cortex, but he was also able to isolate other sensory areas in the cerebral cortex. When he stimulated areas of the auditory cortex in the temporal lobe, patients reported 'hearing' doorbells, engines and a range of other sounds. And when he stimulated the primary somatosensory cortex at the front of the parietal lobe, patients reported 'feeling' a tingling sensation in the cheek, hand, leg and other parts of the body as the tiny electrode was moved from one point to the next. When Penfield shifted the electrode to stimulate the primary motor cortex at the rear of

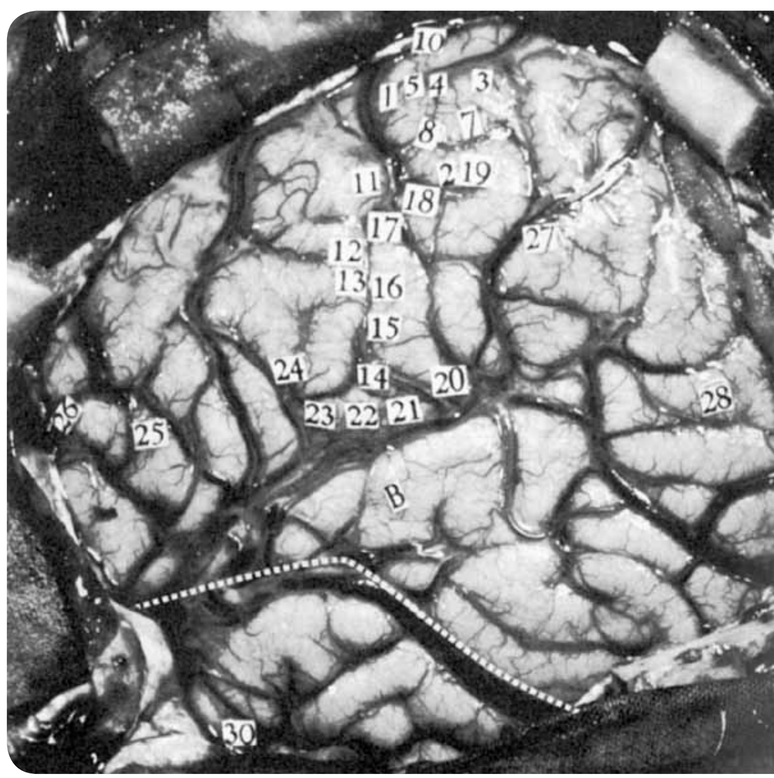


Figure 4.55 Direct electrode stimulation: side (lateral) view of the left cerebral cortex in a conscious patient during surgery. The front of the brain is to the left of the photo and the left temporal lobe is located around and below the tag marked 'B'. The numbers correspond to points that Penfield electrically stimulated. Reactions to these stimulations were observed and noted before surgery was performed to remove the brain area that was causing epileptic seizures.

the frontal lobe, he found that his patients responded by moving specific body parts. As he moved the electrode along this cortical area, a different part of the body moved. This enabled him to identify the areas of the primary motor cortex responsible for initiating movement in those body parts. For example, when he stimulated points at the top of the primary motor cortex, a leg would twitch, and when he stimulated points at the bottom of this cortical area, the patient's jaw or tongue moved (Penfield & Jasper, 1954).

Penfield also identified sites that triggered 'experiential responses' as the patient vividly recalled past events that they had not thought about for years. For example, on stimulation of the site tagged 11 in figure 4.55, a female patient reported: 'Yes, Sir, I think I heard a mother call her little boy somewhere. It seemed to be something that happened years ago.' When asked to explain, she said, 'It was somebody in the neighbourhood where I live.' She added that it seemed that she herself 'was somewhere close enough to hear' (Penfield, 1958).

Over a period of more than 20 years, Penfield and his students pooled the data of hundreds of patients with epilepsy they had carefully studied using direct stimulation. The data was used to map cortical areas and related functions. Their maps have subsequently been confirmed by many other researchers who also used electrodes for direct brain stimulation (Kolb & Whishaw, 1996). For example, American neuropsychologist George Ojemann has examined the effects of cortical stimulation across many areas of the cerebral cortex.

In one study, Ojemann and Mateer (1979) investigated the effect of direct stimulation on specific language areas of the brain, such as areas involved in naming, reading, speech production and verbal memory. Figure 4.56 shows an example of the effects of cortical stimulation on the ability to name objects by a bilingual patient who was fluent in both English and Spanish. The map indicates that stimulation of different areas interfered with either English or Spanish, but not both. In a later study, Ojemann (1991) performed direct brain stimulation on 117 patients with epilepsy undergoing surgery. The patients were required to name pictures while areas of the temporal lobe were stimulated. The electrical current interfered with their ability to name pictures, demonstrating the role of the temporal lobe in picture naming. However, as shown in figure 4.57, their results also indicated that the specific area of the brain associated with an inability to name pictures varied considerably from patient to patient.

Electrodes have also been used for therapeutic purposes in a procedure involving deep brain stimulation. For example, in a recent study of six patients who had failed to respond to 'treatment resistant depression', four gained 'striking and sustained remission of depression' following stimulation through electrodes planted deep in their brains (Mayberg & others, 2008; Myers, 2007). The stimulation served to reduce activity in an area believed by the researchers to be overactive in depression (that is, a nerve area near the structures in the brain stem that form the limbic system). The patients almost immediately after treatment reported mental experiences such as a 'disappearance of the void' and a sense of 'connectedness'. This research finding may promote further experiments to test the possibility of a brain pacemaker that regulate chronic (long-term) cases of depression and possibly other mental illnesses (Mayberg & others, 2008; Myers, 2007). However, in the future, it is likely that TMS will eventually replace electrode stimulation.

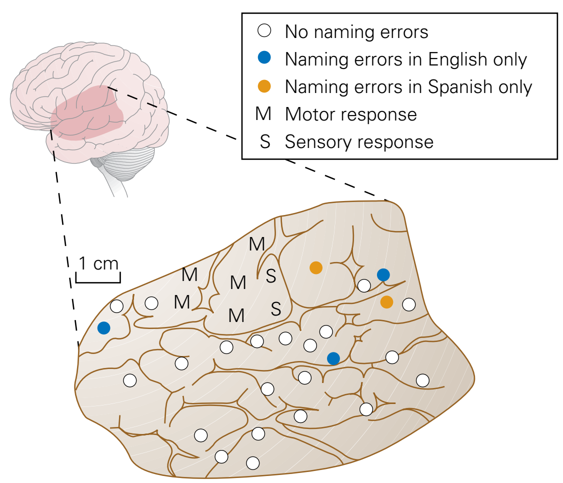
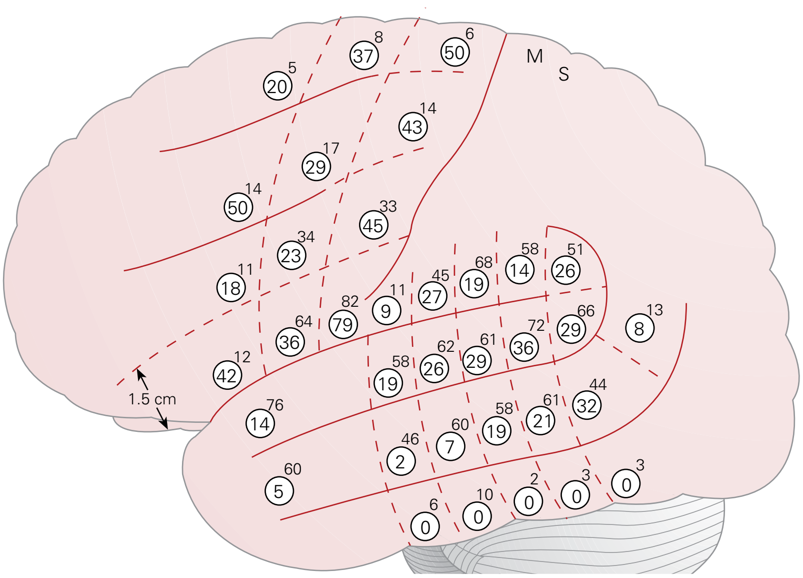


Figure 4.56 Electrical stimulation of some brain sites can interfere with language. This map shows stimulation sites that affected the speech of a patient who was bilingual—fluent in both English and Spanish. Different areas interfere with either one language or the other, but not both.



Source: Ojemann, G.A. (1991) Cortical organisation of language. *Journal of Neuroscience*, *11*(8), 2284.

Figure 4.57 Areas of the brain in which electrical stimulation was found to interfere with picture naming. The numbers represent the percentage of participants whose ability to name pictures was interfered with in each brain area.

Transcranial magnetic stimulation (TMS)

If you've ever held a magnet under a wooden tabletop and used it to drag a needle or pin across the table's surface, you know that magnetic fields can pass relatively unimpeded through insulating material (non-conductors of electricity). The human skull is no exception. **Transcranial magnetic stimulation (TMS)** is a general term for a direct brain-stimulation technique that delivers a magnetic field pulse through the skull and temporarily activates or disrupts the normal activity of neurons in a specific area of the cerebral cortex. The magnetic field induces a harmless electric current in time-varying charges ('pulses'). While receiving stimulation, the person is fully awake and alert. TMS is a non-invasive procedure and there is no need for any substances to be taken or for anaesthetic to be administered. When TMS is used in procedures involving delivery of a single pulse, it is called *single pulse TMS* or *non-repetitive TMS*. This is in contrast to **repetitive TMS (rTMS)** which is used in procedures involving repeated, but not necessarily rapid, delivery of a pulse.

As shown in figure 4.58, the magnetic field pulse is transmitted from a small copper electromagnetic coil that is enclosed in plastic and placed next to the scalp. An electric current is sent through the coil, which induces a magnetic field around the coil and creates the pulse. The single pulse is then directed through the skin and scalp to underlying clusters of neurons. This activates the neurons and they send a burst of neural impulses ('electrical activity') to adjacent neurons, activating them, which in turn activates other adjacent neurons. In this way, a specific area of the cerebral cortex can be activated for a short period. A brief single pulse can cause a burst of brain activity. For example, when the coil is placed just above the skull over an area of visual cortex in the occipital lobe, the participant usually detects flashes of light. If placed over the motor cortex in the frontal lobe, the result is a brief muscle twitch somewhere in the body, depending on which part of the cortex is activated. The pulse does not directly affect the whole brain. It affects only that part of the brain that lies immediately below the skull, about 2 to 3 cm into the brain directly beneath the coil.

In this way, researchers can use TMS to study functions of specific areas of the cerebral cortex. For example, in one study on the function of the motor cortex, TMS was used in volunteers to induce isolated thumb movements in a particular direction by stimulating the area of cortex responsible for thumb movement. The participants were then required to practise moving their thumb in a different direction for 15 to 30 minutes. When TMS was used again to stimulate the same area of cortex, it was found to induce thumb movement in the *new* direction for several minutes before the response reverted to the original direction.
As with electrode stimulation, TMS can be used

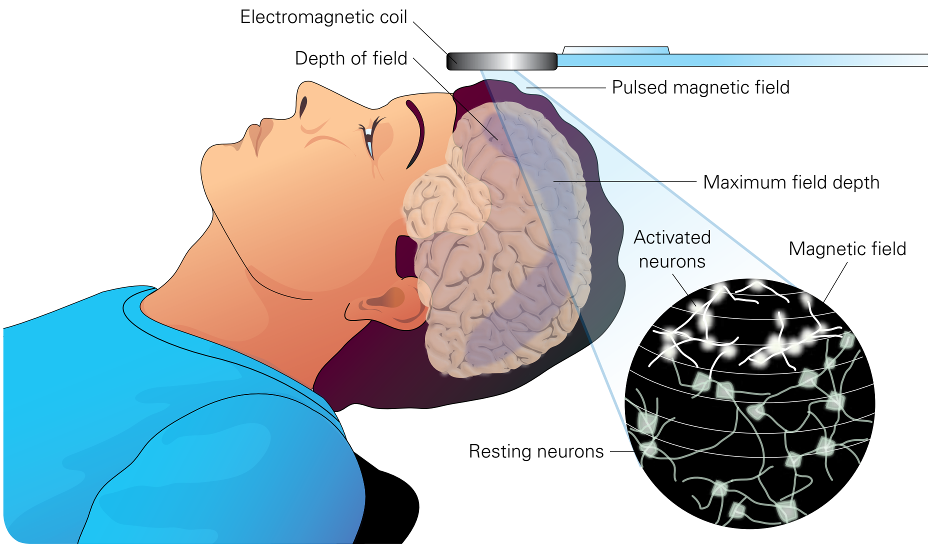


Figure 4.58 In TMS, a magnetic field pulse is directed through the skin and scalp to the cortical surface for a short period to activate or disrupt neuronal function in a specific area of the cerebral cortex.

for mapping brain areas. This is performed by changing the coil position while observing its effects (Breedlove, Rosenzweig & Watson, 2007).

TMS can also be used in clinical settings for diagnostic purposes to help pinpoint specific areas of cortical brain damage and to track patient recovery. For example, TMS can be used with patients who have suffered a stroke, head or spinal injury and show signs of brain damage. It can also be used for pre-surgical assessment of patients with brain tumours and with patients suffering from neuronal diseases; for example, diseases that affect motor skills, such as Parkinson's disease, motor neuron disease and multiple sclerosis.

When rTMS is used, the consecutive pulses cause the neurons to lose their ability to fire. This results in suppression of their activity and consequently brain activity in the stimulated area. Essentially, this is 'turning off' a small area of the brain without causing any damage or unwanted side effects. For example, if the coil is held over Broca's area the person is unable to speak fluently while the current is on but will resume fluent speech as soon as the current is stopped. Similarly, by directing rTMS pulses to other specific brain areas and making them inactive, researchers can measure temporary changes in all kinds of mental processes and behaviour, such as how a person hears, sees, feels, thinks, remembers or moves. For example, researchers have found that rTMS on specific areas of the visual cortex temporarily impairs a person's ability to detect the motion of an object without impairing their ability to recognise that object (Schacter, Gilbert & Wegner, 2009). Furthermore, rTMS can be used to study how the brain organises different functions such as language, memory, vision or attention. Another benefit of rTMS is that researchers can now temporarily create brain 'malfunction' and simulate brain damage, permitting them to perform experiments with human participants that would otherwise not be possible.

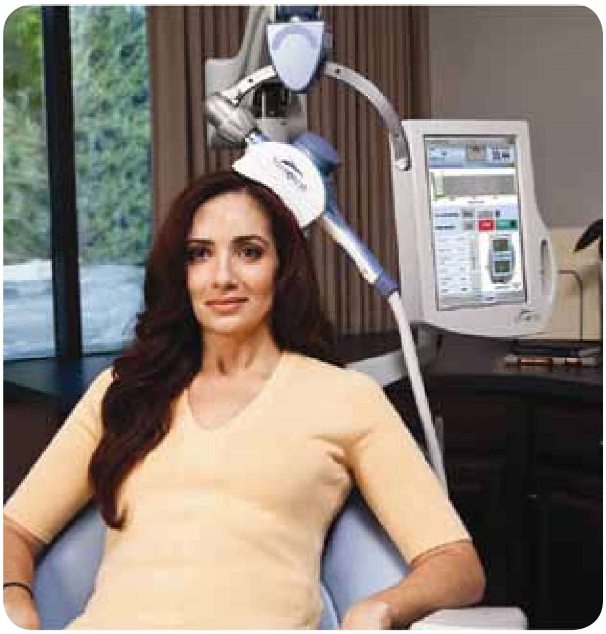


Figure 4.59 TMS can be used for brain research and in clinical settings for diagnostic purposes to help pinpoint specific areas of cortical brain damage and to track patient recovery.

rTMS produces effects that last longer than single-pulse TMS. For example, since the mid 1990s, rTMS has been primarily studied as a therapy for depression. In an independent-groups experiment using the double-blind procedure, 67 Israelis with major depression were randomly allocated to two groups. One group received rTMS to the cortex of the left frontal lobe daily for 30 minutes over a two-week period, while the other group received a placebo treatment (without TMS). At the end of the two weeks, half of the stimulated patients showed at least a 50% improvement in their scores on a scale (test) used to measure depression, as compared with a 25% improvement in the placebo group (Myers, 2007). More recent large-scale studies have confirmed the therapeutic effect of rTMS in treating serious cases of depression (Demitrack & Thase, 2009; Aleman & others, 2007). However, some studies have not found it to be very effective. Although therapeutic rTMS has been accepted as a standard treatment of depression in the USA, Canada and Israel, caution continues to be recommended (Pridmore, 2006). It seems that rTMS is capable of changing the activity in a brain area, even beyond the duration of the rTMS application itself. For example, it may be possible to make a specific brain area work more or less for a period of minutes, or even weeks, when rTMS is applied repeatedly several days in a row. This opens up options for research that were previously never considered possible.

Value and limitations of direct brain stimulation

Direct brain stimulation is a very effective technique for brain research. The use of electrodes has been useful and reliable—many research studies using this specific technique have advanced our understanding of the role of the brain in mental processes and behaviour. More recently, the development of TMS has generated a great deal of interest among psychologists throughout the world about its possible uses for brain research.

Electrode stimulation provided the means for researchers to identify the locations and functions of numerous brain structures and areas, as well as hemispheric specialisation for different functions. Results from many case studies of individual patients have been checked against case study reports of patients with similar conditions, and the results are generally very consistent. Although there can be a great deal of variation from patient to patient in the exact location and extent of specific areas associated with particular responses, it is believed that these individual differences are most likely due to our having different amounts of cortex that are involved in our individual responses (Kolb & Whishaw, 1996). However, control of right leg movement will still be located in the left hemisphere's primary motor cortex between the areas that control the ankle and the knee. The difference is only one of space, and electrode stimulation, at the least, provided pointers to the sort of information processed by a stimulated brain area.

A major limitation of electrode stimulation is that is an extremely invasive research procedure, which imposes risks that, by today's ethical standards, would be considered unacceptable. Although this limitation can be overcome by using animals in research studies, the use of electrode stimulation dropped off markedly in the 1980s. This coincided with the advent of the new neuroimaging technologies that provide more precise information and can be used with healthy patients with intact brains. Another limitation of electrode stimulation involves difficulties in generalising the results. Most studies have been conducted with epileptic patients before surgery. The brains of these patients were not normally functioning brains. Consequently, it is very difficult to generalise the results to people with normal healthy brains.

Electrode stimulation for research with human participants is now rare and mainly of historical interest. Developments in the TMS technique in particular will ensure this continues. However, interest may be renewed as new, safe electrode-based technologies emerge, such as electrode implants that may be able to control chronic and otherwise untreatable brain-related illnesses or disorders in the way that 'pacemakers' control abnormal heart conditions.

TMS has the value of being non-invasive. Unlike electrode stimulation, a hole does not have to be made in the scalp or skull and it can be used with wide-awake participants or patients who do not require any sedation or anaesthetic. Nor does it use X-rays or radioactive substances, as do some of the neuroimaging techniques. However, it can't be used with individuals who have any metal or implanted medical devices in their body or if they have a history of seizures.

The use of single or paired pulses is considered to be completely safe and harmless. Single-pulse TMS delivers a single stimulation to the target area, often in conjunction with the participant performing a cognitive task (such as identifying rapidly presented letters on a screen). Delivery of the pulse is time-locked to the presentation of stimuli so that the researcher can determine when a specific cortical area is required to respond to the cognitive task. The limitation of this method is that if the researcher stimulates at the wrong time, TMS will not disrupt the cognitive process of research interest (Robertson, Theoret & Pascual-Leone, 2003).

The long-term effects of repeated stimulation have not yet been established, especially when fast and high-intensity pulses are used. The most commonly reported side effect during rTMS is scalp pain or discomfort during the treatment session. A mild headache at the site of stimulation following rTMS is also common, occurring in up to 30% of patients or research participants, but the headaches go away quickly following simple pain relief such as taking aspirin. There is no evidence that TMS can trigger migraine or other serious headaches. In fact, a hand-held machine is available for the treatment of migraine. There are no known negative effects on cognitive processes such as memory or ability to concentrate. At present, the only serious side effect that has been reported has been the induction of a seizure or epileptic convulsion in a few individuals when a high energy level of stimulation has been used. This occurred in participants with no history of or predisposition to having seizures. Along with the lack of research evidence on the long-term effects of TMS, the possibility of a seizure, however remote, is a major concern with TMS (Duckworth, 2009).

Another limitation of TMS is that the magnetic field affects only that part of the brain that lies immediately below the skull. This means that TMS can be used only for studying and mapping the cerebral cortex, which is the outermost part of the brain. However, it is likely that a new generation of 'coils' will be manufactured that will enable deeper stimulation.

The main value of TMS is in enabling researchers to temporarily simulate brain damage, permitting them to perform ethically acceptable experiments with human participants that would otherwise not be possible. Many psychologists believe that by manipulating the state of the brain, researchers can now perform experiments that establish cause–effect relationships between particular brain areas and particular behaviours. Rather than relying on case studies of patients with brain damage, or the scans provided by neuroimaging devices, researchers can now manipulate brain activity and measure its effects. Neuroimaging techniques provide images of specific areas that are active and inactive when the brain is doing something. However, this does not necessarily mean that those areas are actually involved in the task. It simply indicates that they are active during the task and may therefore be involved in the task in some way. If the activity of a specific brain area is suppressed, as can be done with TMS, and a participant cannot perform a task, then this provides much stronger evidence that the area is actually used for the task (Schacter, Gilbert & Wegner, 2009).

Box 4.15

Electrical stimulation of animal brains

In the early 1950s, Walter Hess, a Swiss neuroscientist and Nobel Prize winner, pioneered the use of *electrode placement* to electrically stimulate structures located deep in the brain. This type of research is unethical with human participants, so Hess used cats because they have brains similar to those of humans, but with far less area of cerebral cortex. Hess (1957) carefully recorded the behavioural consequences of stimulating each of 4500 brain sites in nearly 500 cats. For example, Hess put a radio-controlled electrode into a specific brain structure called the hypothalamus. By pressing a button, he could send a weak electric current to the hypothalamus at the point of the electrode. He found that, when the hypothalamus was electrically stimulated, an otherwise gentle cat showed behaviours typical of aggression when it was being threatened. As shown in figure 4.60, the cat spat and growled, lashed its tail and extended its paws, and its fur stood on end. Hess concluded that neural activity alone, arising from the hypothalamus, appeared to produce this expression of fear-provoked aggression. The press of a button would instantly turn on the aggression, and would turn it off just as abruptly.

An even more dramatic exhibition of electrical stimulation apparently affecting emotional behaviour was staged by José Delgado, a Spanish neurophysiologist. Delgado (1969) implanted a number of radio-controlled electrodes in the brain of a bull bred specifically to be aggressive in the bullring. Delgado claimed that stimulation would stop the charging bull. Standing in the bullring at the moment of the bull's charge, Delgado activated the electrode, which made the bull stop abruptly (see figure 4.61). Although the popular media emphasised that Delgado was able to control the bull's aggression, Delgado had actually implanted the electrodes in motor areas. When activated, they forced the bull to stop moving forward and then caused it to turn to one side.

Although Hess and Delgado are described as having pioneered electrical stimulation research using animals, the first reported study dates back to 1870. German physiologists Gustav Fritsch and Eduard Hitzig electrically stimulated the frontal cortex of dogs and demonstrated the *contralateral* (opposite side) function of limb movements. They found that stimulation within a particular area of motor cortex triggered movement of a limb on the opposite side of the body, and that when they destroyed the same area of cortex in the brain of a dog, the dog had little control over that same limb (Andrewes, 2001).

Figure 4.60 With an electrode implanted in one area of its hypothalamus, this cat postures aggressively when electrical stimulation is applied.

Figure 4.61 José Delgado, Spanish neurophysiologist and well-known brain stimulation researcher, halting the attack of a bull by stimulating radio-controlled electrodes implanted in the bull's brain.

Box 4.16

Using the EEG in brain research

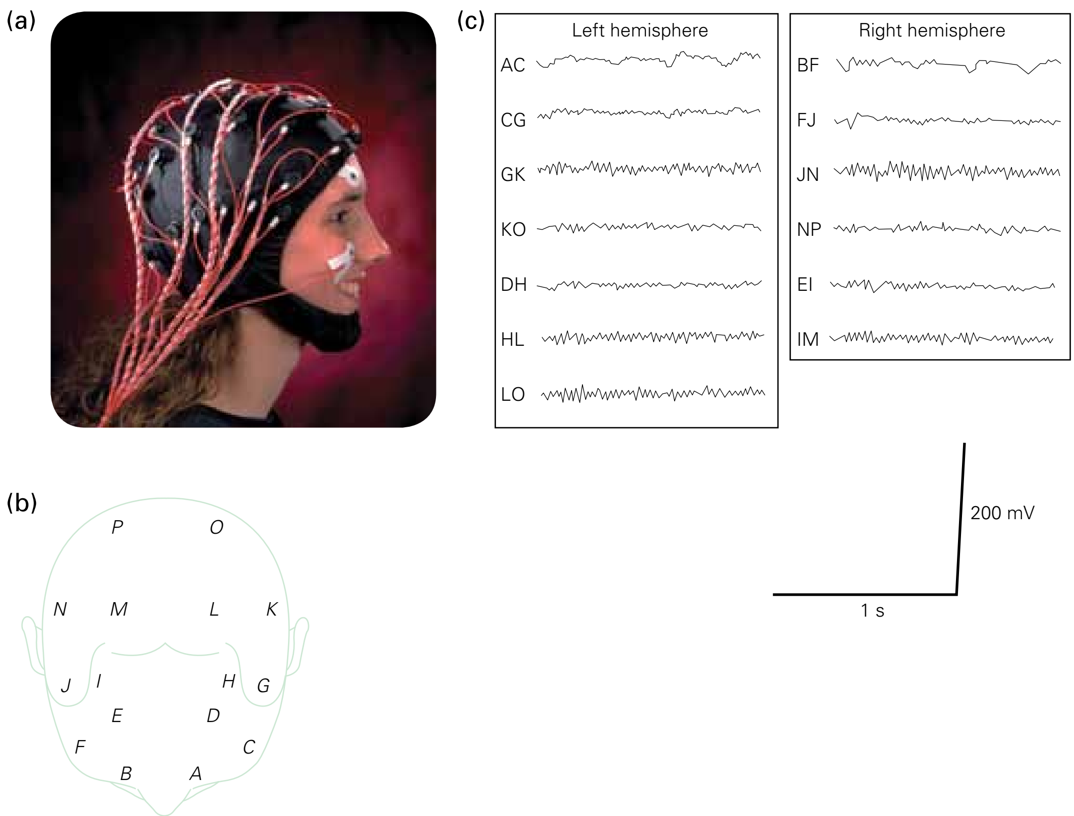
The EEG has been widely used to assist with the diagnosis and psychological study of various brain-related medical conditions, including brain damage and neurological (nervous-system-related) disorders such as epilepsy and Parkinson's disease. More recently, EEGs have been able to identify distinctive patterns of electrical activity in the brain often occurring in people with depression or schizophrenia.

An example of the use of EEG in studying brain-related disorders is illustrated with people suffering from apraxia. *Apraxia* is a serious disturbance in the initiation or organisation of voluntary movements, even though there is no muscle paralysis. In some apraxias, the person is unable to perform familiar actions, such as waving goodbye or smiling when asked to do so. If asked to use a comb placed in front of them, the person with apraxia seems unable to figure out what to do. However, at other points in a discussion with a person with apraxia, they may spontaneously smile or retrieve a comb from their bag or pocket and comb their hair without difficulty. This shows that there is no muscular reason preventing them from performing these voluntary movements. The person's problem is in initiating the behavioural sequence or in selecting the right parts of a sequence and linking them together in an appropriate way.

Figure 4.62 A person with apraxia may not be able to perform the familiar action of waving goodbye when asked to do so.

Various EEG studies on apraxia have found that neurons in motor cortex areas next to and in front of the primary motor cortex (for example, the *secondary motor cortex*) fire almost a second before apraxiacs actually make a movement such as raising an arm or wiggling their fingers. This indicates that the 'non-primary' motor cortex areas play a role in preparing specific voluntary movements before these are initiated. In short, the non-primary areas seem to be responsible for 'get ready!' and 'get set!', while at 'go!' the primary motor area takes over. However, brain damage that disconnects the primary motor cortex from non-primary areas seems to disturb communication between these two areas of the brain.

The EEG is useful in providing general, or 'overall', information about brain activity without being invasive. The equipment can be more easily accessed by researchers than the very expensive neuroimaging devices, and it can be used with a wide variety of participants, including infants. The EEG can also be used to study brain wave activity over relatively long periods of time, as shown in sleep studies. Alternatively, it can be used to study ongoing activity in the brain while the participant performs long, complex tasks. Since its development in the 1920s, it has provided valuable information about different levels and types of brain wave activity associated with various thoughts, feelings and behaviours, as well as hemispheric specialisation.



Source: Rosenzweig, M.R, Breedlove, S.M., & Leiman, A.L. (2002). *Biological psychology – An introduction to behavioural, cognitive, and clinical neuroscience.* (3rd ed.). Sunderland, Massachusetts: Sinauer Associates, p. 82.

Figure 4.63 (a) Multiple electrodes used for EEG recording. (b) Each electrode can be assigned a letter on a map of the scalp. (c) Typical EEG records showing electrical activity measured between various points on the scalp.

A limitation of the EEG is that it does not provide detailed information about which particular structures of the brain are activated and what their specific functions might be. Electrodes attached to the scalp detect information from a relatively large area of the brain and it is difficult to pinpoint the specific area of the brain that is the source of the brain wave activity. Specific changes in brain wave activity do occur in response to the presentation of a particular stimulus, such as a flash of light, but the changes in brain wave activity can be hidden by the overall background activity of the brain. Furthermore, the strength of the electrical activity at its source is reduced after having travelled through the thick bone structure of the skull. Therefore, the EEG merely provides a summary of all the activity of neurons firing within the brain. Using an EEG to understand the workings of the brain has been likened to ‘blind men trying to understand the workings of a factory by listening outside the walls’ (Hassett, 1978) and ‘like studying the activity of a car engine by listening to the hum of the motor’ (Myers, 2007).

Learning Activity 4.24

Review questions

1 Distinguish between
  a invasive and non-invasive brain research methods
  b structural and functional results of direct stimulation or neuroimaging research methods.
2 Describe the potential benefit of using a brain research method that obtains functional information compared with a method that obtains structural information for studies on the role of the brain in mental processes and behaviour.
3 What is direct brain stimulation?
4 a What is electrode stimulation?
  b What is the key assumption of electrode stimulation when used to study brain structure and function?
  c Explain how electrode stimulation is used for brain research, with reference to an example of a research study and key findings.
5 a What is transcranial magnetic stimulation (TMS)?
  b Distinguish between single-pulse TMS and repetitive TMS.
  c Briefly explain how TMS can be used to activate or inactivate cortical areas with reference to the effects of electrical stimulation on stimulated neurons.
  d Describe two advantages and two limitations of TMS when compared with the use of direct electrode stimulation in brain research. Ensure you refer to the possibility of establishing cause–effect relationships through TMS research.
6 a What is the key assumption of the EEG method when used for brain research?
  b Explain how the EEG method is used to study the brain in a cognitive process other than consciousness.
  c Describe an advantage and a limitation of the EEG method with reference to key findings from an EEG study.
7 a Explain how the case study method is used for brain research, with reference to an example of a case study (see also pages 53–56 in chapter 1).
  b What are two distinguishing features of a case study?
  c Briefly describe two advantages and limitations of the case study method, with reference to key findings of a case study on brain roles and/or functions.

Learning Activity 4.25

Probe the brain

Go to the website www.pbs.org/wgbh/aso/tryit/brain. Click on 'Probe the Brain Activity'. At this website you can adopt the role of a researcher as your cursor changes into an electric probe. The motor cortex is highlighted, and as you touch various points along it, you will cause the corresponding body part on the 'patient' to move. You will also be provided with the name (and a number) for that body part. When you have travelled along the motor cortex with your probe from one end to the other you should have located 17 different body parts. If you manage to locate all 17, your 'patient' will reward you.

Now go back a page and click on 'Mapping the Motor Cortex: A History'. Learn about the first experiments that used electrical stimulation of different brain areas in the late 19th century. In 'Part II: Wilder Penfield Maps the Brain' the work performed by Wilder Penfield in the 1950s is briefly described.

If you wish, examine the research performed by Wilder Penfield and Roger Sperry in more detail. These are both accessed via the 'Related People and Discoveries' links. Alternatively, click on 'CT Scan and MRI Introduced' to read about how they are used to study the brain.

1 Write a description of the way the body parts are organised along the motor cortex (without actually naming all 17 from the above activity) and explain why certain parts are represented unequally when 'mapped' on the motor cortex.
2 Summarise how CT and MRI work, and outline advantages and disadvantages of each technique for brain research.

Computerised tomography (CT)

Brain research methods were significantly advanced with the development of neuroimaging techniques in the early 1970s. The first neuroimaging technique was computerised tomography. Computerised tomography (CT), or **computerised axial tomography (CAT)** as it is more specifically referred to, is a neuroimaging technique that produces a computer-enhanced image of a cross-section ('slice') of the brain from X-rays taken from different angles. The procedure involves moving an X-ray source in an arc around the head while a computer compiles different 'snapshots' of the brain area being investigated.

CT is a medical procedure that can only be performed by a specialist doctor called a radiologist. For a brain CT scan, the research participant (or patient) must first be given an injection of a substance into the vein of their arm or hand. The substance that is injected is commonly called contrast and is based on iodine. This is used to highlight the brain's blood vessels and greatly assists the radiologist and researcher in interpreting the CT images. Contrast is not radioactive and rarely has any serious side effects, although mild reactions are experienced by up to 39% of people (Royal Australian and New Zealand College of Radiologists, 2010).

During the CT procedure, the participant is required to lie very still on the CT scanner bed with their head inserted into the scanner opening (see figure 4.64a). An X-ray source is slowly moved in a circular path around the head, at each position delivering a small amount of radiation, which passes through the head and brain (see figure 4.64b). An X-ray detector opposite the X-ray source analyses the amount of radiation that has passed through the brain. This procedure creates a thin, horizontal cross-sectional image, or a 'slice' of the brain, only a few millimetres thick (see figure 4.64c). The X-ray source and detectors are then moved to a new position, and the procedure is repeated many times. A computer then combines the many cross-sectional images taken from all the different angles around the head into a composite cross-sectional, two-dimensional or three-dimensional image. The image produced is called a *computerised tomogram scan (CT scan)* or *computerised axial tomogram scan (CAT scan)* and provides far greater clarity and detail of the brain area under investigation than a conventional X-ray. For example, imagine the brain as a loaf of

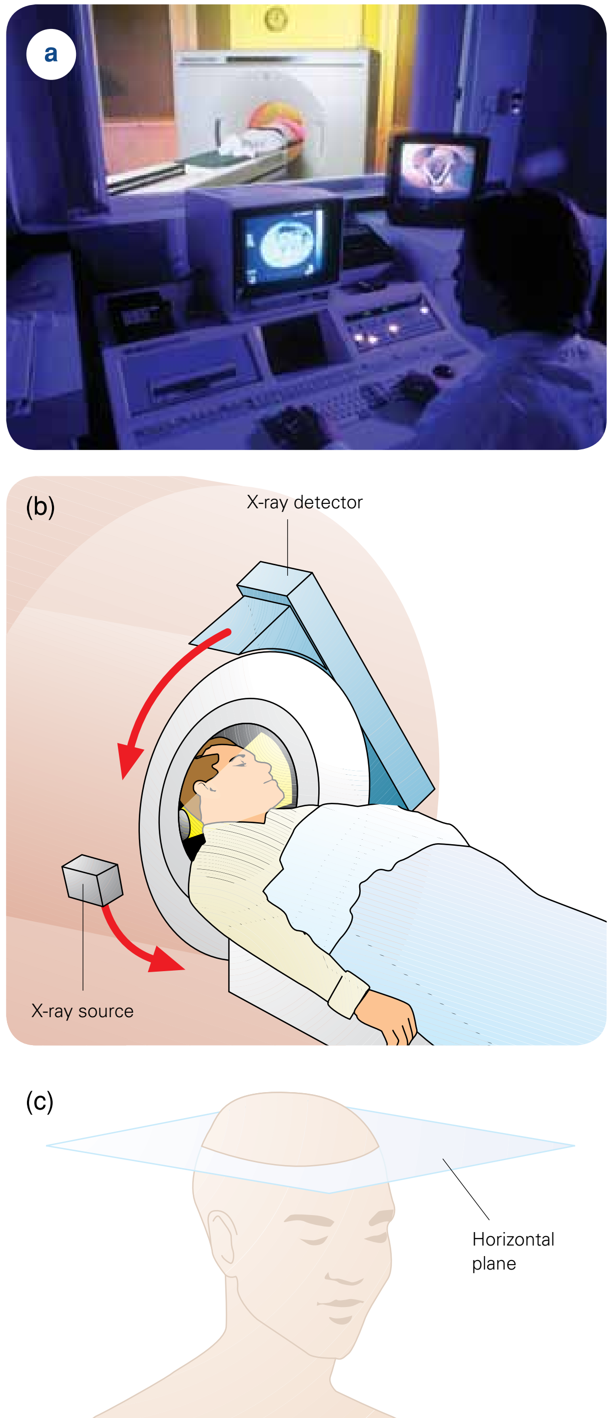


Figure 4.64 (a) A CT scanner. (b) A CT scan is produced by a computer that compiles a series of different X-ray images taken from different angles around the head. (c) A horizontal plane is a cross-section of the brain shown in a CT scan.

sliced bread. As you remove each slice of bread, you can see the entire surface of that slice from the crust to the centre. The brain is seen on CT slices in a similar way, from the scalp to the thalamus in the centre. When these 'slices' are added together, a three-dimensional image of the brain can be obtained.

The development of CT scanning technology provided a new way of looking at a live intact human brain without using invasive, often dangerous, procedures. Although the use of CT for brain study requires injection of a contrast medium, psychologists and medical experts do not view this as invasive. Furthermore, the radiation dosage during the X-ray procedure is believed to be relatively harmless, and risks to the participant's health are considered to be negligible. CT is extremely useful for spotting and identifying the precise location and extent of damage to or abnormalities in various brain structures or areas. For example, a CT scan can help identify the location and size of tumours and the location and extent of damage caused by a stroke, injury or other brain disorder. It has also been used in research to look for and identify possible abnormalities in brain structures among people with a mental illness such as schizophrenia and depression. Furthermore, CT has enabled observation of physical changes or differences in the brains of patients with Parkinson's disease, Alzheimer's disease and many other brain-related disorders. Although it has been a valuable device for brain study, a CT scan has a significant limitation in that it shows only brain structure or anatomy. It does not provide information about the activity of the brain; that is, brain function. The development of the CT changed the way that researchers could look inside and take images of the brain, without using unpleasant or risky procedures. It also demonstrated the potential value of neuroimaging and led to the development of better technologies for other types of image reconstructions (Kolb & Whishaw, 1996).

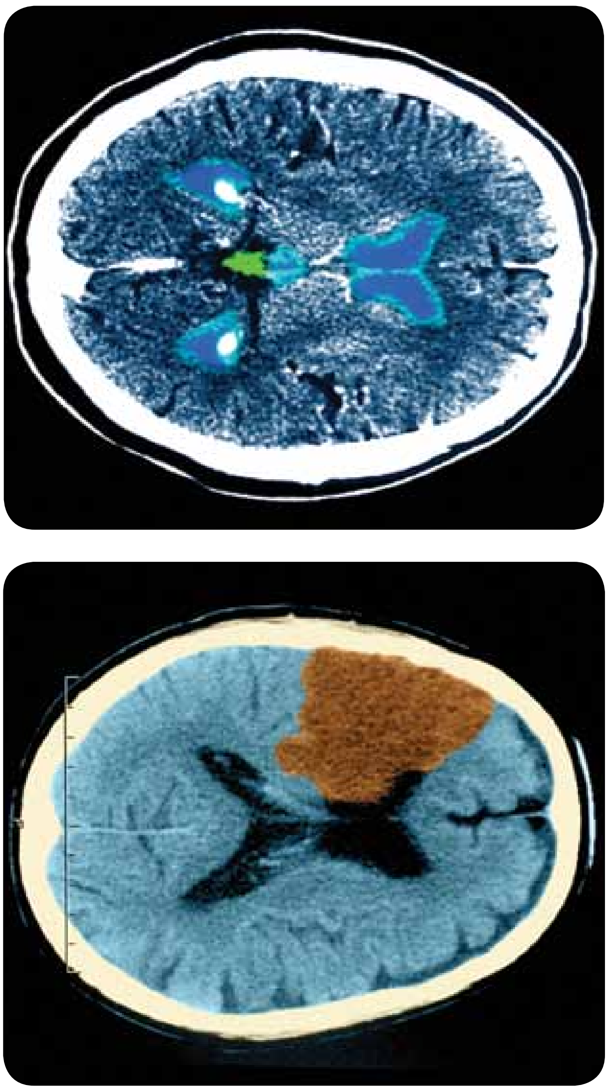


Figure 4.65 The CT scan at the top is of a normal brain; the CT scan at the bottom shows the area of brain damage in a person who has suffered a stroke.

Magnetic resonance imaging (MRI)

The invention of magnetic resonance imaging in 1977 was another breakthrough in neuroimaging technology. **Magnetic resonance imaging (MRI)** is a neuroimaging technique that uses harmless magnetic fields and radio waves to vibrate atoms in the brain's neurons to produce an image of the brain. These vibrations are detected by a huge magnet in the chamber surrounding the motionless person, and are channelled into a computer (see figures 4.66 and 4.67). The computer then processes the vibrations and assembles them into a coloured image that indicates areas of high and low brain activity. The computer can also analyse the signals for subtle differences that identify the type of brain tissue that generated them, such

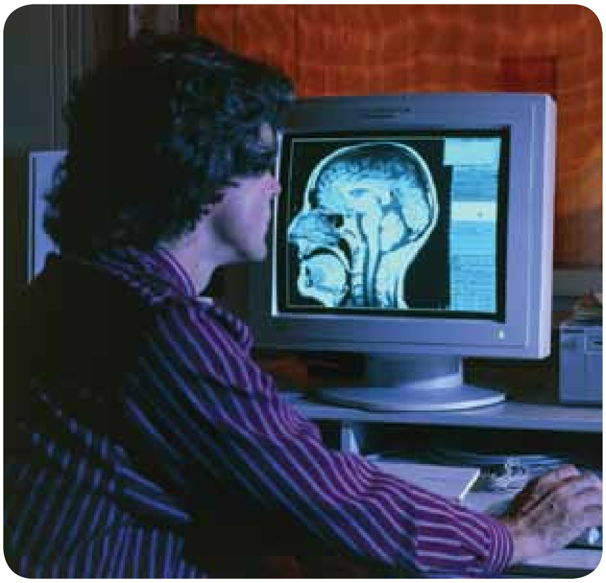


Figure 4.66 Magnetic resonance imaging (MRI). During the MRI procedure, the person is required to lie very still inside a device that is like a large magnet, while the researcher observes the image on a screen.

Figure 4.67 Magnetic resonance imaging produces very clear pictures of brain structures.

as blood, nerve fibres or membranes. The MRI technique is more sensitive than CT. Consequently, MRI provides an image of the brain and structures that is clearer and more detailed than CT.

Like CT, MRI has primarily been used for diagnosing structural abnormalities of the brain. However, MRI can be used to detect and

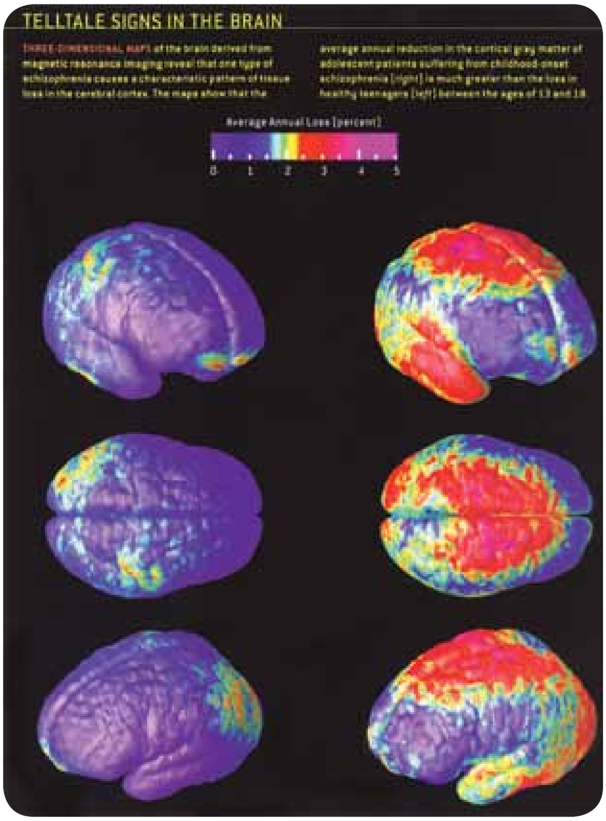


Figure 4.68 These three-dimensional images of the brain derived from MRI technology show that the average annual reduction in cortical grey matter of adolescent patients suffering from childhood-onset schizophrenia (right) is much greater that the loss in healthy teenagers (left) between the ages of 13 and 18 years.

display extremely small changes in the brain. For example, MRI can more clearly distinguish between brain tissue that is cancerous and non-cancerous. The image can also reveal tissue degeneration and blood clots and leaks that may indicate a stroke. MRI has been used to diagnose spinal cord abnormalities in children (Bale & others, 1986) and degenerative diseases of the central nervous system involving impaired speech and tremors (Giesser & others, 1987), as well as areas of brain damage associated with epilepsy (Oabbari & others, 1986). MRI has been used to diagnose more unusual disorders such as *prosopagnosia*, which is an inability to recognise familiar faces despite having the ability to recognise familiar objects (Farah, 1990), and *akinetopsia*, which is the lack of motion perception (Shipp & others, 1994).

Value and limitations of MRI

The development of MRI technology enabled even more precision in the study of the structure of the live human brain in a non-invasive and harmless way. Like CT, MRI has been invaluable for determining damage or abnormalities to particular brain areas or structures. Its main advantage over CT is that it provides more detailed and clearer images of the brain, which are almost of photographic quality. In addition, it does not use X-rays or radioactive substances. However, one limitation is that, like other neuroimaging devices, it cannot be used with people who have internal metallic devices such as heart pacemakers or steel pins in bones. Importantly, like the CT, its main limitation for brain study is that it shows only brain structure, or anatomy, and not function.

Learning Activity 4.26

Review questions

1. a What is computerised tomography (CT)?
   b Explain how CT is used for brain research, with reference to an example of a CT study.
   c Briefly describe an advantage and a limitation of the CT method, with reference to key findings from a CT study.
   d Is CT more or less invasive than direct electrode stimulation? TMS? EEG? Explain your answers.
   e Does CT provide more or less information about brain function than direct electrode stimulation? TMS? EEG? Explain your answers. Explain your answers.
2. a What is magnetic resonance imaging (MRI)?
   b Explain how MRI is used to study the brain, with reference to an example of an MRI study.
   c What is the main advantage of MRI when compared with CT?
   d Briefly describe an advantage and a limitation of using MRI for brain research, with reference to some key findings from an MRI study.
3. Which technique—direct brain stimulation, CT or MRI—would be best for studying
   a brain structure?
   b brain function?
   Explain your answers.

Positron emission tomography (PET)

The CT and MRI techniques produce useful images of brain structures, but do not reveal whether those structures are involved in any given mental process or behaviour. Images of the physiological functioning and activity of the brain were first provided in the late 1970s by a technique called positron emission tomography. **Positron emission tomography (PET)** is a neuroimaging technique that uses a radioactive tracer to enable production of a computer-generated image that provides information about brain structure, activity and function during various tasks. In brain research studies, PET is used to record the levels of activity in different areas of the brain while the participant (or patient) is involved in a cognitive or behavioural activity of some kind, such as thinking, imagining, remembering, talking or moving a body part (see figure 4.68). Of course, the type of tasks that can be given to participants is limited by the size of the chamber. Consequently, tasks used in PET studies are often relatively simple.

PET provides images of the 'working brain' by tracking blood flow around the brain. It is assumed that brain areas that require increased blood flow have increased neuronal activity (and vice versa).

Figure 4.69 A PET scanner can be used to identify brain areas that are active in people without brain damage during everyday activities.

Blood flow is tracked by measuring the use of glucose (a sugar) by neurons in the brain area that is active.

Prior to the PET procedure, a harmless radioactive substance is injected into the participant's blood vessels (or it may be taken orally). When this substance enters the bloodstream it travels to the brain. As a particular area of the brain is activated during some mental process or behavioural response, the radioactive substance in the blood, which serves as a tracer that can be followed, emits radioactive signals. The signals are detected by a sensitive electronic device and recorded in the PET computer. The computer compiles these signals into images that are commonly called *PET scans*.

Each PET scan uses a colour code to indicate different levels of brain activity. In ascending order, the colours violet, blue, green, yellow and red each represent different amounts of activity. For example, if a person is listening to someone talking during the PET procedure, the areas of the brain involved with speech comprehension will be activated and highlighted in the PET scan in red and yellow (see figure 4.70). This enables the researcher to identify the level of activity of different brain areas in speech comprehension. As shown in figures 4.70 and 4.71, a PET scan looks like a coloured 'map' of the brain's activity, with different colours indicating areas of greatest and least activity. PET scans are less detailed than MRI images. Consequently, MRI images are often used to enhance the less detailed PET scans (see figure 4.72).

PET was originally designed to diagnose abnormalities in the brain and is highly effective for this purpose. For example, it can clearly distinguish a brain tumour, which typically shows up as a very active area of the brain. An area of brain deterioration can also be relatively easily identified, and typically shows up in the PET scan as an inactive area (even if that brain area is structurally intact). PET technology can also provide information on the brain functioning of specific groups or populations of research interest, such as people with mental illnesses. For example, the PET scans in figure 4.71 compare different areas of brain activity in individuals with schizophrenia and depression. In studies of people

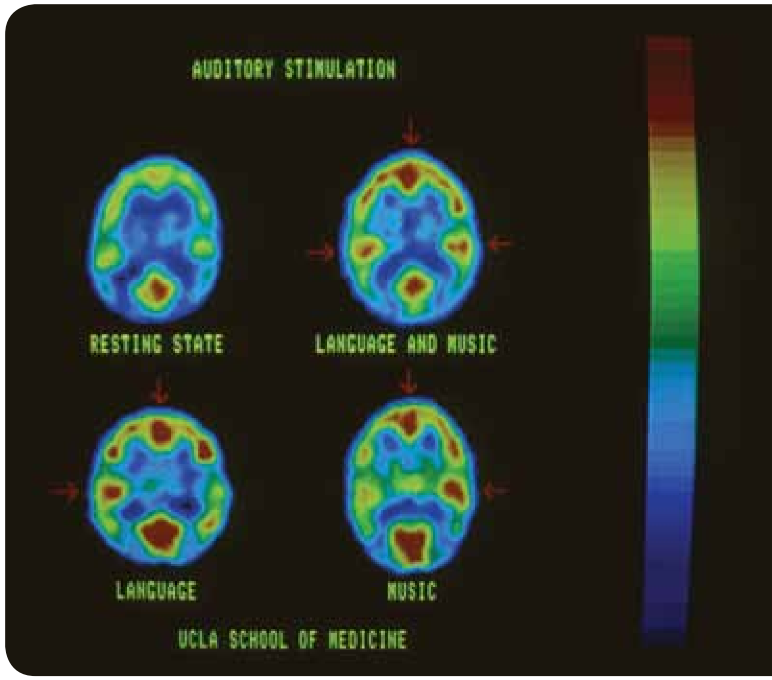


Figure 4.70 PET scan: listening to speech and music

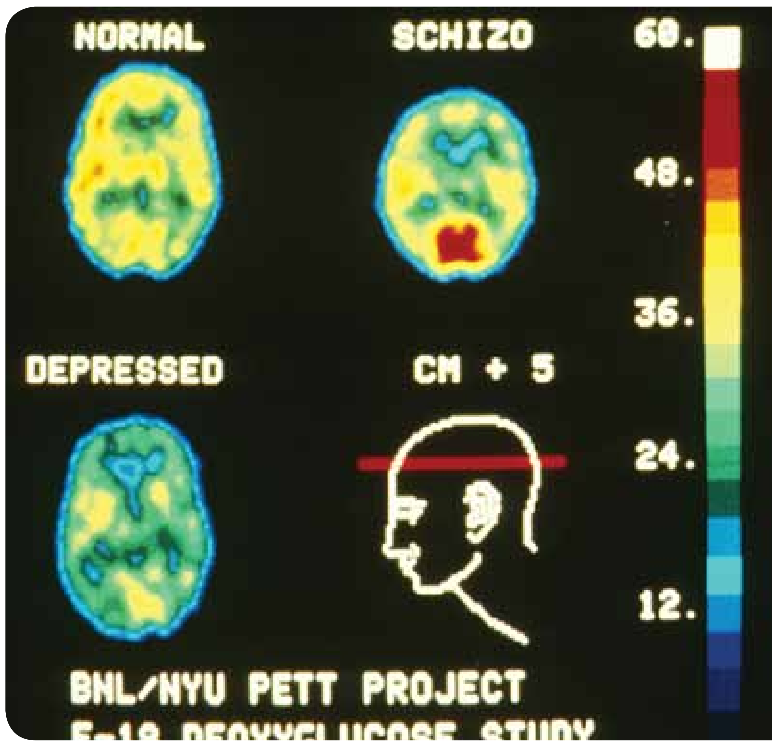


Figure 4.71 PET scans and mental illness. The scans show the differences in metabolic levels in normal, schizophrenic and depressed individuals. Red indicates highest metabolic activity, with yellow next, followed by green and then blue. During depression, for example, brain activity is considerably reduced, especially in the frontal lobe areas of the brain (shown at the top of the brain images).

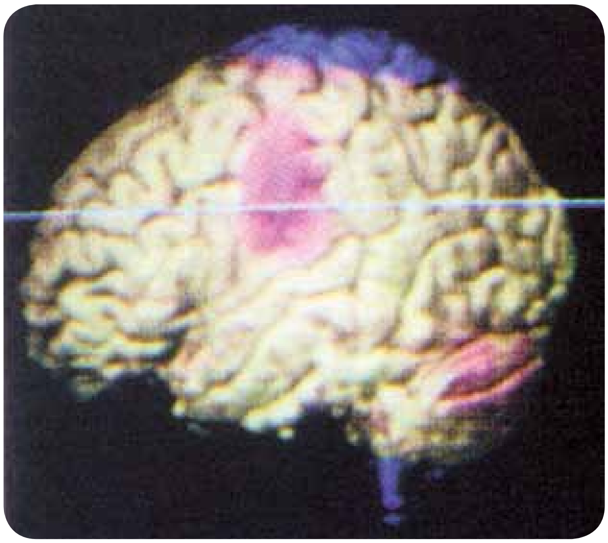


Figure 4.72 A PET scan and an MRI are combined to create a three-dimensional image of the brain of a young girl with epilepsy. The picture of the outer surface of the brain is from the MRI. The pink area from the PET scan shows the source of the epileptic activity.

with schizophrenia, it has been found that when individuals indicate that they are hearing voices, activation of the auditory cortex in the temporal lobe is evident in the PET scan (Dierks & others, 1999; Frith, 1999). In some of these studies, PET has been used to monitor the effects of different medications used in treating various disorders. PET is also used to identify brain areas that are active and inactive in 'normal' people during everyday activities such as when resting or listening to music (see figure 4.70). This suggests that the specific brain areas may be involved (or not involved) in those activities.

PET has been widely used in experimental situations to show areas of brain activity when people are involved in activities such as paying attention, daydreaming, responding to sensory stimuli, moving limbs and performing mental processes such as planning, problem-solving, decision-making, speech, learning and remembering. For example, PET studies have found that when we imagine ourselves carrying out a particular movement, the motor areas of the brain that are activated are similar to those that are activated when we are actually doing that activity (Jeannerod, 1995). PET studies have also found that different aspects of language are associated with different brain areas. For example, areas of the brain that are active when people silently say the name of an animal (that is, use *sub-vocal speech*) are different from those that are active when they actually say the name (Martin & others, 1996). Other PET studies have found that different brain areas are active when we hear words, as compared to when we say or see words (Springer & Deutsch, 1998). Similarly, different areas of the brain are active when we are speaking pronounceable words such as 'cat' as compared with unpronounceable words such as 'xac' (Posner & Raichle, 1994).

Value and limitations of PET

PET is a very useful technique for brain study and has enabled researchers to obtain valuable information about the role of the brain in behaviour and mental processes. Its development has advanced our understanding of how the brain functions. The major advantage of PET is that it enables detailed images of the functioning brain; that is, the brain 'at work' as it performs tasks. Importantly, researchers can observe different brain areas that interact when a person is required to do a certain task; for example, the extent to which different areas of the brain function together or change together. A further advantage is that people without brain damage can be used in research studies. This overcomes the criticism that patients with brain damage sometimes compensate and complete tasks in a different way from people without brain damage (Andrewes, 2001). In detecting areas of brain damage, PET is more sensitive than CT and MRI. Furthermore, the use of colour coding in PET scans makes it relatively simple to identify areas of the brain that are active and inactive.

Despite these advantages, PET also has limitations. The main limitation is that researchers cannot determine whether an active brain area is actually involved in the mental process or behaviour under investigation. Unlike TMS, there is no scope for suggesting cause–effect relationships between active or inactive areas and thoughts, feelings or behaviours being studied. Another major limitation of PET scanning is that because the radioactivity decays rapidly, it is limited to studying relatively short tasks. However, this has been overcome through the development of SPECT, which is like PET, but uses radiation tracers that are longer lasting than those of PET. PET also requires injection of a radioactive substance, but the radiation dosage is harmless, and risks to the person's health are considered to be negligible. PET needs a 40-second interval between scans, and each individual scan takes 30 seconds to complete. This means that PET doesn't necessarily pick up the very rapid progression, or changes, in brain activity associated with different brain functions. The researcher also needs to remain sensitive to the fact that observed differences in levels of brain activation of different areas may be associated with other factors relating to the research task given to the participant; for example, task duration (that is, length of time taken to do the task) and task difficulty (with many tasks being relatively simple due to the constraints of chamber size).

Before *f*MRI technology became available, PET scanning was the preferred neuroimaging technique for brain research. However, it still continues to make significant contributions to the study of the brain.

Single photon emission computed tomography (SPECT)

A variation of the PET and differing in certain technical features, **single photon emission computed tomography (SPECT)** uses a longer-lasting radioactive tracer and a scanner to record data that a computer uses to construct two- or three-dimensional images of active brain regions.

Like PET, SPECT images are also functional in nature rather than being purely anatomical, or structural, as are CT and MRI images. Though very useful, SPECT images are not as good as PET images. SPECT images have a lower resolution and are therefore not as clear or detailed as PET images. However, the similarity between SPECT and CT in the method of image processing allows the images to be combined using SPECT–CT scanning when a better resolution is required. For example, it may be important to pinpoint the site of a brain structure or abnormality in a SPECT scan and merging a SPECT with CT enables the researcher to more accurately pinpoint its location (Soo & Cain, 2009).

When compared with PET, the better value of SPECT for brain research relates to the longer-lasting radioactive tracers that are used; that is, they have longer decay times. Consequently, the tracer stays in the bloodstream for longer and is

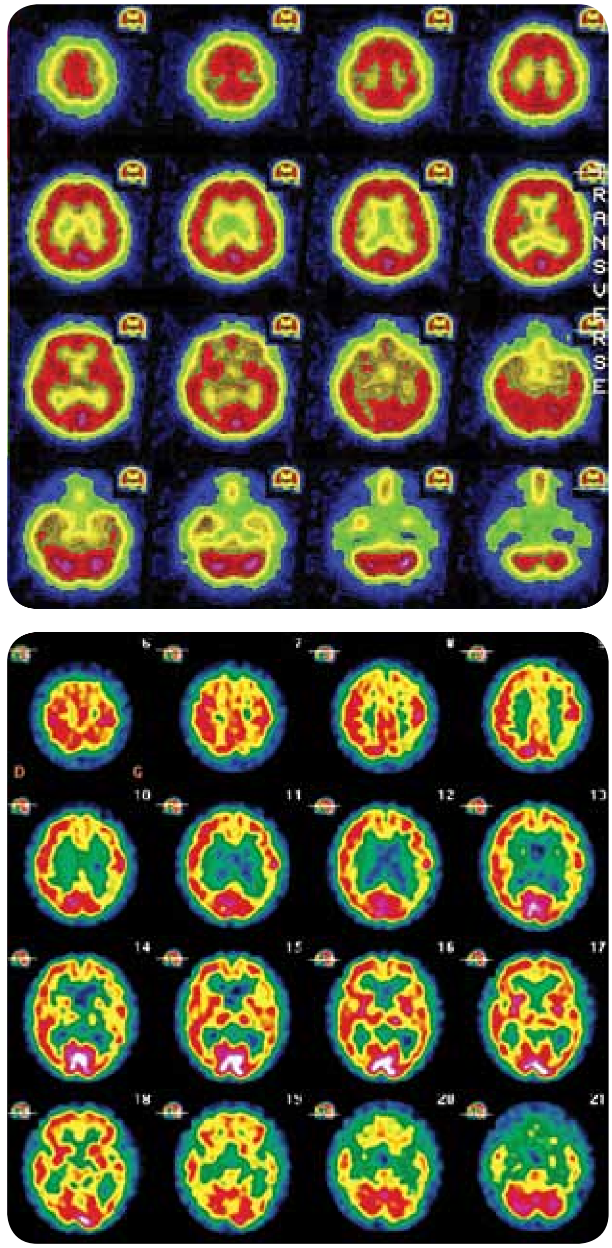


Figure 4.73 SPECT scans of a healthy human brain (top) and the brain of a person with Alzheimer's disease (bottom), showing less activity (areas in red). One advantage of SPECT is that a long-lasting radioactive tracer is used so research participants can be given longer tasks.

not absorbed as quickly by surrounding tissue. This means that participants can also be given longer-lasting tasks in research studies. If there is a need to observe rapid changes in brain activity for functional research, then PET is preferred. When suitable to do so, however, researchers tend to prefer SPECT over PET as it has the advantage of being significantly less expensive to use than PET.

Functional magnetic resonance imaging (*f*MRI)

Functional magnetic resonance imaging (*f*MRI) is a neuroimaging technique that enables the identification of brain areas that are particularly active during a given task by detecting changes in oxygen levels in the blood flowing through the brain. The technique is based on the standard MRI, and measures subtle changes in blood oxygen levels in the functioning brain. When an area of the brain is active, there is increased blood flow to that area, as more oxygen is required by the active functioning neurons. A computer analyses the blood oxygen levels in the area, and creates an image with colour variations. As with the PET and SPECT scan, the colour variations reflect the level of activity of different brain areas and structures while the participant engages in various experimental tasks (see figure 4.74). Despite this apparent similarity, *f*MRI, PET and SPECT use different technologies, as does TMS.

An important advantage of *f*MRI is that it can take numerous pictures of the brain in rapid succession and can therefore detect brain changes as they occur from moment to moment. Consequently, it can provide an image of brain activity averaged over seconds, rather than the several minutes required by PET and the even longer time required by SPECT. This means that *f*MRI images of brain structures and activity are more highly detailed and more precise. Some researchers also connect *f*MRI to three-dimensional virtual reality displays to obtain an even more detailed view of the brain while it is engaged in various functions (see figure 4.75).

One application of *f*MRI in brain research has been in the study of hemispheric specialisation with intact brains. Many *f*MRI studies have confirmed findings from previous research using other, less sophisticated, brain study techniques.

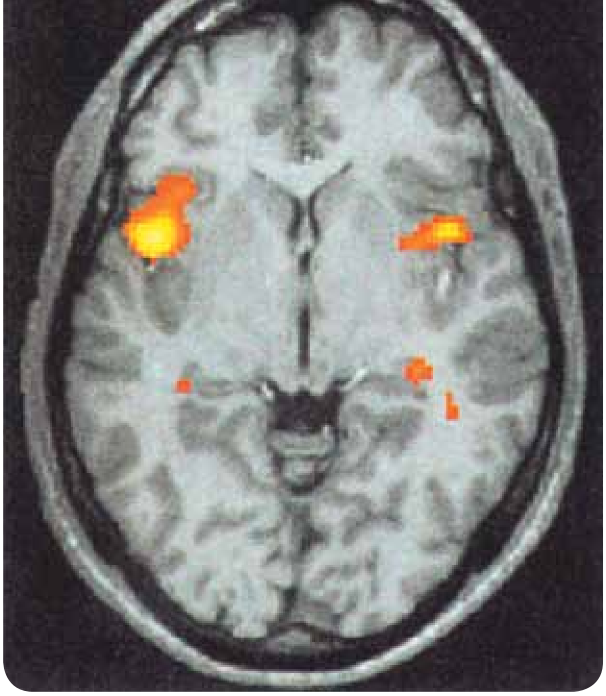


Figure 4.74 An *f*MRI image showing the areas of the brain that become especially active when a person thinks about their romantic partner.

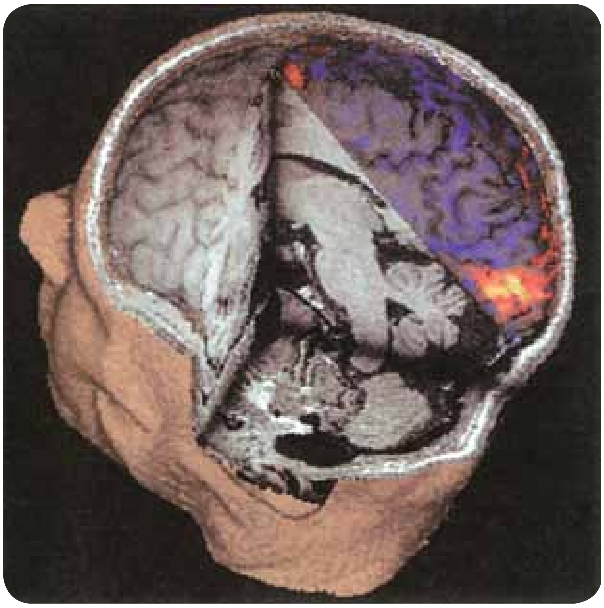


Image generated by Dr Krish Singh, Cardiff University

Figure 4.75 This *f*MRI scan shows activation in the primary visual cortex after visual stimulation. The coloured activation map is superimposed on a high-resolution anatomical scan, which is produced in three dimensions.

For example, figure 4.76 shows *f*MRI images that provide evidence of hemispheric specialisation of voluntary movements in opposite sides of the body. Other *f*MRI studies have obtained evidence that contradicts or builds on the findings of previous

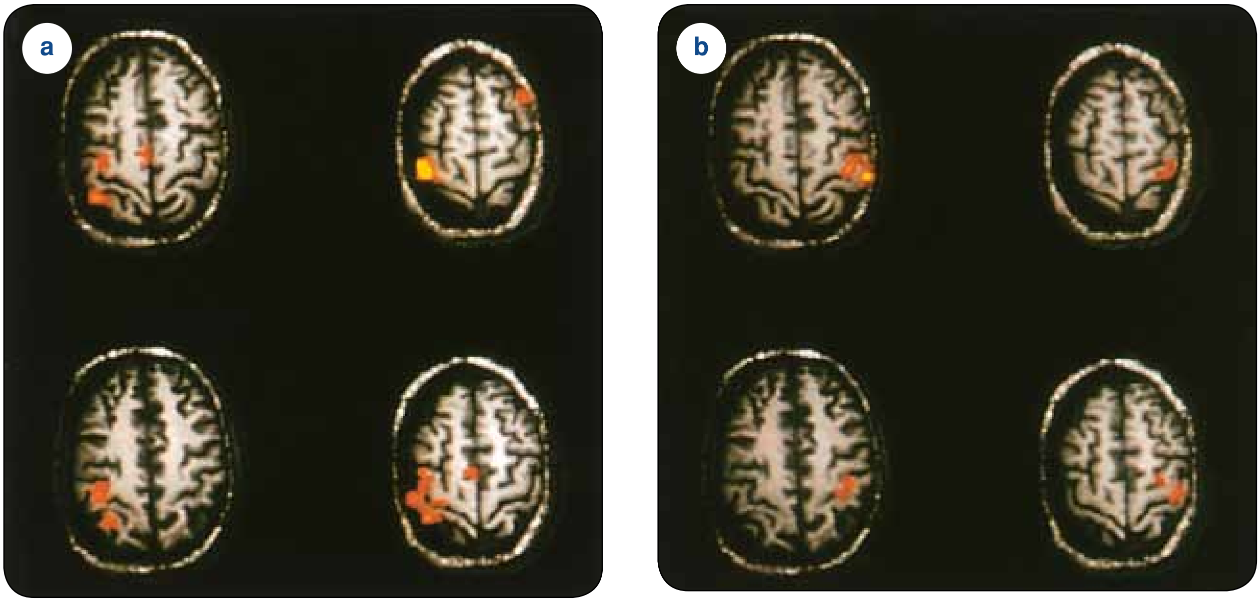


Figure 4.76 These *f*MRI images (four horizontal slices) show areas of the motor cortex that are activated during a hand extension (flexion) task (the right hemisphere is on the right side of the images): (a) right-hand task: activation is seen in left-hemisphere motor areas; (b) left-hand task: activation is seen in right-hemisphere motor areas.

research using other techniques. For example, *f*MRI studies have found that the right hemisphere has a larger role in certain verbal tasks (for example, interpreting the meaning of words) than previously thought.

Value and limitations of *f*MRI

Unlike PET and SPECT, the *f*MRI technique does not require exposure to radiation. Like PET, *f*MRI enables detailed images of the functioning brain while a person (with an intact or damaged brain) performs a task requiring mental processes or behavioural responses. The use of colour coding makes it easy to interpret images of brain functioning, and the images produced by *f*MRI are more detailed than PET and SPECT images. When using *f*MRI, as is the case with PET and SPECT, the researcher needs to remain aware of the fact that observed differences in levels of brain activity of different areas may not just be the direct result of the specific task being undertaken. This means that, unlike TMS, there is no scope for suggesting cause–effect relationships between active and inactive areas and mental processes and behaviours under investigation. Furthermore, the levels of brain activity may also be associated with other factors relating to the research task performed by the participant; for example, task duration (that is, the length of time taken to do the task) and task difficulty. These variables are also relevant to TMS, but researchers can conduct experiments in which they exert control over their potential influence.

Box 4.17

Subtraction and averaging when using neuroimaging for brain research

Brain research using neuroimaging usually employs a 'subtraction and averaging' procedure to determine brain activity that can be attributed to the experimental treatment and no other variable. In the PET scans shown on page 258, the researchers conducted an experiment on attention. The first step involved scanning changes in brain activity of a participant while the participant looked at a fixed point on a blank screen (control condition). The second step involved scanning changes in brain activity while the participant engaged in the experimental task—tracking a dot moving across a flickering checkerboard pattern on the computer screen (experimental condition). The fourth step involved 'subtracting' the scan taken in the control condition from the scan taken in the experimental condition. This difference image revealed the brain activity that could be assumed to be due to the experimental task. Finally (centre row), the difference images from each individual participant were combined and 'averaged'. This step helped to minimise any uncharacteristic or unusual brain activity among the participants. The averaging procedure was also used to create a composite PET image (the 'mean difference image') that was used to identify the brain areas that were activated by the experimental task.

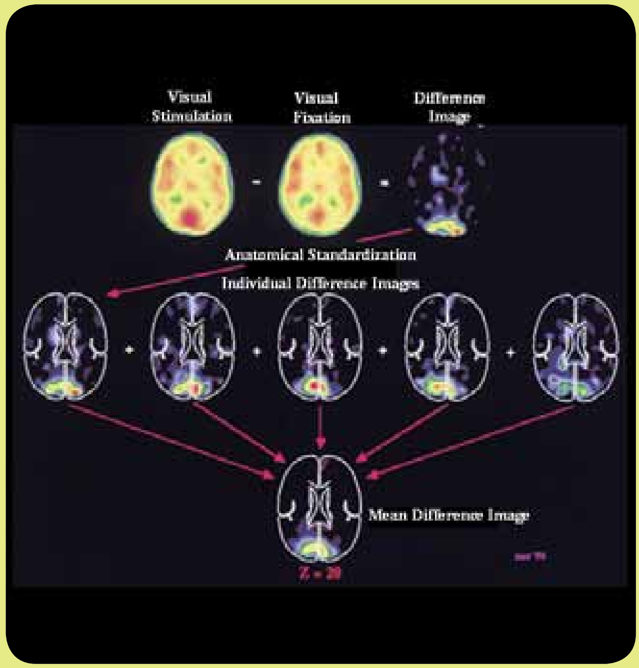


Figure 4.77

Phonics could prevent dyslexia

Daniel Cho

Using functional magnetic resonance imaging, American psychologist Sally E. Shaywitz and her colleagues have identified what appear to be two distinct types of dyslexia-related reading disorders, one of which may result from ineffective reading instruction early in life. Dyslexia is an impaired ability to read or to learn to read.

Shaywitz studied the neural activity of 27 normal readers, 19 'accuracy-improved readers' who have learned to read more accurately by going at a slow pace, and 24 'persistently poor readers' who struggle with both speed and comprehension. Images showed that the slow but accurate readers did not activate the same brain regions when reading as the normal readers, suggesting that they lacked some standard neural circuitry but their brains had compensated with other pathways.

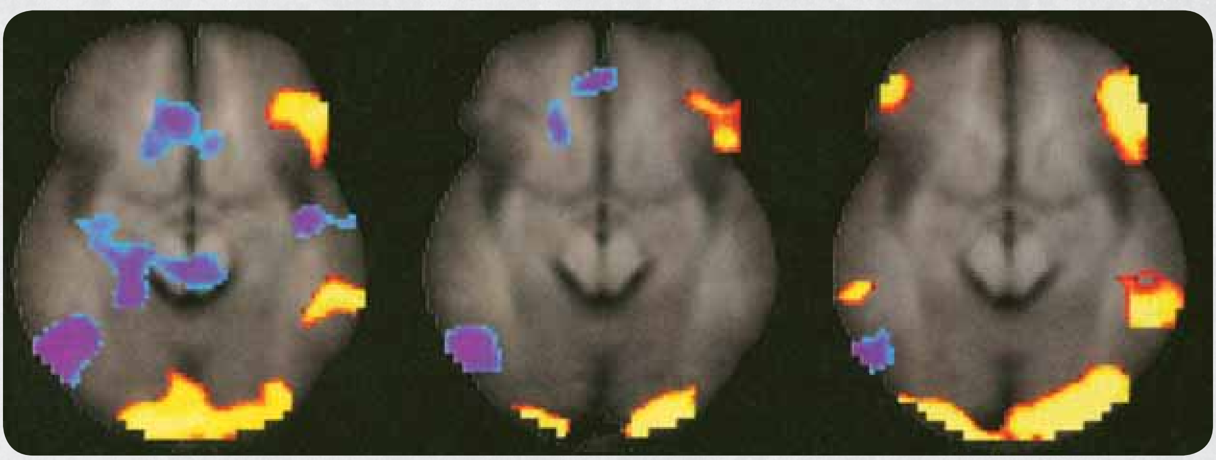


Figure 4.78 Slow readers (*centre*) lack standard brain circuitry (*yellow*) but, oddly, poor (*right*) and normal (*left*) readers use similar regions.

More surprising, though, was the discovery that persistently poor readers showed brain activity in some of the same regions as normal readers. 'It tells us that the system is there for reading but that it hasn't been properly activated,' Shaywitz says. The poor readers also showed activity in a brain region associated with memory retrieval. She concludes that poor readers, instead of translating letters into words as normal readers do, were trying to identify words by rote memory.

Source: adapted from Cho, D. (2004). Phonics could prevent dyslexia. *Scientific American Mind*, *14*(1), p. 6.

Learning Activity 4.27

Review questions

1 **a** What is position emission tomography (PET)?

b Explain how PET is used to study the brain, with reference to an example of a PET study.

c Briefly describe an advantage and a limitation of the PET technique, with reference to some key findings from a PET study.

d What is the main advantage of PET when compared with direct brain stimulation techniques, CT and MRI?

2 **a** What is single photon emission computed tomography?

b What is the main advantage and main limitation it has in brain research when compared with PET?

3 **a** What is functional magnetic resonance imaging?

b Explain how *f*MRI is used to study the brain, with reference to an example of an *f*MRI study.

c What is the main advantage of *f*MRI when compared with PET?

d What is the main limitation of *f*MRI when compared with TMS?

Learning Activity 4.28

Summarising brain research methods

Use your answers for other relevant learning activities as well as additional text research to complete a copy of the table below. Summarise, compare and contrast the different techniques for conducting brain research in the table.

Method	Description	Key feature	How the technique is used	Research example	Advantages	Limitations
Case studies						
Direct electrode stimulation						
Single-pulse TMS						
rTMS						
EEG						
CT						
MRI						
PET						
SPECT						
*f*MRI						

Learning Activity 4.29

Selecting brain research methods

1 Choose five of the following topics and explain which brain research method is likely to be best for investigating each topic. Where appropriate, you may suggest more than one method or a combination.
   a Determine the extent of structural damage caused by a stroke resulting from internal bleeding.
   b Determine whether cortical areas in lobes other than the occipital lobe are involved in vision.
   c Examine the role of the amygdala, a structure deep within the brain, in aggressive responses.
   d Determine whether areas of motor cortex adjacent to the primary motor cortex are involved in planning a voluntary movement, before sending this information to the primary motor cortex for execution.
   e Measure variations in patterns of electrical activity in a comatose patient.
   f Determine whether the primary somatosensory cortex controls balance.
   g Identify specific areas of the frontal lobe affected by a tumour (that is, abnormal reproduction of neurons).
   h Identify whether damage to a language area explains someone's reading difficulties.
   i Investigate the role of the reticular activating system in consciousness.
   j Observe sex differences in brain functioning while reading a map.
   k Determine whether the frontal lobe receives information from other lobes during a problem-solving task that involves physically manipulating an object while receiving a multimedia explanation of the object and related problem.

2 Choose another topic and explain how it could be investigated using each neuroimaging technique and a topic that could be investigated using EEG. Describe one advantage and one limitation of each technique for studying the topic of research interest.

Ethical principles in brain research

As you are aware, PET (and SPECT) requires injection of a radioactive substance. The procedure is considered harmless and the wellbeing of research participants in a PET study is protected through strict control of the radiation dosage and the number of scans in a PET session. Yet although the procedure is considered harmless, would it be ethically permissible for a child with no known brain abnormality to undergo the PET procedure as a participant in a brain study designed specifically for research purposes; for example, to study some aspect of the brain's development? Or to compare and contrast the cortical area devoted to some specific behavioural function in children's and adults' brains? Consider also the case of an adult with an intellectual disability that is known to be linked to brain damage and who does not have the intellectual capability to give informed consent to participate in a brain study to explore brain areas that may be linked to their disability. Would it be ethically permissible for this intellectually disabled person to be included as a participant in a PET study undertaken specifically for research purposes?

As discussed in chapter 1, all psychological research, whatever the area of research interest, is subject to strict nationally prescribed ethical principles or 'standards' that safeguard the welfare and rights of research participants. In addition, psychologists have a Code of Ethics, which provides guidelines that must be followed when working with people (and animals) in any research situation. Finally, researchers must submit their proposals for conducting research to an ethics committee or panel for close scrutiny and evaluation. In the case of a child participant, informed consent for involvement in psychological research on the brain could be given by the child's parent or legal guardian, and in the case of an intellectually disabled adult, informed consent could be given by the person's wife or husband or partner, legal guardian or a person with medical power of attorney. However, it would be unethical and illegal for a psychologist to independently conduct a brain research study such as any of the PET studies just described. PET technology involves medical procedures. For example, the administration of an injection and the use of radiological neuroimaging equipment are both medical procedures.

Unlike doctors, radiologists, neurologists, neurosurgeons and psychiatrists, psychologists are not medically qualified and therefore are *not* legally or ethically permitted to administer *any* medical procedures. Similarly, brain research studies using any other neuroimaging device (for example, SPECT, CT, MRI and *f*MRI), brain recording device (for example, EEG) or electrical brain stimulation (for example, electrodes and TMS) also involve medical procedures. However, this does not mean that a psychologist could not be a *member* of a team of researchers undertaking a brain study using one or more medical procedures. In such a study, the psychologist could be responsible for and contribute to various aspects of the research, except for any aspect involving administration of a medical procedure or any other treatment for which they were not suitably qualified, experienced or permitted (legally or ethically) to administer.

Consistent with the requirements of the *National Statement on Ethical Conduct in Human Research*, issues such as *integrity*, *respect for persons*, *beneficence* and *justice* would need to be considered in the planning of any research study. As well as ensuring protection and respect of participants' rights, these considerations also ensure the research will be worthwhile and consequently of potential value to society. For example, consider again the PET study using a child as a participant.

Key questions that would need to be answered in the researcher's proposal to conduct the PET study would include:

- 'Is the researcher demonstrating a genuine commitment to the research because of its potential value in advancing humankind's understanding of the brain?' and 'Is the researcher demonstrating a genuine commitment to ethical principles and guidelines generally and specifically relevant to the PET study?' (that is, questions about *integrity*)
- 'Does the research respect the dignity of the child?', 'Are the welfare, rights, beliefs, perceptions, customs and cultural heritage of the child respected in the research design?' and 'How is the research designed to ensure that the child is respected?' (that is, questions about *respect for persons*)
- 'What risks of harm could arise in the proposed research?', 'How big is each risk?', 'What is the likelihood of each risk occurring?', 'Has the research been designed to minimise each risk?', 'Do the potential benefits of the research findings justify any risk?' and 'Have the child's parents or legal guardian been fully informed of the risks and benefits involved in the research?' (that is, questions about *beneficence*)
- 'What is the justification for selecting this child as a research participant rather than another child?' and 'Is the child representative of other children or people intended to benefit from the research?' (that is, questions about *justice*).

Clearly, brain research raises many important ethical questions and issues, particularly given the medical procedures that are often involved. Researchers must ensure that all ethical principles and guidelines promoted by the National Statement are followed when planning, conducting and reporting their research.

Researchers are required to prepare a research proposal to demonstrate that all relevant ethical issues have been considered and addressed for every stage of the research, including participant selection and research design, and in the reporting of results. As an added safeguard to protect the welfare and the rights of human participants in research, and to ensure the research is of potential benefit to the community or to humankind, the proposal must be submitted to an ethics committee or panel for evaluation and approval.

Approval by the ethics committee or panel is based on whether the research proposal meets the ethical principles and guidelines promoted by the National Statement.

Box 4.18

Lobotomy: damaging the brain to treat mental illness

In the late 1930s and 1940s, Portuguese neurologist Egaz Moniz devised the *prefrontal lobotomy*, a surgical procedure that severed nerve fibres to cut off the foremost portion of the frontal lobes from the rest of the brain. The operation was used to treat individuals with severe emotional disorders, and included the control of aggressive or violent behaviour. Moniz received the Nobel Prize in Physiology or Medicine in 1949 for his advancement of the lobotomy.

In the USA, many doctors embraced the lobotomy and performed it on tens of thousands of men and women with severe mental illnesses such as schizophrenia, major depression, obsessive–compulsive disorder and pathological violence. The lobotomy was a crude but simple operation, sometimes performed in a doctor's office using a local anaesthetic, with an ice pick inserted into the brain via an area just below the eyeball and the top of the eye socket. The ice pick was then moved around until the connecting neural tissue was severed, in part or whole, depending on the diagnosis of the patient's disorder.

The operation generally had the effect of decreasing the patients' emotional responsiveness. Many became emotionally docile; that is, extremely and consistently calm, even when in frustrating circumstances. Unfortunately, the operation often had adverse effects on cognitive functions. The foremost area of the frontal lobes is not only involved in regulating emotional responses, but also has association areas that are involved in monitoring and planning behaviour. Consequently, the lobotomy left most patients unable to plan and organise their lives effectively. This eventually led to reservations and caution in the use of the lobotomy, although it continued to be practised until the mid 1950s, when new medications were developed to treat severe emotional disorders.

Figure 4.79 Neuropsychiatrist Walter Freeman performs a lobotomy in 1949 before a group of interested onlookers by inserting a needle through a patient's eye socket and into the brain.

Learning Activity 4.30

Review questions

1 Define the meaning of each of the following ethical principles or practices and explain their relevance in the conduct of psychological research on the brain:

- **a** protection and security of participant confidentiality
- **b** voluntary participation
- **c** informed consent
- **d** integrity
- **e** respect for persons
- **f** beneficence
- **g** justice.

2 A researcher plans to conduct an EEG study on patterns of electrical activity in the brain that are associated with tasks involving thinking (for example, solving arithmetic and word problems) as compared with voluntary movements (for example, wiggling the toes, rotating the knee, walking on a treadmill). The researcher proposes to compare responses of two groups of participants: people with brain damage to the left hemisphere and people with brain damage to the right hemisphere. All the brain-damaged participants have been used by the researcher as participants in two previous brain studies (unrelated to the proposed study) and provide the advantage of being readily accessible because they reside in special-care accommodation close to the university where the researcher lectures on neuropsychology. The researcher does not expect any difficulties in obtaining informed consent from the participants' spouses and legal guardians. The researcher expects that the study will advance understanding of hemispheric functioning because the EEG has newly developed electrodes that are renowned for their exceptional sensitivity. The study also provides an opportunity to use the refined EEG technology and possibly refine the technique further.
Analyse the ethical acceptability of the proposed study, with reference to each of the ethical principles or practices considered for question 1. Comment on whether the proposed study is ethically acceptable in relation to each ethical principle. Give reasons for your judgments.

Learning Activity 4.31

Applying ethical principles in brain research

Make a judgment about the ethical acceptability of each of the following research studies, which focus on hypothetical applications of neuroimaging techniques. Ensure you refer to ethical principles of particular relevance to each study.

Study 1

A researcher proposes to conduct a brain study using *f*MRI with a group of volunteer adult male criminals who have been imprisoned for crimes involving theft or fraud. The researcher will investigate whether these people have any brain areas or structures that are different from those of adult males who have never committed any crime. The researcher believes that the study may lead to the development of a brain scanning procedure that can be used by employers to screen job applicants. The researcher also believes that it may be possible to use brain scans as evidence in court by either prosecution or defence lawyers to help establish the link between criminal behavioural tendencies and brain structure and function.

Study 2

Following a terrorist suicide bombing that killed many innocent people in a European country, a researcher decides that there is a need for a reliable and effective means of detecting lies and deception. The researcher proposes to conduct a series of neuroimaging studies to test the effectiveness of different neuroimaging techniques in lie detection for security purposes; for example, to screen individuals at airports. The researcher also believes that neuroimaging techniques could be used by police, courts and parole boards for lie detection purposes and by juries to assist with decision-making. Volunteer adult males who are devout members of a religious cult will be compared with adult males who are not members of this cult, and also with a group of adults who are atheists (do not believe in God). To encourage participation in the research study and compensate participants for inconvenience over a three-month period, all participants will be paid.

Learning Activity 4.32

Evaluation of research on the brain

A psychologist wanted to test research findings that specific areas of the primary motor cortex in the left and right frontal lobes are involved in specific voluntary motor movements on opposite sides of the body.

She tested her hypothesis through an experiment conducted as part of a case study involving one male research participant. The participant was suffering from severe, unpredictable epileptic seizures and had been referred to the psychologist by the participant's doctor, as the psychologist had expertise in diagnosing the source of epileptic seizures.

Taking advantage of the opportunity to test her hypothesis, the psychologist obtained permission from the participant to study voluntary motor movements during the *f*MRI session organised to locate the source of the epileptic seizures. Approval for the experiment was also obtained from an ethics committee.

Working as a member of a team that included a qualified radiologist and neurosurgeon, she asked the participant to raise his right foot when a yellow light was flashed in the scanning chamber and to raise his left foot when a blue light was flashed. There were five trials involving each foot, but the different coloured lights were flashed randomly. She found that a specific area of primary motor cortex in the left frontal lobe was active whenever a voluntary movement of the right foot was made and a corresponding area of cortex in the right frontal lobe was active whenever a voluntary movement of the left foot was made. These results supported the hypothesis and confirmed previous research findings.

1. Construct a hypothesis for this experiment.
2. What is the independent variable?
3. What is the dependent variable?
4. Explain why the psychologist flashed the lights randomly.
5. What is a limitation of this study?
6. Explain whether demand characteristics and experimenter effects are potential confounding variables.
7. To what extent can the results be generalised? Explain with reference to external validity.
8. Explain the meaning of participant confidentiality, voluntary participation and informed consent in relation to this experiment.

Chapter 4 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Broca's area is located in the frontal lobe of the left hemisphere.

2 ______ EEG is a direct brain stimulation technique.

3 ______ The reticular activating system is most active while we sleep.

4 ______ The central nervous system comprises the brain and spinal cord.

5 ______ Visual perception occurs exclusively in the occipital lobe.

6 ______ The primary auditory cortex is entirely located in the temporal lobe of the left hemisphere.

7 ______ Each cerebral hemisphere can specialise in or exert greater control over particular cognitive processes.

8 ______ If the spinal cord is severely damaged, the brain is likely to lose control over the body but not sensory input from the body.

9 ______ Transcranial magnetic stimulation is a non-invasive brain research technique.

10 ______ Consciousness is best described as a perceptual anomaly.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 4 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the four lobes primarily receives and processes information from the body senses?

A occipital
B frontal
C parietal
D temporal

Q2 The main advantage of SPECT when compared with PET is that

A SPECT only provides information about brain function, whereas PET only provides information about brain structure.
B SPECT only provides information about brain structure, whereas PET only provides information about brain function.
C SPECT provides three-dimensional brain images, whereas a PET only provides two-dimensional images.
D SPECT uses a longer-lasting radioactive tracer than does PET.

Q3 Broca's area is located closest to the _____ cortex.

A auditory
B motor
C somatosensory
D visual

Q4 The outer layer of neural tissue covering the human brain is called the

A corpus callosum.
B cerebral cortex.
C primary cortex.
D association cortex.

Q5 Which of the following statements about hemispheric function is correct?

A The left and right hemispheres control voluntary movements on both sides of the body and receive sensory information from both sides of the body.
B The left and right hemispheres exchange and process sensory information before deciding which side of the body requires control of voluntary movements.
C The right hemisphere controls voluntary movements on the right side of the body and receives sensory information from the right side of the body.
D The left hemisphere controls voluntary movements on the right side of the body and receives sensory information from the right side of the body.

Q6 The thalamus

A receives and filters information from the cerebral cortex and transmits it to lower brain structures.

B receives and filters information from all the major senses and transmits it to the cerebral cortex.

C connects the left and right cerebral hemispheres.

D coordinates the activities of brain areas involved in speech production and comprehension.

Q7 A major function of the spinal cord is to

A connect the brain and peripheral nervous system.

B protect the vertebrae.

C enable sensory neurons to connect directly with motor neurons.

D initiate voluntary muscle movements.

Q8 A distinction between motor neurons and sensory neurons is that

A motor neurons send messages to the sensory receptor cells, whereas sensory neurons send messages from the sensory receptor cells.

B motor neurons send messages to muscles and glands in the peripheral nervous system, whereas sensory neurons send messages from the somatosensory cortex.

C motor neurons carry information away from the central nervous system, whereas sensory neurons carry information to the central nervous system.

D motor neurons connect to interneurons, whereas sensory neurons do not.

Q9 Which of the four lobes is primarily involved in vision?

A occipital

B frontal

C parietal

D temporal

Q10 The primary motor cortex controls

A voluntary movements of skeletal muscles.

B involuntary movements of skeletal muscles.

C the amount of cortex that is sensitive to movement.

D the sensitivity of body parts.

Q11 A neurosurgeon electrically stimulated parts of a patient's primary somatosensory cortex. If the patient was conscious during the procedure, which of the following was probably experienced?

A 'hearing' faint sounds

B 'seeing' random visual patterns

C movement of one or more of the larger body parts

D a sense of having the skin touched

Q12 Which of the four lobes receives and processes auditory information?

A occipital

B frontal

C parietal

D temporal

Q13 Research has found that the amount of primary motor cortex devoted to specific body parts reflects the

A degree of stimulation of the body parts.

B degree of precise control required by each of the parts.

C sensitivity of the sensory receptors controlling the body parts.

D sensitivity of the body parts.

Q14 Which of the following tasks is considered to be a specialisation of the right cerebral hemisphere?

A reading a novel
B following the directions in a recipe
C finding one's way around a maze
D logical reasoning

Q15 For change blindness to occur, the change in the visual scene has to occur when

A change is expected.
B there is a visual disruption.
C change is unexpected.
D there is a conscious sense that change is occurring.

Q16 Which of the following brain study techniques would provide the most precise information on brain function?

A *f*MRI
B EEG
C MRI
D CT

Q17 Which is the largest of the four cortical lobes?

A frontal
B temporal
C occipital
D parietal

Q18 Which of the following statements about spatial neglect is **not** correct?

A Spatial neglect is a disorder involving attention.
B Spatial neglect has many types of subtypes.
C Spatial neglect usually involves neglect of the right side.
D Spatial neglect is most commonly associated with damage to the right parietal lobe.

Q19 You have an itchy leg, so you scratch it. The sensation of the itch is processed by the _____, whereas the scratching movements are controlled by the _____.

A frontal lobe; parietal lobe
B parietal lobe; frontal lobe
C primary motor cortex; primary somatosensory cortex
D primary somatosensory cortex; primary motor cortex

Q20 Which of the four lobes has an area of cortex that initiates voluntary movements of body parts?

A occipital
B frontal
C parietal
D temporal

Q21 Which of the following is **not** a correct description of a brain study technique?

A using PET to simulate the brain's electrical activity
B using the EEG to record the brain's electrical activity
C using MRI to examine the brain's structure
D using CT to examine the brain's structure

Q22 Motion after-effect is best described as

A a trick.
B a curiosity.
C an illusion.
D a brain disorder.

Q23 Wernicke's area is located in the

A left temporal lobe.
B right temporal lobe.
C left frontal lobe.
D right frontal lobe.

Q24 Studies of change blindness indicate that

A individuals are always aware of what is going on in their environment.

B memory is not involved in conscious awareness.

C change can be detected without having a conscious experience of the change.

D prolonged exposure to a visual stimulus can result in 'fatigue' by neurons detecting upward direction.

Q25 The brain research technique likely to provide the most useful information about the role of the brain in mental processes and behaviour is

A PET.

B *f*MRI.

C TMS.

D SPECT.

The answers to the Chapter 4 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Which cerebral hemisphere tends to process information simultaneously as a whole rather than in an analytic, sequential way?

____

1 mark

Question 2

Wernicke's aphasia involves difficulties with speech ______________________________,

whereas Broca's aphasia involves difficulties with speech ______________________________.

2 marks

Question 3

a What is the reticular activating system (RAS)?

____

____

____

____

1 mark

b What role is the RAS believed to have in consciousness?

1 mark

c How does the RAS perform this role?

2 marks

Question 4

List three distinguishing characteristics of synesthesia.

3 marks

Question 5

a Describe a split-brain participant's likely response when an image of an object is flashed to the right hemisphere and they are required to identify the object.

1 mark

b Explain why the participant in (a) is likely to respond in this way.

1 mark

c What do split-brain studies indicate about consciousness and cognitive processing in the brain?

3 marks

The answers to the Chapter 4 short-answer questions are available at www.OneStopScience.com.au.

5 The peripheral nervous system

Why is it that we don't keep biting our tongue when we talk or chew? How is it that our right and left hands can work together in performing activities such as playing the piano or tying a shoelace? What enables us to successfully do a number of different activities simultaneously, such as talking, watching the road and chewing gum as we ride a bike?

The coordination by the brain of different parts of our nervous system enables us to perform all these behaviours in a fluent way. For example, the neurons carrying messages from the brain about movement in your jaw stay in close contact with the neurons that convey information about the movement of your tongue muscles, generally preventing you from biting your tongue. The neurons that convey information about movement in your right hand communicate with those that carry information about movement in your left hand, enabling you to coordinate activities requiring both hands, such as playing the drums. In fact, the messages sent through the complex network of neurons extending throughout your entire body enable you to perform many complex behaviours simultaneously.

While the roles of the central nervous system (CNS) are to integrate and coordinate all incoming neural information and to initiate messages sent to different parts of the body, the CNS does not have direct contact with the outside world. The CNS relies on the peripheral nervous system to provide it with information about both the external world and the body's internal environment, and to carry messages from the CNS to various parts of the body. The term 'peripheral' means outlying or surrounding. Thus the peripheral nervous system (PNS) is the entire network of nerves located outside the CNS. The PNS extends from the top of the head, throughout the body to the tips of the fingers and toes and to all parts of the skin.

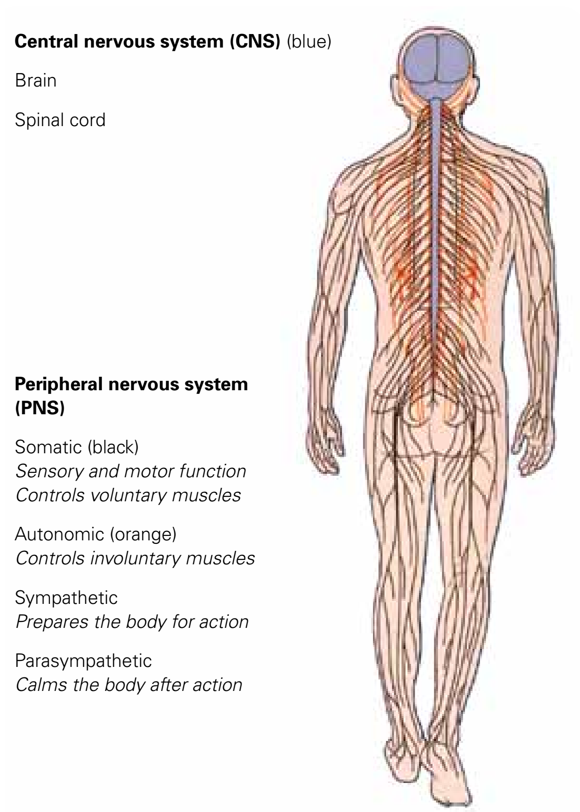


Figure 5.1 The human nervous system can be divided into the central nervous system (CNS), consisting of the brain and the spinal cord, and the peripheral nervous system (PNS), consisting of all nerves outside the CNS. The PNS informs the CNS about events in the environment, and transmits commands from the CNS to the body.

The PNS has two main functions: to carry information from the sensory organs and internal organs to the CNS, and to convey information from the CNS to the muscles, organs and glands. It enables communication between the CNS and all other parts of the body outside the brain and spinal cord.

In the human nervous system, messages can only travel in one direction along the neuron. To accommodate this, the PNS has two different pathways for communicating information to and from the CNS. One of these pathways consists of a set of neurons—the *sensory neurons*—that carry information from sensory organs, muscles and internal organs to the CNS. The other pathway consists of a set of neurons—the *motor neurons*—that carry instructions or messages from the CNS to muscles, organs and glands. The messages carried by the motor neurons enable us to move our muscles, cause glands to release hormones and activate internal organs such as the lungs to expand and contract so that we breathe.

The somatic nervous system

You are able to feel the heat of a wood fire because of the coordination of the PNS and the CNS. The heat given from the fire is received by the sensory neurons (called receptors) of the skin, which are part of the PNS. The sensory neurons then transmit the information to the CNS. The **somatic nervous system**, a subdivision of the PNS, controls the skeletal muscles attached to our bones. These muscles typically produce observable bodily movement as they expand or contract in response to messages received from the CNS. The neural message that begins in the CNS is carried along a network of motor neurons to the muscle(s). When the neural message reaches the muscle, a neurotransmitter is released. *Neurotransmitters* are chemical substances that, in this instance, assist in the transmission of a neural message from the neuron to the muscle. The release of the neurotransmitter onto the muscle causes the muscle to expand or contract, resulting in the required movement.

Thus, it is the somatic nervous system that initiates all skeletal muscle activity enabling you to perform voluntary actions such as scratching your

Figure 5.2 When motor neurons (shown here as tan-coloured fibres) release neurotransmitters onto muscle tissue, the muscle contracts, causing noticeable movement.

Figure 5.3 The sensory function of the somatic nervous system is demonstrated when information from the sensory receptors in the body (skin, muscles, bones and joints) is transmitted to the central nervous system (CNS), resulting in the experience of a bodily sensation.

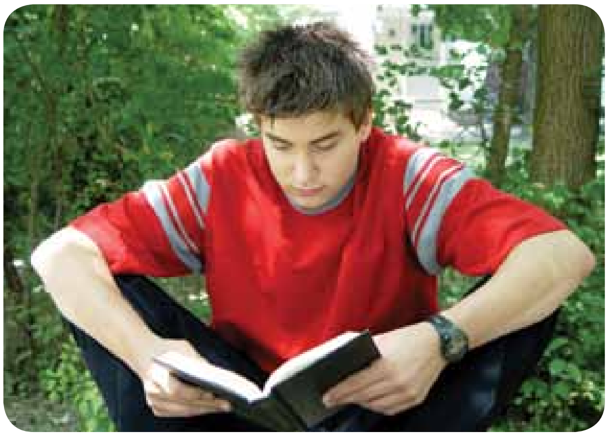


Figure 5.4 The motor function of the somatic nervous system (turning the page of a book) is demonstrated when skeletal muscles voluntarily move in response to a message received from the central nervous system (CNS).

head, talking, riding a surfboard, dancing, chewing and wriggling your toes. Skeletal muscles are completely inactive in the absence of neural input; that is, neural messages from motor neurons.

Research studies involving people who have permanently lost the use of their limbs in accidents have provided valuable information about the importance of the somatic nervous system in skeletal muscle movement. For example, *paraplegia* results when the spinal cord is cut above the area where the spinal cord prevents any communication between the somatic nervous system and the CNS. Damaged nerves in the spinal cord do not regenerate; thus, the loss of voluntary movement to and sensory messages from all parts of the body below the point of severing is permanent. People with paraplegia experience a loss of control over voluntary muscle movement in the lower part of the body, including both legs and, in some cases, loss of bowel and urinary bladder control.

Most instances of paraplegia result from accidents, and restrict individuals to wheelchairs for the rest of their lives. *Quadriplegia* results when the spinal cord is severed above the spinal nerves that control the arms and legs, thus preventing control of voluntary muscles below the neck.

Figure 5.5 Paraplegia demonstrates the importance of the somatic nervous system in skeletal muscle movement. The condition is usually caused by spinal cord damage (or disease) that prevents the somatic nervous system from communicating with the CNS and usually results in the loss of voluntary muscle movement in the lower part of the body. Despite having restricted movement, people with paraplegia can participate in, enjoy and succeed in many aspects of life.

Individuals with quadriplegia usually experience the loss of sensation and muscle control in their entire body below the neck, including both arms and both legs.

Learning Activity 5.1

Review questions

1 **a** Briefly describe the two main functions of the somatic nervous system.

b Give an example of each of these functions, but use examples not referred to in the text.

2 Whenever you write an answer to any question, both the sensory and motor functions of the somatic nervous system are involved. Explain both the sensory and motor roles of the somatic nervous system when writing an answer.

Learning Activity 5.2

Visual presentation—somatic nervous system communication

Prepare a poster with a diagram and brief notes to show the ways that information is transmitted by the somatic nervous system, both to and from the central nervous system. An example of a sensory *and* a motor activity should be used to describe the action of the somatic nervous system. Use arrows (for direction) and labels (for identification) to illustrate the flow of sensory and motor information. Ensure that the correct names are used for the various structures identified in the diagram.

The autonomic nervous system

It's dark. You are alone at home, lying on your bed. Out of the corner of your eye, you detect some movement outside your window. As you look up, you notice a glint of something shiny—a torch or a knife, perhaps. Within a second or so of detecting the movements, fear overcomes you as your mind races with what the object might be, who might be out there and what might happen to you. Your immediate physiological reactions may include an increase in your heart and breathing rates, the appearance of goosebumps on your skin and 'butterflies' in your stomach. However, when you see your cat's face peering through the window, you realise that the glint was the metal bell around its neck, which has caught the neighbour's porch light. The physiological changes that appeared instantly with your fear response start to diminish. You may feel your heart rate noticeably slow down, your breathing become more regulated and the goosebumps and feeling of butterflies disappear.

An experience such as this demonstrates the action of the other subdivision of the PNS, called the autonomic nervous system. This system is actively involved when you experience emotions such as fear, anger and excitement at very intense levels. The **autonomic nervous system (ANS)** is a network of nerves that connects the CNS to the body's internal organs (such as the heart, stomach and liver) and glands (such as sweat, salivary and adrenal glands), providing feedback to the brain about their activities. The ANS is called 'autonomous' because many of the organs, glands and processes under its control are self-regulating and not usually under voluntary control. For example, your heartbeat, breathing, digestion and perspiration occur without the need for you to consciously activate or control them. They usually function independently of the brain.

While skeletal muscles are completely inactive in the absence of motor neuron messages from the brain, the muscles involved in the activity of internal organs and glands (called *visceral muscles*) have built-in mechanisms for generating activity and are not dependent on voluntary control by the brain. This is an important feature of the ANS, as it functions continuously—whether we are awake, active, asleep, under an anaesthetic, or even in a coma (see box 5.1). Regardless of our level of awareness or alertness, the ANS keeps the vital organs and systems of our body functioning, thus maintaining our survival.

Unlike the somatic nervous system, which is responsible for *initiating* skeletal muscle movement, the ANS *regulates* the activity of the visceral muscles, organs and glands. Thus the messages carried between the CNS and the visceral muscles, organs and glands either increase or decrease their respective activities to meet varying demands placed on the body.

Figure 5.6 The autonomic nervous system (ANS) is activated when we experience emotions at very intense levels.

The ANS is not completely self-regulating. For example, there are a few responses that we can voluntarily control at certain times, such as blinking, heartbeat and breathing rate. Furthermore, some people are able to use particular learned techniques to control specific autonomic responses. For example, in India, it has been reported that some yogis (Hindu holy men who practise yoga) have increased their heartbeat from a normal 75 beats per minute to 300 beats per minute without undertaking any physical activity, or have slowed it down to less than 50 beats per minute. Some are also reported to be able to control their body temperature to the extent that one side of their hand is warm while the other side is cold (Blanchard & Young, 1973; Pines, 1973).

People who aren't yogis can also learn to control various specific autonomic responses using a technique called biofeedback training. *Biofeedback* is a process by which a person receives information ('feedback') about the state of an internal bodily activity that normally occurs automatically, and then uses thought processes to exert control over that activity. Feedback about the state of the autonomic response being controlled is usually provided by a monitoring device connected to the person. The person learns a strategy, such as relaxation and/or visualisation, in order to control a particular autonomic response.

Biofeedback training has been used with varying degrees of success to help people to manage stress-related problems such as high blood pressure, chronic pain and migraine headaches. This is considered in Unit 4, Chapter 12: Stress and health.

Box 5.1

Keeping the body alive: the role of the ANS

In 1975, at 21 years of age, Karen Ann Quinlan lapsed into a coma at a party for reasons that still remain unclear to doctors. Diagnostic tests of blood samples revealed traces of aspirin and a mild tranquiliser, as well as a blood alcohol level consistent with her having drunk several glasses of alcohol. However, neurological tests revealed little or no activity in many brain areas. Given the extent of her brain damage, doctors believed that she would recover few, if any, mental or voluntary physical abilities if she regained consciousness. As with all coma patients, Karen was kept alive by various nasogastric ('nose to stomach') and intravenous drips, as well as a respirator to ensure that she kept breathing. She was completely incontinent (unable to control the functions of her bladder or bowel) and she had to be turned over in her bed several times a day to prevent pressure sores from developing.

Karen's case made news throughout the world when her parents asked for and received permission from the courts to disconnect her from the respirator that was believed to be keeping her alive. When the respirator was turned off, Karen continued breathing on her own. This is not unusual for a short period of time. Yet Karen remained in her comatose state for nearly ten years before she eventually died of respiratory failure. Karen's autonomic nervous system (ANS) continued to regulate her breathing, heart activity and other vital bodily functions, despite her extensive brain damage.

Figure 5.7 Despite extensive brain damage, part of Karen Ann Quinlan's autonomic nervous system continued to function, keeping her alive for nearly ten years in a comatose state.

Learning Activity 5.3

Review questions

1. a. Explain why the autonomic nervous system is described as autonomous.
   b. Is 'autonomous' an accurate term for describing this nervous system? Explain with reference to an example.
2. Explain the relationship of the autonomic nervous system to the central nervous system with reference to a physiological response.
3. What is the key difference between skeletal muscles and visceral muscles?
4. Which is more important in maintaining our survival: the autonomic nervous system or the central nervous system? Explain with reference to an example.

Learning Activity 5.4

Distinguishing between the somatic nervous system and the autonomic nervous system

Which division of the peripheral nervous system is more likely to be involved in each of the following responses: the somatic nervous system (S), the autonomic nervous system (A) or both (B)?

- picking up a pen
- eating dinner
- sweating before having to give an important speech
- clenching your fists while watching a scary movie
- crouching on the blocks awaiting the starting siren before swimming in a 50-metre freestyle final
- washing the dog
- blinking
- talking on the phone
- laughing at a joke
- flinching when you hear a loud noise.

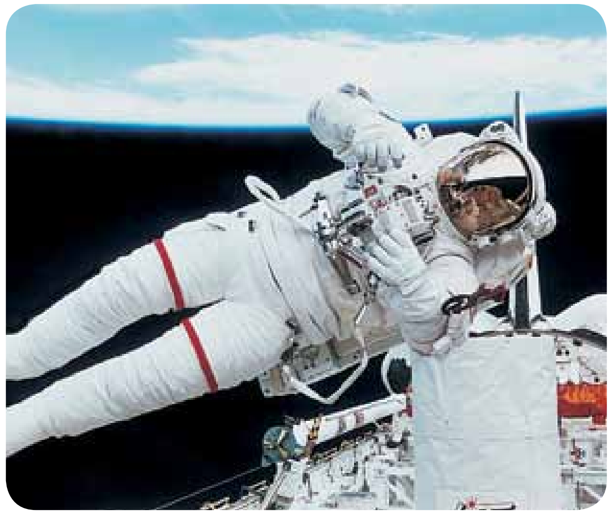


Figure 5.8 In outer space, the temperature is extremely cold and there is no oxygen. Astronauts wear special space suits to restrict heat loss and to maintain adequate oxygen pressure for brain function. On earth, these functions occur automatically through the activity of the autonomic nervous system.

Divisions of the ANS

Most visceral muscles, organs and glands receive messages from two sets of neurons that produce opposite effects and come from two distinct divisions of the ANS: the sympathetic division and the parasympathetic division. The sympathetic division of the autonomic nervous system (usually called the sympathetic nervous system) is responsible for *increasing* the activity of most visceral muscles, organs and glands in times of vigorous activity, stress or threat.

The parasympathetic division of the autonomic nervous system (usually called the parasympathetic nervous system) is responsible for *decreasing* the activity of most visceral muscles, organs and glands, and keeping the body functioning in its normal state.

The coordinated activities of the sympathetic nervous system are demonstrated when you play tennis. During the game, your sympathetic nervous system speeds up your heart rate to pump more blood and oxygen to your muscles. It causes your liver to release sugar into your bloodstream for energy, and induces sweating to keep your skin cool and prevent you from overheating. After the game, your parasympathetic nervous system takes over. Your heart rate slows down, constricting the blood vessels in your muscles so the blood flow is diverted to the internal organs, and your sweat glands gradually slow down the production of sweat as the body returns to its 'normal' state.

While the sympathetic and parasympathetic nervous systems are both active at the same time, one system usually dominates at any given time.

The sympathetic nervous system

The **sympathetic nervous system** is the part of the ANS that activates internal muscles, organs and glands to prepare the body for vigorous activity, or to deal with a stressful or threatening situation. It enhances survival by providing an immediate response, in a split second, to any kind of emergency.

When an emergency is perceived, neurons in the sympathetic nervous system activate target organs and glands to respond in the required way. Glands that are activated include the two adrenal glands, which are located just above your kidneys. The adrenal glands secrete the hormones adrenaline and noradrenaline into the bloodstream. These hormones then circulate throughout your body, complementing and enhancing the effects of the sympathetic nervous system by activating various muscles, organs and other glands in preparation for dealing with the potential emergency. The result is that heart rate and blood pressure increase, breathing rate increases so more oxygen can be taken in, sugar and fat are released from storage to provide instant energy to the skeletal muscles, the pupils dilate to allow more light to enter the eye and enhance vision, and sweat glands increase their production of sweat to cool the body. In addition, the digestive process is slowed down. The sympathetic nervous system is also involved when you blush or get goosebumps, making the hairs on your body stand on end (see box 5.2).

Figure 5.9 An unexpected confrontation has activated the sympathetic nervous system in both of these animals.

Box 5.2

Goosebumps

Goosebumps appear when the fine hairs on your skin stand on end. The appearance of goosebumps is controlled by the sympathetic nervous system.

Human body hairs are so short that when they become erect, nothing much happens. The response of goosebumps has been described as an evolutionary response linked to our ancient ancestors, who had hairier bodies. Erecting the hairs helps non-human mammals conserve their body warmth in a cold environment by increasing insulation around their bodies. In several species it also serves as a defence against enemies in emergency situations. Consider, for example, a frightened cornered cat. By erecting its hairs, it looks larger and by doing so may deter its opponent.

The echidna's quills, which are an effective defence against potential predators, are actually modified body hairs. In an emergency situation, sympathetic nervous system activity leads to erection of the quills, just as it leads to erection of hairs in other mammals. The behaviour that makes the quills so useful (that is, their erection in response to fear) is said to have evolved before the quills themselves did.

Source: adapted from Kalat, J. (1992). *Biological psychology*. Belmont, California: Wadsworth.

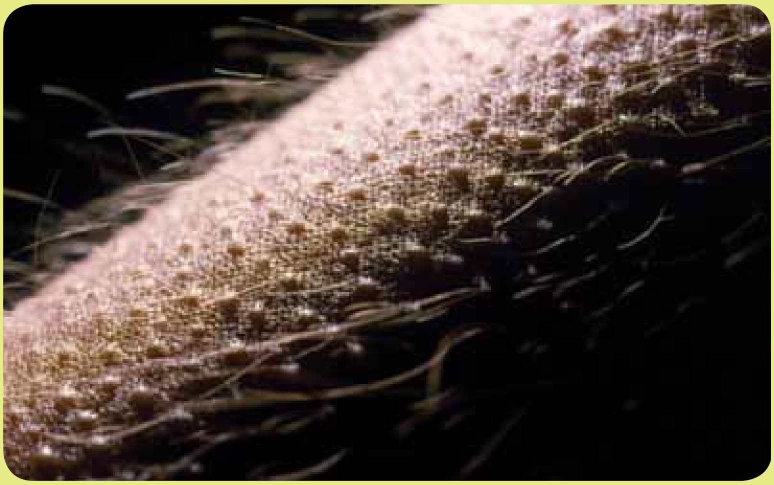


Figure 5.10 The appearance of goosebumps is controlled by the sympathetic nervous system.

The parasympathetic nervous system

The parasympathetic nervous system generally has the effect of counterbalancing the activities of the sympathetic nervous system. The **parasympathetic nervous system** has two main functions: it keeps the systems of the body functioning efficiently and, in times of minimal stress and in the absence of threats, helps it to maintain the internal body environment in a steady, balanced state of normal functioning (called *homeostasis*). It also restores the body to a state of calm, once the need for the activity of the sympathetic nervous system has passed.

The parasympathetic nervous system dominates the sympathetic nervous system most of the time. It is involved in everyday functioning. For example, when you eat, the parasympathetic nervous system stimulates the stomach and intestine to digest food. It is also involved in the elimination of wastes and the protection of the visual system through the production of tears and through automatic pupil constriction in conditions of bright light. In addition, when returning the body to a balanced state, the parasympathetic nervous system reduces heart rate and breathing rate, minimises the release of sugar and fats into the bloodstream, and acts in a way that is opposite to the sympathetic nervous system.

If you had to jump out of the way of an oncoming car, the sympathetic nervous system would immediately be activated. Once the danger had passed, the parasympathetic nervous system would take over and the various bodily systems and functions activated by the sympathetic nervous system would gradually begin to return to normal. The parasympathetic nervous system takes longer to return the body to its normal state compared with the sympathetic nervous system's immediate activation. This is because of the lingering presence of the hormones released when the sympathetic nervous system is activated. These remain in the bloodstream for some time after the threat has passed.

Table 5.1 The activities of the sympathetic and parasympathetic nervous systems

Bodily organ	Bodily function	Sympathetic nervous system action	Parasympathetic nervous system action
pupils	regulate the amount of light entering the eye	dilate (expand)	contract
salivary glands	digestion	decrease salivation	increase salivation
heart	pumps blood	accelerates heart rate	slows heart rate
bronchioles of lungs	breathing	dilate (expand)	contract
stomach	digestion	decreases contractions	increases contractions
liver	produces bile to aid digestion, maintains blood sugar (glucose) level	increases the release of glucose (sugar)	decreases the release of glucose (sugar)
gall bladder	stores bile	inhibits the release of bile	stimulates the release of bile
adrenal glands	secrete the hormones adrenaline and noradrenaline	stimulate hormone secretion resulting in increased heart rate, blood pressure, breathing rate, relaxation of intestinal muscles	inhibit hormone secretion
bladder	urine storage	relaxes	increases contractions
intestine	digestion	relaxes	increases contractions
genitals	reproduction	excite	relax
sweat glands	regulate temperature	increase production of perspiration	decrease production of perspiration

Figure 5.11 Riding on a roller coaster activates the sympathetic nervous system. After the ride is over, the parasympathetic nervous system restores the body to a state of calm.

Learning Activity 5.5

Review questions

1 In what main way do the sympathetic nervous system and the parasympathetic nervous system differ?

2 a What is the role of the sympathetic nervous system in enhancing survival?
  b Give examples of three bodily functions that *increase* their activity as a result of the action of the sympathetic nervous system.
  c Give examples of three bodily functions that *decrease* their activity as a result of the action of the sympathetic nervous system.

3 a Describe three main functions of the parasympathetic nervous system.
  b Give examples of three bodily functions that are affected as a result of the action of the parasympathetic nervous system. Briefly explain the purpose of these changes resulting from the action of the parasympathetic nervous system.

4 Why does it take longer for the parasympathetic nervous system to 'slow down' bodily functions than it does for the sympathetic nervous system to 'speed up' bodily functions?

Learning Activity 5.6

Sympathetic versus parasympathetic nervous systems

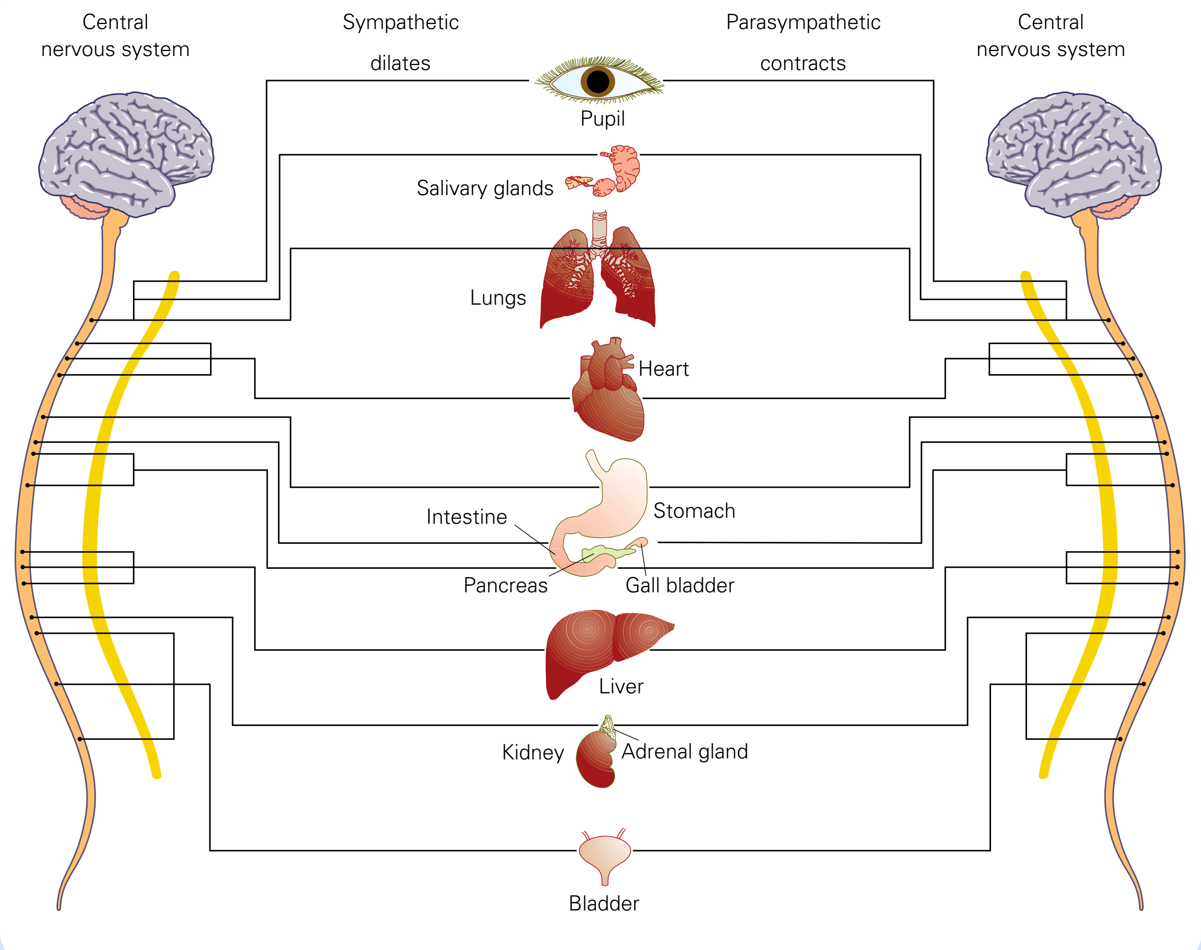
1 Which division of the autonomic nervous system is likely to be dominant if you are in each of the following situations?
  a lying on the beach reading a book
  b waiting for the delivery of your VCE results
  c preparing for a blind date
  d hearing an unexpected loud knock on the front door at 2 am while watching TV alone
  e eating dinner
  f watching a terrifying scene in a movie
  g sitting in class listening to a teacher's explanation.

2 Which division of the autonomic nervous system is likely to be dominant when each of the following physiological responses is observed?
  a increased rate of digestion
  b decreased salivation
  c increased pulse rate
  d decreased pupil size
  e increased perspiration.

Learning Activity 5.7

Summarising the activities of the sympathetic and parasympathetic nervous systems

Photocopy and complete the diagram below to summarise the activities of the sympathetic and parasympathetic nervous systems. Write your answers on the lines connecting the various organs and glands, as shown for the pupil.



Chapter 5 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ The somatic nervous system is a division of the autonomic nervous system.

2 ______ The autonomic nervous system is completely self-regulating.

3 ______ Some autonomic nervous system functions can be controlled through intentional effort.

4 ______ Pupil dilation may automatically occur following sudden activation of the sympathetic nervous system.

5 ______ Contractions of the intestines and bladder may decrease following sudden activation of the sympathetic nervous system.

6 ______ The parasympathetic nervous system 'counterbalances' the activity of the central nervous system.

7 ______ The peripheral nervous system is 'bigger' than the central nervous system.

8 ______ The human nervous system normally functions as a coordinated 'whole'.

9 ______ The peripheral nervous system communicates with the central nervous system via sensory and motor neurons.

10 ______ Skeletal muscle movements are initiated by the somatic nervous systems.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 5 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 A mosquito lands on your arm. You move your hand to swat it. Your sensation and your response are the result of _____ activity.

A adrenal gland
B autonomic nervous system
C somatic nervous system
D parasympathetic nervous system

Q2 Maria saw a child run across the road and get hit by a car. When she reached the child, who was unconscious on the road, Maria was in a state of panic. She was sweating and her heart was racing. Maria's physiological state when she reached the child resulted from the activation of the _____ nervous system.

A parasympathetic
B sympathetic
C somatic
D central

Q3 The division of the nervous system that automatically restores bodily systems to their normal level of functioning after heightened activity is called the _____ nervous system.

A somatic
B central
C sympathetic
D parasympathetic

Q4 As the result of a car accident, Jana was diagnosed with paraplegia. Her inability to use her legs to walk is the result of the inability of her _____ nervous system to communicate with her _____ nervous system.

A central; autonomic
B somatic; central
C somatic; sympathetic
D autonomic; sympathetic

Q5 A key role of the peripheral nervous system is to

A integrate and coordinate all neural information arriving from outside the body so that messages can be sent to different parts of the body.
B carry information to and from the CNS.
C carry information to sensory organs, muscles and glands, but not the CNS.
D carry information from muscles, organs and glands to the CNS.

Q6 Which division of the nervous system transmits messages to initiate muscle activity?

A sympathetic
B parasympathetic
C autonomic
D somatic

Q7 Something gives you a sudden and unexpected fright. Which division of the nervous system will be activated when this happens?

A sympathetic
B parasympathetic
C somatic
D central

Q8 Which of the following statements about the sympathetic and parasympathetic nervous systems is correct?

A The sympathetic nervous system stimulates secretion of adrenaline, whereas the parasympathetic nervous system inhibits secretion of adrenaline.
B The sympathetic nervous system increases contractions of the bladder, whereas the parasympathetic nervous system relaxes the bladder.
C The parasympathetic nervous system increases heart rate, whereas the sympathetic nervous system restores the heart rate to its normal level of functioning.
D The parasympathetic nervous system dilates the pupils, whereas the sympathetic nervous system contracts the pupils.

Q9 The autonomic nervous system

A regulates movements of skeletal muscles.
B initiates movements of skeletal muscles.
C regulates the activities of visceral muscles, organs and glands.
D regulates biofeedback and biofeedback responses.

Q10 Sensory neurons carry information to the _____, and motor neurons carry information from the _____.

A somatic nervous system; peripheral nervous system
B central nervous system; somatic nervous system
C central nervous system; central nervous system
D peripheral nervous system; peripheral nervous system

The answers to the Chapter 5 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Which nervous system structure connects the peripheral nervous system to the central nervous system?

____

1 mark

Question 2

Explain why someone in a comatose state with severe damage to the cerebral cortex may still be able to remain alive for a prolonged period without artificial life support.

____

____

____

____

2 marks

Question 3

Explain the interrelationship of the sympathetic and parasympathetic nervous systems with reference to an example.

____

____

____

____

3 marks

Question 4

Describe the main role of both motor and sensory neurons within the peripheral nervous system.

____

____

____

____

2 marks

Question 5

Distinguish between the roles of the autonomic and somatic nervous systems in human behaviour.

2 marks

The answers to the Chapter 5 short-answer questions are available at www.OneStopScience.com.au.

6 Memory

Imagine for a moment what life would be like without your memory. You would have no recollection of what happened to you two seconds ago, ten minutes ago or even ten years ago. Without memory, every moment would be a new experience. Each person you met would be a stranger and each task you tackled would be a new challenge. Even the most basic tasks that most of us take for granted, such as tying a shoelace or brushing our teeth, would be difficult because there would be no memory of how to do them.

Imagine the effect on your social life. You would not be able to hold a conversation and you would have no friends because you would have no memory of ever having met a person or knowing anything about them from one encounter to the next. Furthermore, without memory you would have no self-concept or personal identity. Our self-concept develops from the many experiences we have during our lives. With no recollection of any of these experiences we would have no basis for developing an understanding of 'who I am'. Each time you looked in the mirror you would be confronted by a complete stranger. In this sense, it is memory that provides meaning to our lives by integrating the past and the present, and enabling us to think about the future.

Human memory is not a single organ like the heart, liver or brain. Nor is it a single 'thing' located in one specific part of the brain. Memory consists of a collection of complex interconnected and interacting systems, each of which serves a different purpose and operates in a very different way. We do not have *a memory*—we have different

"Waiter, I'd like to order, unless I've eaten, in which case bring me the check."

Figure 6.1 When memory is perfect—and not so perfect *memory systems*. Despite their differences and the uncertainty about precisely how many memory systems we have, human memory operates in a unitary way, as if it were a single system. Although the systems share a common function of storing information learned through experience so that we can retrieve and use it when required, they process and store different types of information in different ways.

Given the amount of information processed by memory over a lifetime, its accuracy and reliability is remarkable. However, human memory is not perfect. Every moment of our lives is not automatically recorded in our memory as if on DVD, to be filed away for future reference. Often we fail to properly process and store information that we need to recall and use at a later point in time. Furthermore, many of our memory lapses result from the important need to forget—if we are to remember efficiently (Baddeley, Eysenck & Anderson, 2009).

Our perceptual systems, such as vision and hearing, are constantly bombarded with stimuli during our waking lives. At the time of receiving the sensory information, the brain must select what information will be attended to, processed and stored in the various memory systems, and what will be eliminated and therefore not stored in memory. This selective process of storing and retrieving information is necessary because our memory systems would be overloaded if they had to retain information about every moment in our lives. Imagine what it would be like if you remembered everything. The case study of S. described in box 6.1 provides some insights.

In conversation, we sometimes hear about people who are said to have 'lost their memory'. This generally refers to the situation whereby one or more memory systems malfunction and someone has noticeable problems with memory or a serious case of amnesia. To have no memory at all would mean that you would probably be unconscious or dead (Baddeley, 1999).

Recent advances in neuroimaging techniques have enabled significant developments in the study of the relationship between memory and neurological structures and processes in the brain. It is clear that the brain is vital for memory, both neurologically and psychologically. Although a great deal of what psychology knows about memory has been derived through experimental research and case studies of amnesiacs and patients with brain damage, any study of memory without a consideration of the neural basis of memory would be incomplete. The focus of this chapter is on psychological descriptions and explanations of memory, taking account of neurological processes believed to be involved in memory. In the next chapter, we examine psychological theories of forgetting and ways of minimising forgetting and improving memory.

Box 6.1

An extraordinary memory

There are various case study reports of individuals with extraordinary memory abilities. A well-known case study is that of S., a journalist who was studied by Russian psychologist Alexander Luria (1968).

S. approached Luria in his early 20s when he was experiencing problems in everyday life because his memory was *too good*. He rarely forgot anything at all and often recalled experiences in such vivid detail that he could not remove them from his consciousness. His memories lingered in his consciousness in a distracting way and interfered with his ability to concentrate on a task. For example, S. had difficulty understanding something he was reading because his mind would be flooded with visual images of previous experiences as he read.

Over almost 30 years, Luria tested S.'s memory in a number of different ways. One of the experiments typically presented S. with a series of words, then numbers, then letters, either by reading them to him aloud or having him read them from a sheet of paper. After alternatively listening or reading, S. was able to repeat the information exactly as it had been presented. Even when the list of words, numbers or letters contained 30, 50 or even 70 items, S. could correctly recall all the information.

To concentrate on the information, at regular intervals S. would close his eyes or stare into space. Once all information had been presented, S. would ask for a pause while he went over the information in his mind. Interestingly, he could recall the information perfectly whether he was required to recall it in the order in which it was presented, or in the reverse order—starting with the last item presented then progressing to the first item. Follow-up experiments revealed that S. had no difficulty reproducing any lengthy series of words or numbers after a month, a year or even several years.

In one series of experiments, S. quickly memorised the meaningless formula shown below by using visual images that he linked together into a story. Even though S. was not warned that he would be tested on his recall of this formula, he was able to reproduce it perfectly 15 years later.

$$N \cdot \sqrt{d^2 \cdot \frac{85}{VX}} \cdot 3 \sqrt{\frac{276^2 \cdot 86x}{n^2 V \cdot \varpi 264}}\, n^2 b = sv \frac{1624}{32^2} \cdot r^2 s$$

S. studied the formula for seven minutes and then reported how he memorised it. He used vivid images associated with each piece of information to be remembered and linked them together into a story. The following is an example of how he made up stories to aid his memory.

Neiman (N) came out and jabbed at the ground with his cane (.) He looked up at a tall tree, which resembled the square-root sign (√), and thought to himself: 'No wonder this tree has withered and begun to expose its roots. After all, it was here when I built these two houses' (d2). Once again he poked his cane (.). Then he said, 'The houses are old, I'll have to get rid of them; the sale will bring in far more money.' He had originally invested 85 000 in them (85).

Although Luria was able to develop a detailed understanding of S.'s memory ability, he was unable to help S. Interestingly, S. eventually found himself an unusual way to make his life more comfortable. After losing many jobs, he decided to go on stage as a 'memory expert'. He was able to astound audiences with his ability to recall information and was able to earn a comfortable living (Lahey, 1992).

With only a few minutes' study of a table such as table 6.1, S. could reproduce it in reverse order, horizontally or vertically, and reproduce the diagonals.

Table 6.1 An example of a table memorised by S.

6	6	8	0
5	4	3	2
1	6	8	4
7	9	3	5
4	2	3	7
3	8	9	1
1	0	0	2
3	4	5	1
2	7	6	8
1	9	2	6
2	9	6	7
5	5	2	0
x	0	1	x

Box 6.2

World Memory Championship

The annual World Memory Championship is held over a period of three days during which contestants compete in ten disciplines. Each discipline involves memorising as much information as possible in a set amount of time. It could be, for example, to memorise a deck of cards as fast as possible or to memorise as many binary digits (0s and 1s) as possible in five minutes. After committing items to memory within the set time, each contestant is given another specific amount of time—in general, double the memorising time—to recall the information in the correct order. Some of the current records, as of 2009, are shown below.

Figure 6.2 Reigning memory champion Ben Pridmore from the UK also competes in the World Othello Championships.

Discipline	Description	Record
Speed cards	To commit to memory and recall a single pack (deck) of 52 playing cards in the shortest possible time: five minutes to memorise and five minutes to recall.	24.97 seconds
1-hour playing cards	To commit to memory and recall as many separate packs (decks) of 52 playing cards as possible: one hour to memorise and two hours to recall.	1404 cards
30-minutes binary digits	To commit to memory as many binary digits (1 0 1 1 0 1, etc.) as possible when presented in rows of 30 and recall them perfectly: 30 minutes to memorise and one hour to recall.	4140 digits
Names and faces	To commit to memory and recall as many names as possible when shown photos of faces and link them to the right face: 15 minutes to memorise and 30 minutes to recall.	195 points
5-minutes historic dates	To commit to memory and recall as many fictional numerical historic dates as possible and link them to the right historic event: five minutes to memorise and 15 minutes to recall.	118 dates
Five-minutes numbers	To remember the most random numbers in five minutes.	405 digits

Learning Activity 6.1

Thinking about memory

1. Can you think of any activity you do that does not depend on memory? If so, give an example.
2. Do you believe that you could you learn if you couldn't remember? Could you remember if you couldn't learn? Briefly explain each of your answers.
3. Suggest an explanation of why we don't remember everything that happens in our lives.

Defining memory

Memory is very closely related to learning. If no learning occurs, there is nothing to remember; to learn requires 'memorisation'. Without memory, a great deal of learning would not be possible. Nor would learning have much value. At most times, we learn with the understanding that at some future time we will be able to recall what we learned. The existence of memory indicates that learning has occurred. Given the close relationship between memory and learning, human **memory** is often defined as the storage and retrieval of information acquired through learning. Essentially, memory is as an internal record or representation of some prior event or experience.

Although there are other ways of defining memory, all descriptions typically refer to memory as requiring and therefore involving three fundamental processes: encoding, storage and retrieval. In the 1960s, psychologists who adopted the cognitive approach described these processes using the digital computer as an analogy; that is, human memory was likened to a computer in terms of the way incoming information is processed. This approach still remains useful, although human memory is much more sophisticated than a computer, and differs in many other ways.

When you strike the keys of a computer keyboard to enter information, your actions are translated into an electronic language, or code, that the computer can handle. Similarly, information that is received and stored in memory must be converted from its raw sensory state to a form that the brain can process and use. New information must also be placed, or represented, in some form—sound, visual image, touch or meaning—in the memory system. Psychologists use the term *encoding* to describe this process. **Encoding** is the process of converting information into a useable form or 'code' so that it can enter and be stored in memory.

Next, these encoded representations of information must be retained in memory. Storage is the retention of information over time. Personal computers typically store information on a hard drive, whereas human memory stores information in the brain. In people, the stored representations of information in the brain are referred to as 'memories'.

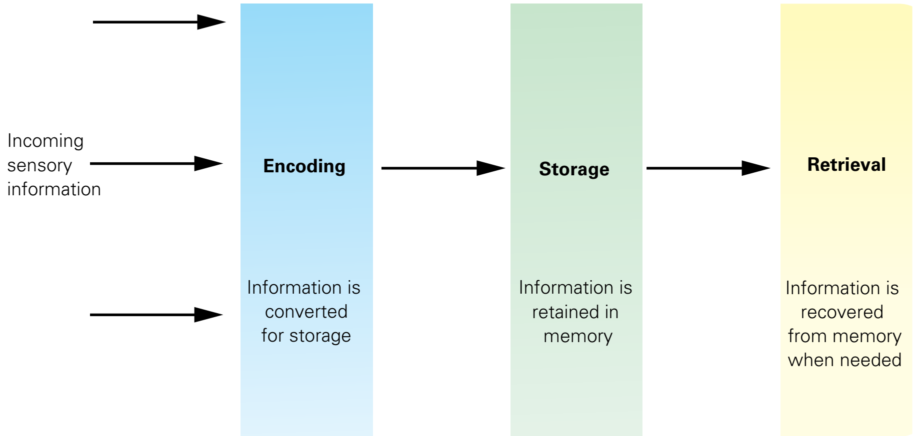
Finally, information is retrieved, or located and taken out of storage, when it is needed. **Retrieval** is the process of locating and recovering the stored information from memory so that we are consciously aware of it. The retrieval of some information, such as your name and your birthdate, is usually so fast and requires such little effort that it seems automatic. However, other information requires greater effort to locate, such as when you answer a question about information learned in Year 7 Science. In these instances, we often rely on *cues* (prompts) to retrieve information that has been stored in memory. Likewise, when you touch particular keys on the computer keyboard you prompt the computer to retrieve specific information from its memory. This information is presented on the computer monitor or can be printed out in a hard copy. When human memory works effectively, encoding leads to storage, and storage enables retrieval.

Although these three processes serve different functions, they interact. For example, how information is encoded determines exactly what information is stored and how that information is stored, which in turn can limit what can

Figure 6.3 In the 1960s, psychologists who adopted the cognitive perspective to explaining mental processes and behaviour likened human memory to information-processing by a computer. The analogy is still useful but is now regarded as having limitations, particularly as human memory is viewed as comprising different memory systems for different types of information.

subsequently be retrieved. Consider a simple physical device intended to aid memory—a shopping list. If it is to be an effective memory aid, you need to write legibly in a language that can be understood by whoever uses the shopping list. If it were to get wet, the ink would blur (impaired storage) making it less distinct and harder to read (retrieval). Retrieval would be harder if your handwriting was poor (an encoding–retrieval interaction) and if the writing was smudged (a storage–retrieval interaction). The situation is further complicated by the discovery that human memory comprises not one but several interrelated memory systems which can vary in how, and for how long, information is encoded, stored and retrieved (Baddeley, Eysenck & Anderson, 2009).

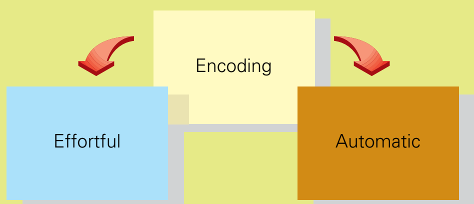
Figure 6.4 A simplistic representation of the three fundamental processes required for human memory: *encoding*, *storage* and *retrieval*. If any one of these processes fails, memory will fail.



Box 6.3

Automatic and effortful encoding

With certain types of information, encoding takes place automatically without any mental effort. For example, think about your bedroom. When were you last there? What colour are the walls? Where is the bed located? You can probably provide this information relatively easily, despite the fact that you have probably never made a deliberate mental effort to encode it. Research findings suggest that people tend to automatically encode information about their location in space and time, and the frequency with which they experience various events. But other kinds of



information tend to require deliberate, effortful encoding to enable processing in memory. This involves specifically attending to the information to be retained, labelling it and then associating it with other material already in memory, or rehearsing it until it is familiar. For example, a ballet dancer may know exactly how to do a *pas de bourrée*, yet may have trouble remembering the term. In this case she has probably heard the term, but because she rarely uses it, she has not made the effort to encode it.

Students sometimes rely on automatic encoding when effortful encoding would be far more effective. For example, they may assume they can encode the material in a textbook as effortlessly as they can encode the colour of their bedrooms, but then they may experience retrieval problems at exam time (Wade & Tavris, 1990).

Learning Activity 6.2

Review questions

1. How is memory commonly defined in psychology?
2. a. Describe the processes of encoding, storage and retrieval.
   b. Explain the interrelationship between these processes with reference to an example not used in the text.
   c. Explain whether memory is possible *without* any one of these processes.
3. Explain why comparing human memory to information-processing by a computer may misrepresent or oversimplify human memory.

Models for explaining human memory

Human memory is too complex and multifaceted to be studied all in one piece. Instead, like many other complex phenomena and constructs, psychologists tend to break memory down into components that can be studied separately from one another and consider how each component contributes to an understanding of the whole. A *model* is then used to represent, describe and explain memory and its components and processes. Typically, models of human memory are visual diagrams that use boxes to represent components and arrows to represent the movement of information from one component to another.

Although many models have advanced psychology's understanding of memory, no single model has been shown to capture all aspects of human memory. Some models of memory, however, have been more influential than others. Three such models are Atkinson and Shiffrin's (1968) *multi-store model*, which describes memory as having three components called the sensory register, the short-term store and the long-term store; Baddeley and Hitch's (1974) *model of working memory*, which changed views on the roles and functioning of short-term memory; and Craik and Lockhart's (1972) *levels of processing framework*, which emphasised the importance of the 'depth' at which we process information in determining how well the information is stored for retrieval when needed. We examine each of these models and how they have influenced contemporary descriptions and explanations of memory.

The Atkinson–Shiffrin multi-store model

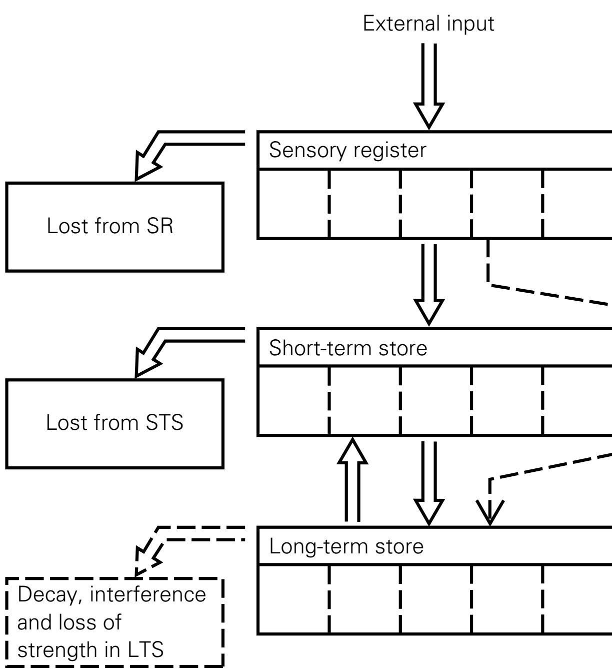
In the 1960s, psychology had shifted from the assumption that human memory was a single memory system towards the idea that two, three or perhaps more memory systems were involved. A very influential model that represented the shift in thinking away from memory as a single system was proposed by American psychologists

Richard Atkinson and Richard Shiffrin in 1968. Their *multi-store model* was so influential that many psychologists called it the *modal model* because it was representative of many similar models that were proposed at that time. It is also known as the *stage model* because it proposes that the flow of information moves in stages through each component of memory (Baddeley, Eysenck & Anderson, 2009).

The **Atkinson–Shiffrin multi-store model** represents memory as consisting of three distinguishable components called the sensory register, the short-term store and the long-term store. Each component, or store, represents a place where information is held and processed. As shown in figure 6.5, the three components are represented as separate memory stores through which information is transferred. When sensory information is received from the environment, it usually flows from the sensory register to the short-term store and then to the long-term store. Information may also flow from the sensory register to the long-term store or back from the long-term store to the short-term store. Each component stores, encodes and processes information in different ways, but they operate simultaneously and interact.

According Atkinson and Shiffrin (1968), the *sensory register* is the entry point for all new information into memory from the external environment. It stores vast quantities of incoming visual information for up to several hundred milliseconds. Any information in the sensory register that is attended to is transferred to the short-term store. If the sensory information is not attended to, its 'memory trace' (neural imprint) simply decays and disappears forever. In some cases, information may bypass the short-term store and transfer directly to the long-term store. However, Atkinson and Shiffrin did not explain how or why this occurred. Instead, they allowed for the possibility that it could occur. They also considered the possibility that there may be different sensory registers for different types of sensory information; for example, a separate sensory register for visual information and a separate sensory register for auditory information.

Atkinson and Shiffrin (1968, 1971) described the *short-term store* as a 'temporary working memory' in which we manipulate information that is held to perform everyday functions. It holds all information that we are consciously aware of at any point in time. The short-term store receives inputs of information from the sensory register as well as information retrieved for use from the long-term store. However, unlike the sensory register (and long-term store), the short-term store has a limited capacity, being able to hold up around seven items of information at the same time. Furthermore, information can only be held there for about 30 seconds unless a conscious effort is made to keep it there longer. This can be achieved through a process such as rehearsal. For example,



Reprinted from *Psychology of Learning and Motivation*, Volume 2, R.C. Atkinson, R.M. Shiffrin, *Human Memory: A Proposed System and its Control Processes*, Copyright 1968, with permission from Elsevier http://www.elsevier.com.

Figure 6.5 The Atkinson–Shiffrin multi-store model. This diagram shows the structure of human memory and the flow of information through memory. Memory is represented as consisting of three different components called the *sensory register*, the *short-term store* and the *long-term store*.

rehearsal could involve intentionally repeating the information over and over, such as when we try to remember a telephone number. Alternatively, it may involve actually using the information.

According to the multi-store model, rehearsal of information in the short-term store is a crucial process. For example, rehearsal of new information received from the sensory register enables it to be further encoded and transferred to the long-term store for more permanent storage. If new information is not rehearsed in some way, then the memory trace it formed in the brain 'decays' and the information is lost forever. Continual rehearsal of information in the short-term store enables that information to be held there for as long as it is required. It also has the effect of regenerating, or 'renewing', the information's memory trace, thereby making it an even stronger 'memory' when transferred to the long-term store.

Atkinson and Shiffrin (1968) described the *long-term store* as holding information relatively permanently in a highly organised way and having an essentially unlimited capacity. Unlike the sensory register and short-term store, information transferred to the long-term store does not usually decay and may be stored for up to a lifetime. All information is eventually completely lost from the sensory register and the short-term store. Nevertheless, we can fail to retrieve sought-after information from the long-term store. According to Atkinson and Shiffrin, our inability to retrieve the required information primarily results from the use of ineffective search strategies to find the right memory trace for that information. The presence of related information in the long-term store may also result in 'interference' with the sought-after information, thereby disrupting the retrieval process (Shiffrin & Atkinson, 1969).

An important aspect of the Atkinson–Shiffrin multi-store model is its description of human memory in terms of its *structural features* and its *control processes*. In distinguishing between structural features and control processes, Atkinson and Shiffrin used a computer analogy. They likened structural features to the computer and control processes to the computer programmer who determines the operation of the computer.

Structural features are the permanent, built-in fixed features of memory that do not vary from one situation to another. The three different stores are the basic structural features. Other structural features include the function of each component (the role it plays), the storage capacity of each component (the amount of information it can hold at any given moment) and the duration, or length of time, for which information can be held by each component. **Control processes** are selected and used by each individual and may vary across different situations. They are under the conscious 'control' of the individual and which control process is used depends on what the individual does. For example, attention is a control process. Whether or not the individual chooses to attend to and select incoming sensory information will determine whether that information is transferred from the sensory register to the short-term store. Rehearsal is also a control process and its use determines whether information is retained in the short-term store, for how long it will be held there and whether it is transferred to the long-term store. Similarly, retrieval is a control process. The 'search' strategy chosen by the individual will determine whether some or all of the required information in the long-term store will be retrieved.

After it was published more than 40 years ago, the multi-store model played an important role in shifting the study of human memory from the idea that memory is a single system towards the view that memory involves multiple systems. It still remains useful for providing a framework to describe and explain the basic workings of memory. Although it was based on substantial and extensive research findings, some of its underlying assumptions have since been built upon, challenged or even refuted on the basis of more recent research findings.

For example, it is now clear that information from the environment does not simply 'flow' through a sensory register, then a short-term store and finally to a long-term store in what was essentially described by Atkinson and Shiffrin as a three-stage sequence. There is also considerable evidence that there is a separate sensory register for auditory information and haptic (touch) information, and possibly a sensory register for each of the other senses. Many psychologists now refer to these sensory registers collectively as comprising a *sensory memory* system within human memory. Others tend to overlook sensory memory when describing memory, viewing it more as a perceptual system rather than a memory system (Baddeley, 2009).

Atkinson and Shiffrin identified characteristics of the short-term store that distinguished it from long-term memory and still remain accurate, such as its storage capacity and duration. They also recognised the importance of the short-term store and its fundamental roles. However, it is now believed to be a much more complex system than the temporary working-memory store they described. The short-term store—or *short-term memory, short-term working memory* or simply *working memory* as it is now commonly called—is no longer believed to be a single store in which information is rehearsed until it flows into the long-term store or is discarded. Using neuro-imaging techniques, researchers have matched short-term memory and other 'stores' with physical locations in the brain. This has provided evidence that short-term working memory consists of a number of separate, interacting components or sub-systems that process different types of information (Baddeley, 2009). Researchers have also distinguished between different types of rehearsal in short-term memory. Maintenance rehearsal, as described by Atkinson and Shiffrin, is still relevant, but simply repeating information over and over does not guarantee transfer to long-term memory. For example, how many times have you rehearsed a new phone number or a name only to have it slip away as soon as you were distracted? Psychologists now believe that a type of rehearsal called elaborative rehearsal better promotes encoding and is much more effective for long-term storage.

Furthermore, psychologists no longer view the long-term store, or *long-term memory* as it is now commonly called, as a 'single' memory component. It seems, for example, that long-term memory has different sub-systems or stores, such as episodic and procedural memory, each of which processes and stores different types of information. There is also evidence that information is not always simply retrieved from a long-term store and is available for use exactly as it was originally stored. For example, memories of experiences retrieved from long-term memory can be 'constructions' that we build or rebuild, sometimes in ways that lead to distortions of memory, or even 'false memories'. There is now also a much better understanding of how information may be organised in our long-term memory systems and of the importance of organisation for encoding and retrieval.

These and other aspects of human memory are not adequately addressed, if at all, in Atkinson and Shiffrin's original multi-store model. This is hardly surprising given the number of years that have passed since the multi-store model was first described and the research on memory that has been conducted since then, more recently aided by sophisticated neuroimaging techniques. Consequently, we reconsider the components of the multi-store model to elaborate on some of the key features of sensory memory, short-term memory and long-term memory in the light of subsequent research findings.

Learning Activity 6.3

Review questions

1. Explain the meaning of the term model of memory.
2. What is the Atkinson–Shiffrin multi-store model of memory?
3. a Distinguish between structural features and control processes in memory, with reference to examples.
   b Explain whether each of the following is a structural feature or control process:
      i deciding whether retrieved information is correct
      ii a memory trace
      iii encoding.
4. Briefly describe other key features of the Atkinson–Shiffrin model.
5. What are the most important ways that the three stores are different from each other?
6. In what three ways is the Atkinson–Shiffrin model a useful model of memory?
7. What are three main limitations of the Atkinson–Shiffrin model? Explain each limitation with reference to an example or an aspect of memory now believed to be different in some way.

Learning Activity 6.4

Visual presentation summarising Atkinson and Shiffrin's three components of memory

Make a copy of the following table and use it to summarise key characteristics of the three components of human memory, as described in the Atkinson–Shiffrin multi-store model of memory.

Main characteristics of Atkinson and Shiffrin's memory components

Component	Function	Capacity	Duration
sensory register			
short-term store			
long-term store			

Sensory memory

In the course of a typical day, thousands of sights, sounds, smells and other stimuli from the external environment bombard your sensory receptors. All of this information, whether you pay attention to it or not, is briefly held in sensory memory.

Sensory memory is the entry point of memory where new incoming sensory information is stored for a very brief period of time. The information received by each sensory system is assumed to be retained as an exact copy of its original, 'raw', sensory form (rather than in an encoded form). As proposed by Atkinson and Shiffrin, we can store vast amounts of sensory information in sensory memory. Some psychologists suggest that it may have an unlimited storage capacity.

An important function of sensory memory is that it stores sensory impressions long enough for each impression to slightly overlap the next. Thus we perceive the world around us as continuous, rather than as a series of disconnected visual images or disjointed sounds. To test this, quickly wave a pen back and forth in front of your face. You should see the fading image trailing behind the pen. This is assumed to be an example of your visual sensory memory at work. It seems as if our visual sensory memory momentarily stores a snapshot of the image then replaces it with another overlapping image.

Sensory information remains in sensory memory just long enough for us to attend to and select the information to be transferred to short-term memory (STM) for processing. It is a kind of information *buffer*; that is, a temporary storage system for information that may subsequently undergo further processing. We are not consciously aware of most of the information that enters sensory memory. Nor can we consciously manipulate information in sensory memory or extend the time period for which information is retained there. However, when we direct our attention to it, we transfer the information to STM and become consciously aware of it. For example, if your attention is focused on reading this page, you will be unaware of many of the sounds around you. Although the information has been received in sensory memory, it is not until you direct your attention to focus on sounds outside, or the feel of your watch around your

Figure 6.6 If you went to a popular nightclub, your senses would be bombarded by hundreds of different sights, sounds, smells and other stimuli. These would initially be stored in separate sensory stores called *sensory registers*. Psychologists believe that there probably is a separate sensory register for each of the senses.

wrist, that you are aware this information had been initially registered in your sensory memory.

It is assumed that any stimulus received in sensory memory is available to be selected for attention and for processing in STM. For example, all the objects in your visual field and all sounds loud enough for you to hear are available to be transferred to STM at any given moment. If the sensory information is not attended to and no further processing occurs, its impression fades and therefore cannot be transferred to STM, or subsequently to long-term memory (LTM), and is permanently lost from experience.

Incoming sensory information is assumed to be stored in separate sensory systems called *sensory registers*, each of which retain sensory information for different periods of time. Psychologists believe that there probably is a separate sensory register for each of the senses. For example, the many visual images you process while at a nightclub will be stored in the visual sensory register (called *iconic memory*), while the sounds of music and voices of people will be stored in the auditory sensory register (called *echoic memory*). Only the visual and auditory sensory registers have been studied extensively.

Iconic memory

The term **iconic memory** (from the Greek word *icon*, which means image) is used to describe visual sensory memory; that is, the brief sensory memory for incoming visual information. Visual images in their original sensory form are usually retained in iconic memory for about one-third of a second, but they last just long enough to recognise and process the sensory information.

To experience iconic memory, close your eyes for one minute. Near the end of the minute, hold your hand about 25 centimetres in front of your eyes. Then open your eyes and rapidly close them again. You should see an image of your hand that fades away in less than a second (Ellis, 1987).

When you go to the movies, you see what appears to be a continuous scene in which people, animals and objects move quite normally. What is actually presented to your eyes, however, is a series of individual frames of pictures of frozen images, interspersed with brief periods of darkness. In order to see a continuously moving image it is necessary for the visual system which includes iconic memory to store the information from one frame until the next frame is presented. Likewise, if you move a 'sparkler' in a particular pattern, such as a figure 8, when in a darkened room, you will 'see' the number '8'. Recognition of the whole figure is possible because iconic memory holds the image of the tip of the sparkler very briefly in each position of the figure 8. Because each new image is registered in iconic memory before the previous image fades, you are able to 'see' the entire figure (Baddeley, 1999).

Figure 6.7 The persistence of the image of the sparkler allows the child to 'draw' a series of circles.

The existence of a sensory register for visual sensory information was first demonstrated in several experiments by American psychologist George Sperling. In his best-known experiment, Sperling (1960) used a tachistoscope to very briefly present participants with sets of 12 letters arranged in a pattern such as that shown in table 6.2 below.

Table 6.2

G	K	B	L
M	V	X	P
R	W	Z	C

Sperling projected the sets of letters on a screen for about one-twentieth of a second. This amount

Figure 6.8 American psychologist George Sperling conducted the best-known experiment on iconic memory.

of time was chosen because it is too brief for any eye movements to occur during the presentations of the letters. The participants were required to verbally report as many of the letters as they could recall. Most could recall only four or five letters in each set, no matter how many letters they were shown. Sperling found that with such short exposure, reporting all the letters in a set was impossible.

However, most of Sperling's participants reported that, for an instant, they had seen *all* of the letters that had been briefly flashed on the screen. But, by the time they could say four or five of them, the image of the remaining letters had faded. Sperling reasoned that all letters in each set were seen because they had been initially registered in some way and should therefore all be available for a brief time. But because the image disappeared so quickly, only a few letters could be named before they were lost from iconic memory.

To test whether all the letters were actually retained in iconic memory, Sperling conducted a further experiment in which he sounded a tone just after a pattern of letters was flashed on the screen. On hearing a high tone, the participants were told to report only the letters from the top row, on a medium tone the middle row, and on a low tone the bottom row (see table 6.3). Under this condition of the experiment, the participants had to select a line from the visual image they held in iconic memory.

Table 6.3

G	K	B	L	High tone
M	V	X	P	Medium tone
R	W	Z	C	Low tone

Once participants learned this partial report system, they were able to repeat any row of letters with perfect accuracy. For example, after seeing a pattern of letters flashed on the screen, they would hear the medium tone, direct their attention to the middle line of letters in their iconic memory and 'read them off'.

These results indicated that an image of all of the letters (that is, the whole pattern) had been momentarily stored in iconic memory *after* the pattern left the screen. By delaying the tone for longer and longer intervals (from about one-tenth of a second to one second), Sperling was able to determine how quickly images in iconic memory fade. As the time-delay lengthened, Sperling found that a participant's ability to recall letters in a designated row declined more and more. Subsequent research by other psychologists has found that the typical duration of iconic memory is about 0.2–0.4 seconds (Cowan, 1995).

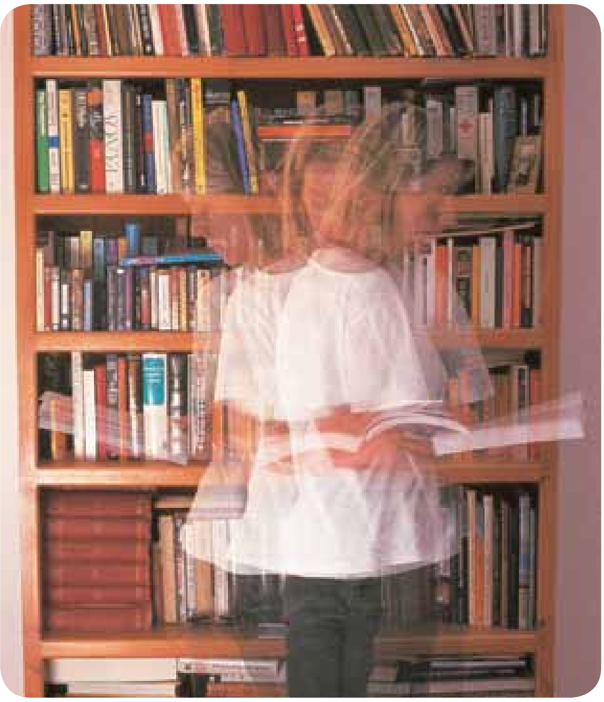


Figure 6.9 If iconic memory did not clear quickly, multiple sensory memory representations of a scene would overlap and distort your perception of the world.

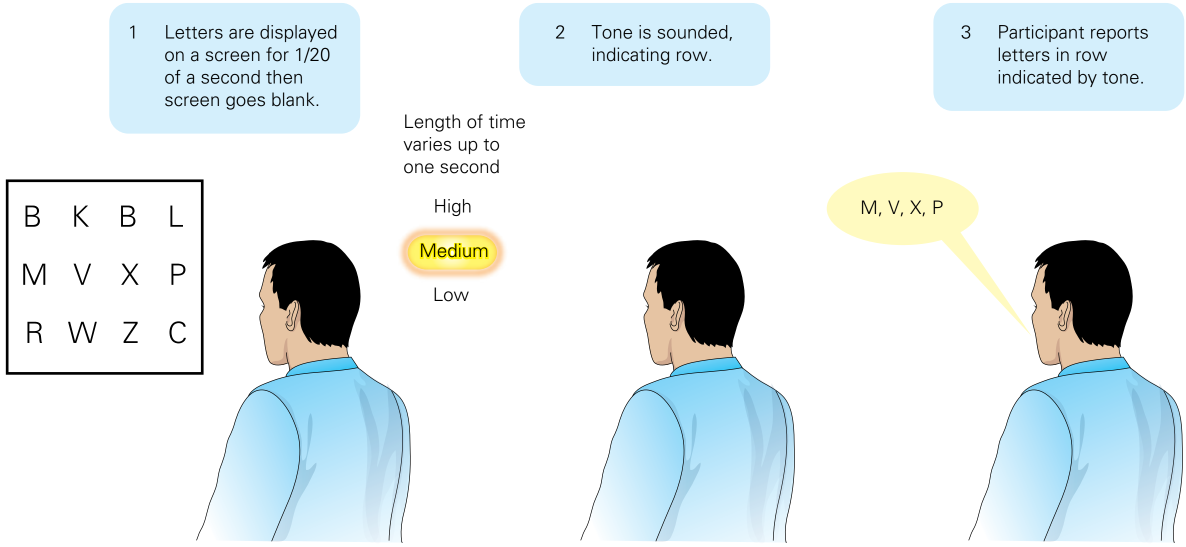


Figure 6.10 Sperling's (1960) classic experiment on the duration of iconic memory

Atkinson and Shiffrin were aware of Sperling's research on iconic memory and took the findings into account when describing their sensory store.

However, many research studies completed on echoic memory were unavailable to Atkinson and Shiffrin when they published their multi-store model in 1968.

Learning Activity 6.5

Evaluation of research by Sperling (1960)

Evaluate the experiment on iconic memory by Sperling (1960). You may present your evaluation as an annotated diagram; for example, as a flow chart. You are required to:

1. Construct an operational hypothesis that could have been tested by the procedures used in the experiment.
2. Identify the IV(s) and DV(s) in the experiment.
3. Briefly state the results obtained.
4. If the results were shown to be statistically significant with $p \leq 0.05$, what would this mean? Would the results be more meaningful with $p \leq 0.01$? Explain your answer.
5. Briefly state a conclusion based on the results obtained.
6. Identify a potential extraneous or confounding variable that could impact on the results obtained if uncontrolled and explain how it was controlled.
7. Comment on the external validity of the experiment and the extent to which the results can be generalised.

Box 6.4

Photographic memory

Some individuals are able to recall highly detailed scenes as if the actual event were occurring before them. People who are unusually good at this task are said to have *eidetic memory*, popularly referred to as 'photographic memory'. Eidetic memories involve *eidetic images*—an exact replica of a visual image that persists over time without distortion. People who have this ability are so good at maintaining an image that they literally 'see' the relevant page of a textbook as they recall the information during an exam.

Eidetic images can apparently last for prolonged periods of time—sometimes days or even weeks—and seem to contain all the information in the original experience. Eidetic images occur most often during childhood (in about 5% of children tested), but are less frequent in adolescence, and are very rarely reported in adulthood (Hilgard, Atkinson & Atkinson, 1979).

In one of the original experiments on eidetic memory, English schoolchildren were shown a complicated street scene that was displayed in the form of a storybook picture for 35 seconds and then withdrawn from view. Some of the children were able to describe this scene as if describing the information with the actual picture in front of them. A few of these children (who it would seem had eidetic memories) could spell out the name of a street that had appeared in the picture even though this street name was a 13-letter German word and the children knew no German (Allport, 1924).

Contrary to popular belief, 'memory experts' generally don't have eidetic memory. Their skill is usually in organising material in memory using *mnemonic*, or 'memory-improving', techniques rather than storing information as long-lasting visual images.

Testing for eidetic memory

Look at the picture in figure 6.11 for about 30 seconds, cover it and then answer the questions below.

1 What colour is the girl's dress?
2 Where are the girl's arms?
3 Is the cat looking to its right or its left?
4 How many red flower 'spikes' are there?
5 What colour is the girl's hair?
6 How many stripes are there on the bottom of the girl's dress?

If you correctly answered all these questions, then you may have eidetic memory.

Figure 6.11 Stimulus picture used to test eidetic memory

Echoic memory

The term **echoic memory** (from the word *echo*) is used to describe auditory sensory memory; that is, the brief sensory memory for incoming auditory information. Echoic memory registers and retains all kinds of sounds, such as speech, the barking of a dog, and the sirens of emergency vehicles. It is called echoic memory because sounds linger in it like an echo. To experience echoic memory, clap your hands once and notice how the sound remains for a very brief time and then fades away.

Studies of echoic memory indicate that it functions like iconic memory, storing sounds (rather than visual images) in their original sensory form. Apart from the sensory register involved, the main difference between iconic and echoic memories seems to be the length of time it takes information to fade. Echoic memory stores information for longer periods than does iconic memory—typically three or four seconds—while visual information is retained in iconic memory for an average of 0.3 seconds.

Table 6.4 Storage of information

iconic (visual) memory	about 0.2–0.4 seconds
echoic (auditory) memory	about 3–4 seconds

Figure 6.12 If you hear this bird's squawk, your echoic memory will retain the auditory information for about three to four seconds. However, if you see a photograph of this bird flashed on a screen for a split second, your iconic memory will hold the visual information for between 0.2 and 0.4 seconds.

Although the retention period is brief, the availability of auditory information for three or four seconds is generally long enough to select what has been heard for further processing and interpretation before the sound disappears completely. For example, consider the times when your attention has been focused on a book you are reading or a television program you are watching, and someone asks you a question. Often, you are aware they are speaking, but since your attention is focused elsewhere, you do not immediately comprehend the message. However, within a couple of seconds you say 'What?' and then answer the question before the person has time to repeat it. It is believed that because the sound of the original question is held in echoic memory for a few seconds, when you directed your attention to what the person said, the information was passed on to STM where it was processed and interpreted. Echoic memory stores the tail-end of the question temporarily while earlier parts of the message are being processed. It is possible that the response of 'What?' occurs just prior to the last parts of the message in echoic memory being transferred to STM.

The relatively longer duration of echoic memory is important for understanding speech. You perceive speech by blending successive spoken sounds that you hear. When you hear a word pronounced, you hear individual sounds, one at a time. You cannot identify a word until you have heard all the sounds that make up the word, so auditory information must be stored long enough for all the sounds involved to be received. For example, if someone says 'compare', you will think of judging something against something else; but if someone says 'compute', you will think of something completely different. The first syllable you hear ('com') has no meaning by itself in English, so you do not identify it as a word. However, once the last syllable is heard, you can put the two syllables together, recognise the word and give it some meaning. If echoic memory storage were as brief as iconic memory storage, speech might sound like a series of separate, distinct sounds instead of meaningful words, phrases and sentences.

In a typical experiment on echoic memory, participants are asked to focus their attention on reading a story and to ignore any spoken words they hear as they read (typically numbers such as 'seven' or 'two' or 'five'). Occasionally during their reading, a signal is sounded after which participants are required to repeat the numbers that they have just heard. The results typically show that participants can repeat accurately the last few numbers they have heard if the signal is presented immediately after the last spoken number, but their recall diminishes when the delay between the last spoken number and the signal increases up to about ten seconds (Cowan & others, 2000).

When asked to describe their experience after one experiment, many participants reported they were only vaguely aware of the spoken numbers while focusing their attention on reading the story. However, at the sound of the signal, they could still 'hear' the last few numbers and could shift their attention to the numbers and repeat them.

Findings from various experiments on sensory memory suggest that although sensory memory can store virtually all the information provided by our sensory receptors, this information fades rapidly (with the rate varying among the senses). Information is lost and replaced so rapidly in the sensory registers that we are rarely aware of our capability for retaining sensory information. It also seems that sensory memory may act as a type of filter to keep out irrelevant and unimportant information and prevent it from cluttering the sensory stores.

Considering the many trillions of bits of information detected by our senses in a lifetime, if we processed everything that reached sensory memory, it would probably lead to confusion, frustration and inefficiency in daily living. For example, when walking through the city of Melbourne, your echoic memory will register thousands of different sounds but you will attend to and remember only a select few of these. If, while crossing Flinders Street, you hear the screech of car brakes nearby, you will probably pay attention to and act on that information because of the potential threat to your safety. At that moment when you are attending to and processing the sound of the screeching brakes, you will ignore other sounds that enter echoic memory, such as people talking, the clicking sound of the traffic lights, the sound of a tram bell or that of a bus departing. It would be chaotic, and even dangerous at times, if we attended to all of the sensory information detected by our receptors.

When you attend to information in sensory memory, it is transferred to short-term memory. Only the information selected for transfer to short-term memory is encoded and has a chance of being stored permanently. Information in sensory memory that is not attended to is lost very quickly—within seconds at most.

Box 6.5

Haptic sensory memory

Haptic, or *tactile, sensory memory* is believed to involve a sensory register that retains physical sensations of touch (and possibly sensations from the tension of internal muscles) for about 1–2 seconds. As well as enabling us to combine a series of touch sensations, it is believed to play a role in helping us to identify objects we can touch but cannot see. To experience tactile sensory memory, touch the back of your hand lightly with the point of a sharp pencil and then quickly pull the pencil away. Focus on the sensation that momentarily remains. You should be able to notice that the sensation of being touched persists for an instant after the pencil is withdrawn.

Figure 6.13 Professional musicians use haptic memory (of finger movements), iconic memory, echoic memory and possibly other sensory memories to eventually commit pieces of music to long-term memory and retrieve them for use when needed.

Box 6.6

Déjà vu

You arrive somewhere for the first time when suddenly you have a weird feeling that you've been there before. This is called *déjà vu*—French for 'already seen'. In psychology, déjà vu is described as the brief and intense feeling that something happening now has happened before in exactly the same way, but without you being able to recall exactly when or where.

Some people believe that déjà vu is evidence of psychic or paranormal experiences, reincarnation or even dreams coming true, but there is no scientific evidence supporting any of these views.

How common are déjà vu experiences? After analysing the results of more than 30 studies on déjà vu that used the survey method, American psychologist Alan Brown (2004) found that about two-thirds of individuals (68%) reported having had one or more déjà vu experiences in their life. He also found that the incidence of déjà vu steadily decreases over the lifespan.

Young adults in the 20–24 year age range tend to have the highest yearly incidence, averaging almost three déjà vu experiences per year. By the time people reach their early forties, they are averaging less than one déjà vu per year. However, a small minority of people seems to be especially prone to déjà vu experiences: about 16% claim to have a déjà vu experience about once a month.

According to Brown (2003), a typical déjà vu experience is triggered by some kind of visual scene, and the intense feelings of familiarity last for just a few seconds. Déjà vu experiences are most common when people are feeling fatigued or emotionally distressed, in the evening and in the company of others rather than alone. Well-educated people and people who travel frequently tend to have a higher incidence of déjà vu experiences (Hockenbury & Hockenbury, 2009).

Many scientific explanations have been proposed for déjà vu. These explanations include neurological possibilities such as temporary brain malfunction and psychological explanations involving memory malfunction or inattentional blindness. For example, American psychologists Carole Wade and Carol Tavris (1990) have explained déjà vu in terms of sensory memory. They suggest that déjà vu may occur when information entering sensory memory 'short circuits', or fails to complete its normal route, and must therefore be reprocessed.

The feeling of familiarity results from the fact that you *did* experience exactly the same situation before—though only a fraction of a second before. If you were unable to determine when the initial processing occurred, you might mistakenly believe that the experience had occurred in the more distant past.

According to the *inattentional blindness* explanation, déjà vu experiences can be produced when you're not really paying attention to your surroundings. When you do focus your attention on the situation a split second later, those surroundings are perceived as suddenly and inexplicably familiar (Hockenbury & Hockenbury, 2006).

Learning Activity 6.6

Review questions

1 What is sensory memory?
2 Distinguish between the terms sensory memory and sensory register.
3 Why can sensory memory be described as a memory system or sub-system rather than a perceptual system?
4 a Define iconic memory and echoic memory with reference to examples that help clarify the definitions.
  b Describe the main distinguishing characteristics of iconic and echoic memory, ensuring you refer to the type of sensory information received and duration of storage.
5 In what way might sensory memory have an adaptive function and assist us in adjusting to ongoing environmental change?
6 Is information in sensory memory subject to an encoding process? Explain your answer.
7 Explain the process involved in the transfer of information from sensory to short-term memory, with reference to an example.
8 With reference to echoic memory, explain the research findings of Cowan & others (2000) that participants were unable to recall spoken information they had not been attending to for about 10 seconds.
9 Distinguish between sensory memory and short-term memory with reference to conscious awareness.

Short-term memory (STM)

Short-term memory (STM) is a memory system with a limited storage capacity in which information is stored for a relatively short period of time, unless renewed in some way. STM stores information temporarily, but for a longer time than sensory memory (and less than LTM). In STM, the information is no longer an exact replica of the sensory stimulus, but an encoding (or representation) of one. Atkinson and Shiffrin identified all these features of STM but proposed that information in STM is stored in a verbal form, such as words and numbers. Subsequent research has found that STM probably also stores information in non-verbal forms, such as visual, spatial and auditory representations (Baddeley, Eysenck & Anderson, 2009).

When you pay attention to information in your sensory memory (or to information retrieved from long-term memory), the information enters your STM. For example, because you are paying attention to this sentence, it has entered your STM. In contrast, other information in your sensory memory, such as the feeling of your socks against your skin, did not enter your STM until your attention was directed to it. STM holds all the information you are consciously aware of at any moment in time. Consequently, STM has been described as the 'seat of conscious thought'—the place where all conscious perceiving, feeling, thinking, reasoning and so on take place.

Duration of STM

Generally, most types of information in STM can be retained fairly well for the first few seconds. After about 12 seconds, however, recall starts to decline and by about 18 seconds almost all of the information disappears entirely if it has not been renewed in some way. Some research findings indicate that information can occasionally linger in STM for up to 30 seconds (which led Atkinson and Shiffrin to describe the short-term store as having a 30-second duration).

The best-known and most influential experiment on the duration of STM was conducted by American psychologists Margaret and Lloyd Peterson (1959). Participants were given *trigrams* (meaningless groups of three letters) to memorise; for example, *qlg*, *jfb* and *mwt*. Immediately after the trigrams were presented, the participants were given a distracter, or interference task, whereby they were required to start counting backwards by threes from an arbitrary three-digit number; for example, '634, 631, 628, …'. This was done to prevent rehearsal of the trigrams. Following a time interval that varied from three to 18 seconds, a light was used to signal that participants were required to recall the trigrams. As shown in figure 6.14, the longer the interval, the less likely a participant was to accurately recall the trigrams. By 18 seconds after the presentation of the trigrams, participants had forgotten almost all of the trigrams. When participants did not have to count backwards, their performance was much better, possibly because they were rehearsing the items to themselves. Similarly, if you repeat a

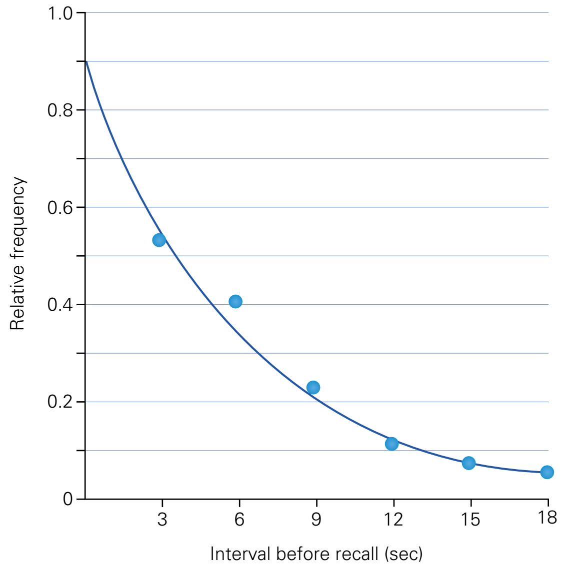


Figure 6.14 Peterson and Peterson (1959) demonstrated that information is retained in STM for about 18 seconds. Participants in the study were given trigrams to memorise. After various intervals of time, they were required to recall the items. The longer the interval, the poorer the participants' recall; after 18 seconds, recall by most participants was close to zero.

telephone number over and over to yourself, it can be retained in STM indefinitely. But if you look up a telephone number and are then distracted by a request from a parent to clean up some mess, you are likely to forget the number almost immediately. The distraction not only prevents rehearsal, resulting in loss of the information, but the new information may result in the limited capacity of STM being exceeded, and displace, or 'push out', the number from STM, thereby causing you to forget it.

Capacity of STM

Compared to sensory memory and LTM, STM is very limited in storage capacity; that is, in the *amount* of information it can hold at any one time. For example, read the following numbers, one at a time, and then (without looking at them) write them immediately on a sheet of paper: 7, 2, 9, 4, 1, 8, 3.

Next, read the following numbers, one at a time, and write them down immediately from memory: 4, 9, 1, 7, 3, 8, 6, 2, 9, 5, 7.

If you have 'average' STM storage capacity, you were probably able to recall the seven numbers in the first set but not all of the 11 numbers in the second set. The limited capacity of about seven 'bits of information' at any one time in STM was first described by American psychologist George Miller (1956) in a journal article called 'The magical number seven, plus or minus two'. Miller reached this conclusion on the basis of his analysis of the results of many research studies that indicated that STM has a capacity to hold between five and nine units of information at any one time. The limit of STM is a range of 7 ± 2 items of information.

Estimates of the capacity of STM are obtained by asking research participants to memorise simple lists of data of different lengths; for example, randomly ordered numbers, letters, nonsense syllables or unrelated words. The length of the list that the participants can recall half the time is considered to represent the capacity of STM (Miller, 1956).

Rarely are we able to hold more than between five and nine bits of information in STM at any given time, regardless of the nature of that information. Research in non-western cultures using Chinese characters as the information to be remembered has also shown a STM capacity of 7 ± 2 pieces of information (Yu & others, 1985). When STM is 'full', new items can only be added by pushing old items out (see figure 6.15).

Space in STM is also filled when we think and when information is temporarily retrieved from LTM to be used or updated. This is one reason why you cannot remember the telephone number you may have just looked up if you begin thinking about what you might say before you dial the number.

Information stored in STM is lost primarily through *decay* (not being used) and *displacement* (being pushed out) by new information (Reitman, 1974). Decay of information in STM occurs when information is not maintained by rehearsal and simply fades away with the passage of time. For example, this may occur when you forget what you want to say in a conversation while you wait for another person involved in the conversation to finish what they are saying. Your thoughts quickly fade from STM because listening to what the speaker is saying prevents you from rehearsing and therefore maintaining in STM the point you wanted

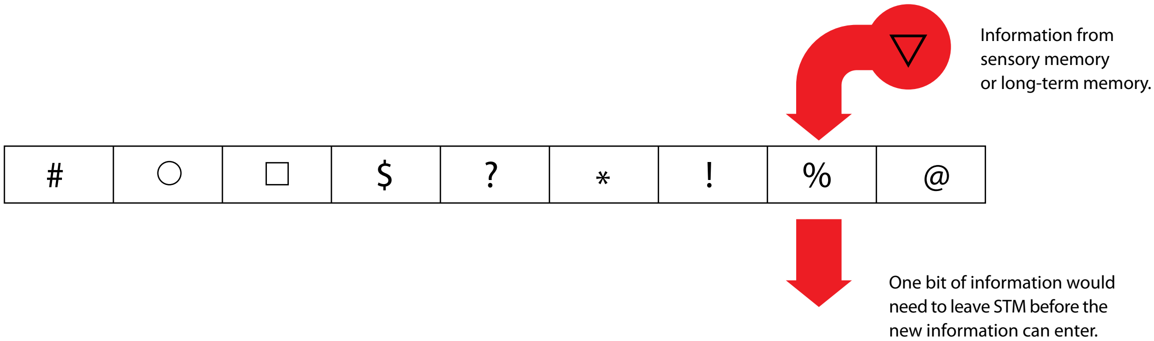


Figure 6.15 When STM is 'full', new items can only enter by pushing an old item out.

to make. Displacement of information from STM was demonstrated in research in which participants called directory assistance for a long-distance telephone number. They showed poorer recall of the number if the person providing the information said 'have a nice day' after giving the number than if they said nothing. The researchers concluded that the friendly message had displaced the phone number from STM (Schilling & Weaver, 1983).

When you think, 'working space' in STM is used up. The limited capacity of STM explains why it is difficult to think about problems involving more than 7 ± 2 issues (or 'items' of information). We forget some aspects of the problem because they exceed the capacity of STM. In such situations, writing down all the points to be considered can prevent the information from being lost. Similarly, fading or displacement can explain the experience of forgetting someone's name straight after they have been introduced to you. If you engage the person in a conversation without rehearsing their name, the lack of rehearsal can result in fading from STM and new information in the form of their name and the conversation may result in the capacity of STM being exceeded and the person's name may be displaced.

Figure 6.16 STM has a storage capacity of 7 ± 2 bits of information. This shopper probably needs a written list to remember all the items she wants to buy unless she uses a strategy that can overcome the limited capacity of STM.

Figure 6.17 When you have to wait for a while to make a point in a conversation, the information you wanted to share may decay from your STM if the waiting time is more than about 18 seconds.

STM as working memory

Many psychologists now prefer to use the term 'working memory' rather than STM. Generally, it is believed that the term 'short-term memory' understates the roles and importance of this system, not only in human memory but also in our conscious experience of the world and our ability to function effectively in everyday life.

The term **working memory** is used to emphasise the active part of memory where information we are consciously aware of is actively 'worked on' in a variety of ways. Working memory enables us to consciously use information from sensory memory and LTM. Information from sensory memory is processed in working memory and information is retrieved from LTM to be used and manipulated in working memory. Often, we combine information from sensory memory and LTM to perform all kinds of mental processes. Interpretation of emotions and feelings, language comprehension, daydreaming, creativity, problem-solving, analysing, reasoning, planning and decision-making all involve working memory. For example, when you think about past events, such as who you shared a cabin with at the last school camp you attended, or when you mentally add the numbers 17 + 5 + 12, the information is temporarily held in working memory while it is being used or worked on. Your working memory enables you to read by holding words from the beginning of a sentence while you continue to process the rest of the sentence. Thus, working memory provides a temporary storage facility and mental 'workspace' for information currently being used in some conscious cognitive activity (Baddeley, 1999).

In both the language and the arithmetic examples, there was a need for the temporary storage of information in order to perform some other task—in these examples, understanding and calculating. Information only remains in working memory while we consciously process, examine or manipulate it. Once the required task has been achieved, the information stored is no longer required and it is either processed further and passed on to LTM or discarded.

Working memory can be compared to the central processing unit (CPU) of a computer. New information can be transmitted into the computer CPU from a keyboard (like sensory memory), or previously stored information can be retrieved from the hard drive or a CD, DVD or other long-term storage device (like LTM). The real work for the computer—the computations and manipulations of the information—occurs within its CPU (Gray, 2007). Later in this chapter, we examine the concept of working memory in greater detail, with reference to Baddeley and Hitch's model of working memory and subsequent revisions of the model by Baddeley.

Learning Activity 6.7

Review questions

1 Define short-term memory (STM).

2 a What is the storage capacity of STM?
  b Give an example of experimental research that could be conducted to test the capacity of STM.

3 a What is the storage duration of STM?
  b Give an example of experimental research that could be conducted to test the storage duration of STM.

4 In what ways is STM like sensory memory and unlike sensory memory?

5 Explain why STM can be described as the 'seat of consciousness' but neither sensory memory nor LTM can be described in this way.

6 a Explain why STM is described as working memory.
  b In your opinion, is *short-term memory* or *working memory* the more appropriate term to describe the memory system that receives information from both sensory memory and LTM? Explain your answer.

7 Describe two ways in which information is frequently lost from STM.

8 You walk from one room to another to pick something up, and you arrive forgetting why you went to the room. You realise that you were thinking about something else and this made you forget the reason for being in the room. Explain why this forgetting occurred in terms of STM capacity and duration.

Learning Activity 6.8

Practical activity on the capacity of STM

This experiment enables you to measure the capacity of STM using a digit span test. The experiment uses an independent variable that has two values: older and younger school students.

Participants could be a class of Year 11 or 12 students and a class of Year 7 or 8 students. Research participants may be tested individually or in groups. All relevant ethical guidelines must be followed.

The digit span test should comprise items (for example, a series of numbers) ranging from two to ten digits. For example: item one: 2–6; item two: 5–3–1; item three: 4–7–2–9 … item nine: 8–3–5–1–7–2–0–6–9–4.

Each test item should be read aloud to participants at regular intervals in a monotone voice at a rate of about one digit per second. Immediately after the presentation of each test item, participants are required to recall the digits in any order. Their responses should be recorded on a sheet of paper, which can be collected and scored afterwards.

- Construct an operational hypothesis that could be tested by this experiment.
- At what level would you set the *p* value for a test of significance? Explain why you would use this value rather than a higher or lower value.
- Analyse the data in terms of the highest number of digits recalled correctly and the differences in mean scores of the two groups of participants.
- Compare your research findings with theoretical expectations or results obtained from other similar studies.
- If there is a difference in the mean scores between the two groups and $p \leq 0.05$, what does this indicate about the results? Would the results be more meaningful if $p \leq 0.01$? Explain your answer.
- Evaluate the experimental design. Identify any potential or actual extraneous or confounding variables and suggest improvements in the experimental design.

Chunking information

We can get around the limited capacity of STM. One way is to learn information well enough to transfer it to LTM, which has an unlimited storage capacity. Another way is to put more information into each of the 7 ± 2 units that can be stored in STM. To illustrate this, read the sequence of letters below:

D N V R C E W V D C S V

Now close your eyes and try to repeat the letters aloud in the same order. Unless you have an exceptional STM, you probably could not repeat the whole sequence correctly. Now try this sequence of letters:

NSW VCR VCE DVD

People are usually able to recall more of the second sequence, even though it is made up of exactly the same letters. The increased ability to recall the second letter sequence demonstrates chunking. **Chunking** is the grouping, or 'packing', of separate bits of information into a larger single unit or 'chunk' of information. The first sequence of letters was probably perceived as 12 separate items, which probably exceeded your STM capacity. The second letter sequence can be perceived as four 'chunks', which is within the capacity of STM and is therefore more likely to be remembered: NSW, VCE, VCE, DVD. Thus, chunking can increase the amount of information held in STM.

Figure 6.18 Waiters can chunk information to remember orders without using a notepad.

Chunks can take many forms. They can be numbers, images, words, sentences, phrases or abbreviations (such as BHP, RACV or CSIRO). In some reading-improvement courses, students are taught to chunk groups of words into phrases so that fewer eye movements are required and the brain can process the phrases as units rather than individual words (Huffman, 2002). Some waiters pride themselves on being able to remember orders of large groups of people without using a notepad, which they do by chunking the information. We also find it easier to remember numbers in chunks (319–528–7451) than as a string of single digits (3195287451). This is why telephone numbers, credit card numbers, tax file numbers and other long strings of numbers (or letters) are typically broken up and organised in groups.

Figure 6.19 Interpreters must store long and often complicated segments of speech in STM while checking LTM for equivalent expressions in the language they are translating into. This task is assisted if the speaker's words are chunked into phrases or sentences.

Learning Activity 6.9

Practical activity on chunking

This experiment enables you to assess whether the number of items retained in STM is increased by chunking. Any group of participants can be used in the experiment. Participants may be tested individually or in a group(s). All relevant ethical guidelines must be followed.

You will need to develop two types of digit span tests comprising sets of numbers (digits). One test should comprise single digits in each set (for example, 2, 7–3, 9–7–4–2, etc.); the other should comprise digits in chunked form (for example, 276–1, 174–36, 615–738–91, etc.). Participants should be presented with 10 sets of digits in each test, and the number of digits should increase by one for each trial.

Administer both tests to each participant, with a short break in time between each test. Present the tests orally at regular intervals in a monotone voice, reading at a rate of about one digit per second. Immediately after you present each test item, ask participants to recall the digits in correct order by writing their responses on a sheet of paper. The sheets should be collected and scored afterwards.

- Construct an operational hypothesis to test whether the capacity to store information is increased by chunking.
- At what level would you set the p value for a test of significance? Explain why you would use this value rather than a higher or lower value.
- Analyse the data in terms of differences between performance on the two tests.
- Compare your research findings with theoretical expectations (that is, Miller's 7 ± 2) or results obtained from other similar studies.
- If there is a difference in mean scores for the two conditions and $p \leq 0.05$, what does this indicate about the results? Would the results be more meaningful if $p \leq 0.01$? Explain your answer.
- Evaluate the experimental design. Identify any potential or actual extraneous or confounding variables and suggest improvements in the experimental design.

Effects of rehearsal

Information can be kept in STM (or working memory) for longer than the usual maximum of about 18 seconds if it is rehearsed in some way. In the study of memory, **rehearsal** is the process of consciously manipulating information to keep it in STM, to transfer it to LTM or to aid storage and retrieval. Psychologists now distinguish between two main types of rehearsal: *maintenance rehearsal* and *elaborative rehearsal*.

Maintenance rehearsal

Maintenance rehearsal involves repeating the information being remembered over and over again so that the information can be retained (or 'maintained') in STM (or working memory). When you hear something for the first time and simply 'go over and over it' so that you don't forget it, you are using maintenance rehearsal. For example, suppose you have given your English teacher a draft essay to look at. When the teacher calls you up to his table he gives you verbal feedback on five specific changes you need to make to your essay. Maintenance rehearsal is one way of remembering what the teacher has said in order to keep the information in your STM until you get back to your seat where you can make a written note of the changes.

Maintenance rehearsal not only involves simple *repetition* of words or auditory information such as the sounds of words, but it can also involve visual or spatial information such as images or 'mental maps'. When the information involves words and sounds, maintenance rehearsal can occur *vocally*, by repeating the information aloud over and over again, or *sub-vocally*, by silently repeating the words, the sounds of words or a tune 'in your head'. When the information is visual and/or spatial, maintenance rehearsal involves using something like an 'inner eye' to maintain the image of the object or scene in STM for a period of time after you first see it. Whether maintenance rehearsal involves words, auditory, visual or spatial information, provided it is not interrupted, information can be retained indefinitely in STM.

Figure 6.20 When a teacher gives verbal feedback on work, maintenance rehearsal can be used to keep the information in STM until the advice can be written down or implemented.

Although maintenance rehearsal can be very effective for retaining information in STM, it does not always lead to long-term retention. In one experiment, participants were asked to memorise pairs of numbers; for example, 295–417, 381–620, 749–836 and so on. After the presentation of each pair of numbers, participants were told to repeat one word per second, out loud, to prevent rehearsal of the numbers. However, unexpectedly for the participants, the memory test given at the end of the paired number presentations involved recalling the words they thought were distractions, and not the numbers. The results showed that merely repeating the words did not guarantee retention. Further, the number of times a person rehearsed a word—four, eight or 12 times—had no effect on the ability to recall that word (Rundas, 1977).

Nonetheless, maintenance rehearsal is a useful technique for coping with the limited duration of STM. One of the limitations of maintenance rehearsal, however, is that when information is continually renewed and therefore retained in STM through the rehearsal process, the amount of new information that can enter is restricted because of the limited storage capacity of STM.

To transfer information to LTM, where it may be stored indefinitely, it is more effective to use elaborative rehearsal.

Elaborative rehearsal

When presented with new information that will be tested at a later date, many students think that repeating the information over and over again will assist them to transfer the information to

LTM and store it there until needed. This strategy uses maintenance rehearsal. While maintenance rehearsal is an effective strategy for retaining information in STM, it does not assist in encoding information for transfer to and more permanent storage in LTM. A much more effective strategy is elaborative rehearsal.

Unlike maintenance rehearsal, elaborative rehearsal involves focusing on the meaning of the information. More specifically, **elaborative rehearsal** is the process of linking new information in a meaningful way with other new information or information already stored in LTM to aid in its storage and retrieval from LTM. For example, rather than 'memorising' the definition of memory for the Unit 3 exam by repeating the definition aloud or writing it down over and over again, your ability to recall the definition will be enhanced if you link it to learning and think about the nature of its relationship to learning. You might note that learning comes before memory (as does the *l* in learning and the *m* for memory). You might also think about key functions of memory such as storage and retrieval and analyse a personal example of when you successfully and unsuccessfully stored and retrieved information that was important. The more you elaborate, or 'flesh out', the various features of the concept and link it to your own experience, the more likely you are to remember it. When we relate new information to personal experiences and our personal situation in some way, we are more likely to remember it. This is called the **self-reference effect**. For example, if the word 'win' is on a list of words to remember, you might link it to the last time you won something, or if the word 'cook' appears, you might link it to the last time you cooked a meal (Matlin, 2002; Rogers & others, 1977).

Elaborative rehearsal is a more active and effortful process than maintenance rehearsal. It is also more effective than maintenance rehearsal

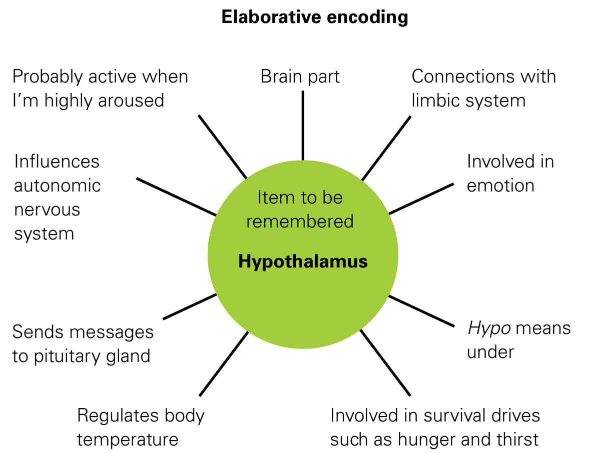


Figure 6.21 Elaborative rehearsal enables more effective encoding, enhancing LTM storage and retrieval. The more associations made between new information and information already in memory, the more likely the new information will be retained.

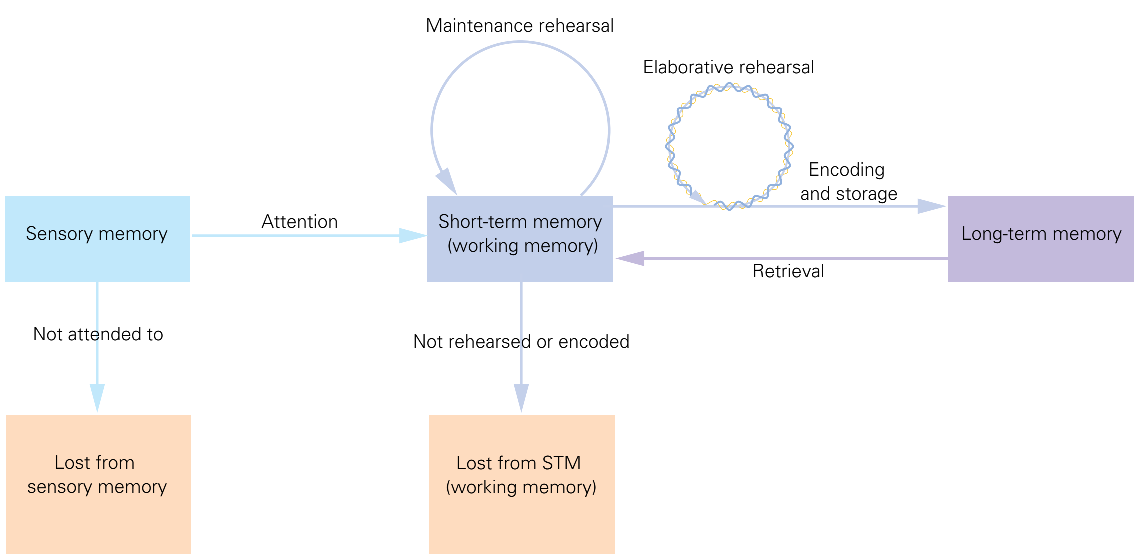


Figure 6.22 A contemporary representation of memory as a multi-store system

for remembering new information because it helps to ensure that information is *encoded* well. Consequently, it is considerably better to process material that you want to store for long periods in a meaningful way, rather than memorise it in a meaningless, repetitive, rote way. Why is elaborative rehearsal a more effective way of encoding new information than maintenance rehearsal? One explanation emphasises that elaborative rehearsal involves a deeper level of information-processing.

Learning Activity 6.10

Practical activity on the self-referencing effect

For the purposes of this demonstration, the participant should not be aware that they will be required to recall the words in the word lists used for the demonstration.

Part A

Ask a volunteer participant to read each word in list A and indicate whether the word is a long word (L) or a short word (S) by writing either 'L' or 'S' in the space beside the word. Participants should work through the list as quickly as possible and then write down as many of the words from list A as they can remember, in any order (that is, free recall).

List A

aggressive	____	friendly	____
sad	____	alert	____
persistent	____	sensitive	____
shy	____	intelligent	____
superstitious	____	sentimental	____
fair	____	good-humoured	____

Part B

Ask the same participant to read each of the words in list B and indicate in the space beside the word whether the word describes them. If they think the word describes them, they should write the letter 'Y' (for yes). If the word does not describe them, they should write the letter 'N' (for no) in the space beside the words. Again, the participant should work through the list as quickly as possible, then close the book. Using a separate sheet of paper, the participant should write down as many of the words from list B as they can remember, in any order (that is, free recall).

List B

trusting	____	cruel	____
outgoing	____	loud	____
emotional	____	talkative	____
loyal	____	lazy	____
helpful	____	considerate	____
careful	____	athletic	____

Interpreting the data

Compare the recall scores for list A and list B. Was memory enhanced by self-referencing? If so, explain why. If not, explain why not. To what extent would the types of words in each list be an extraneous variable?

Craik and Lockhart's levels of processing framework

Some psychologists have argued against the concept that human memory has a specific structure that can be divided into different storage systems and sub-systems through which information flows in some kind of sequence. Among the most influential of these were Canadian psychologists Fergus Craik and Robert Lockhart. In 1972, they proposed a 'conceptual framework of memory', which emphasised the importance of the level at which new information is processed.

Craik and Lockhart's levels of processing framework proposes that the level, or 'depth', at which we process information during learning determines how well it is stored in LTM. According to Craik and Lockhart (1972), memories are best encoded, organised and stored in LTM by meaning (or 'semantically'). If meaning is processed during learning, then LTM will be better than if meaning is not processed. However, processing meaning is not a matter of 'meaning or no meaning'. Instead, there is a continuum of levels of processing ranging from *shallow* to *deep* processing, with levels of processing in between. Information will be retained only briefly if it is processed at a shallow level, but will be retained much longer if it is processed at a deeper level. This is why elaborative rehearsal is more effective than maintenance rehearsal—elaborative rehearsal involves a deep level of processing because there is a focus on assigning meaning to the information.

According to Craik and Lockhart, attending only to the superficial details of what you are learning and remembering would involve shallow processing. The more meaning you give to the information, the deeper the level of processing. For example, consider the following list of words:

soft	swift	warm	sharp
witty	bright	clean	beautiful

If you asked ten people to process this list in a superficial way ('look at each word for five seconds, then circle the words containing the letter i') and asked ten other people to process it in a deep way ('look at each word for five seconds, then circle the words that could be used to describe you'), which group do you think would remember more of the words if, without warning, you asked them to recall the list ten minutes later? Craik and Lockhart's levels of processing framework would predict that the participants who processed the words deeply by using self-referencing to think about their meanings (the second group) would recall more of the words because information processed according to meaning is processed more deeply and therefore is stored more permanently.

There is considerable research evidence to indicate that LTM is better when we process new information semantically (meaningfully, as opposed to attending to its more superficial physical features or properties). For example, Craik and another Canadian psychologist Endel Tulving (1975) conducted an experiment in which they asked participants questions that required processing of words (encoding) in three different ways. The words were flashed on a screen and participants had to process each word (1) semantically (its meaning), or (2) acoustically (its sound), or (3) visually (what its letters look like). For example, quickly answer each of the following questions.

Sample questions to elicit processing	Stimulus word	Answer (yes/no)
1 Does the word fit in this sentence? _____ is a type of clothing.	hat	
2 Does the word rhyme with top?	HOP	
3 Is the word in capital letters?	bin	

Which level of processing would Craik and Lockhart's framework predict is deeper and would therefore best prepare the participants to recognise the words when tested the next day? As shown in figure 6.23, the deeper semantic processing (semantic encoding) required by question 1 resulted in better memory than the shallow processing by sound required by question 2 (acoustic encoding), and much better memory than the very shallow processing of a visual feature required by question 3 (visual encoding).

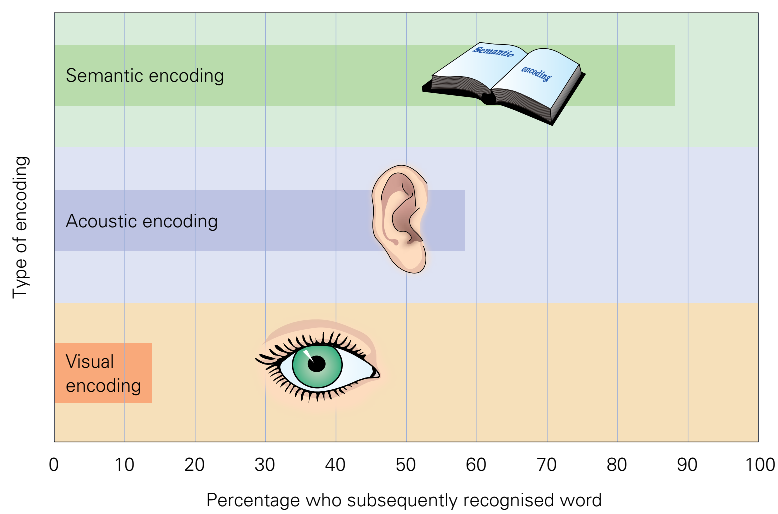


Figure 6.23 Processing a word deeply by its meaning (semantic encoding) results in better recognition of it later than does shallow processing by its sound (acoustic encoding) or visual features (visual encoding).

One problem with the levels of processing framework is that the concept of level or depth has proved difficult to quantify and measure. Despite attempts to precisely identify specific levels of processing within the Craik and Lockhart continuum, there is no generally accepted means of measuring different levels of processing in valid and reliable ways (Baddeley, 1999). Nevertheless, the concept that deep processing results in more effective encoding and better memory for new information is widely accepted and has many practical applications, particularly for students.

How can you process new information at a deep, rather than a shallow, level? Here are a few suggestions by American psychologists Don Hockenbury and Sandra Hockenbury (2006):

- Make sure you understand the new information by restating it in your own words.
- Actively question new information.
- Think about the potential applications and implications of the material.
- Relate the new material to information you already know, searching for connections that make the new information more meaningful.
- Generate your own examples of the concept, especially examples from your own experiences.

These types of mental activities involve elaborative rehearsal, thereby promoting deeper processing and enhancing your memory for new information. In chapter 7, we consider other strategies you can use to improve your memory.

Shallow processing Physical and perceptual features are analysed.	The colours, shapes and patterns that make up the physical appearance of an object such as a flag are detected.
Intermediate processing Stimulus is recognised and named.	The object is identified as the Australian flag.
Deep processing Semantic, meaningful characteristics are used.	Associations with the flag are made; for example, you might think about the time you attended a sports final and sang the national anthem as the flag was raised, or you might think of an ambition to represent Australia in a particular sport at the Olympics.

Figure 6.24 Craik and Lockhart's levels of processing framework proposes a continuum of levels of processing ranging from *shallow* (e.g. the object is made of cloth; is rectangular; is red, white and blue; and has six stars) through to *deep* processing (e.g. 'I'd like to see this flag raised on my behalf when I win a gold medal at the Olympic Games.'), with levels in between (e.g. the object is an Australian flag). The deeper the level of processing, the more effective encoding and better memory for new information.

Learning Activity 6.11

Review questions

1 **a** What is chunking?
b How does chunking increase the capacity of STM?
c Suppose you must memorise a long list of words that includes the following: banana, rabbit, paper, mango, staple, apple, chicken, orange, pencil and elephant. You are allowed to recall the words in any order you wish. How could you use chunking to better ensure storage and recall?

2 **a** Define the terms maintenance rehearsal and elaborative rehearsal.
b Identify two important characteristics that distinguish these two forms of rehearsal.
c Explain why elaborative rehearsal is more effective than maintenance rehearsal in enhancing retention of information in LTM.
d Describe three different ways to elaborate information.

3 Use what you know about maintenance and elaborative rehearsal to respond to the following question asked of a teacher by a student: 'Is it best to read my notes over and over again, or is there something else I could do to study for the exam?' Give two reasons for your answer.
4 Describe two key roles of rehearsal in memory.
5 What is a limitation of the Atkinson–Shiffrin model in relation to their assumption about rehearsal?
6 a According to Craik and Lockhart's levels of processing framework, what determines how well information is stored in LTM and why does this variable determine LTM storage?
   b Explain the meaning of the levels of processing concept.
   c What type of information is more likely to be processed at a shallow level? And at a deep level?
   d Is elaborative rehearsal different from elaborative encoding? Explain your answer.
   e In what way can Craik and Lockhart's levels of processing framework provide support for memory as a multi-store rather than a unitary system?
   f What is a common criticism of Craik and Lockhart's levels of processing framework?

Learning Activity 6.12

Using elaborative rehearsal for deep processing

Choose two of the concepts below and draw a diagram to show how these concepts could be processed deeply using elaborative rehearsal so that they are more likely to be retained in LTM. Figure 6.21 may be used as a model.

- independent variable
- sensory memory
- dependent variable
- iconic memory
- extraneous variable
- confounding variable
- echoic memory
- operational hypothesis
- encoding
- maintenance rehearsal
- external validity
- elaborative rehearsal
- short-term memory
- working memory.

Learning Activity 6.13

Designing an experiment

Design an experiment to test the effectiveness of different levels of processing information. In designing your experiment, ensure you address the following:

1 What type of experimental design will you use? Explain your choice of design.
2 What terms need to be operationalised?
3 Construct an operational hypothesis that could be used for the experiment.
4 What groups will be used?
5 Identify the IV(s) and DV(s).
6 Describe three potential and relevant extraneous variables that need to be controlled.
7 If you find an acceptable significant difference in the results for the two conditions (say, $p \leq 0.05$), what conclusion would you draw? What generalisation could you make?
8 Comment on the ethical considerations that need to be taken into account when planning and conducting this experiment.

Baddeley and Hitch's model of working memory

In 1974 British psychologists Allan Baddeley and Graham Hitch developed a very influential multi-component model of working memory. **Baddeley and Hitch's model of working memory** describes the structure and function of working memory in terms of three components called the phonological loop, the visuo-spatial sketchpad and the central executive. The three components are separate and can function relatively independently but also interact. The phonological loop and visuo-spatial sketchpad are assumed to be sub-systems of working memory, whereas the central executive is assumed to be an 'attentional controller' (Baddeley, 2009).

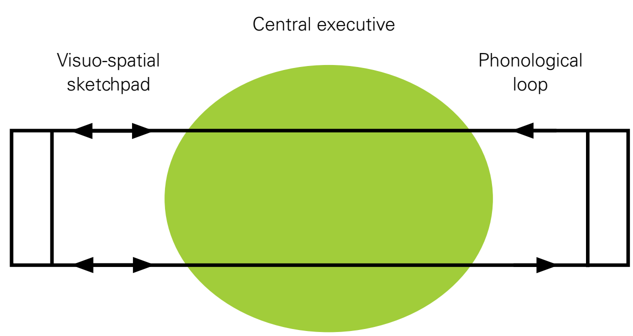
Baddeley and Hitch did not 'invent' the term 'working memory'. It was devised in 1960 by other memory researchers but, according to Baddeley and Hitch (1974), the researchers did not adequately describe or explain what working memory was and how it functioned. Neither did Atkinson and Shiffrin in their multi-store model. So, Baddeley and Hitch adopted the term 'working memory' because its emphasis on 'working' set it apart from other models of STM. According to Baddeley and Hitch, most of these models were more concerned with the basic roles of STM, such as storage and the role of rehearsal, rather than its role as a system that supports and enables complex and important cognitive activities. The latter is what interested Baddeley and Hitch.

Based on their research findings, Baddeley and Hitch (1974) proposed that working memory consists of one sub-system that is specialised for verbal information, one sub-system that is specialised for visual and spatial information, and a 'central executive' that manages the activities in the other two sub-systems and controls the whole system. For example, think of your house or flat, and work out how many doors it has before reading further.

How many doors does it have? In working this out, you probably formed some sort of visual image of your house. This relies on the sub-system specialised for visual and spatial information. You probably then counted the doors verbally using the sub-system specialised for verbal information. Finally, throughout this process there was a need for your central executive to select the strategy to complete the task, to manage the activities of the other two sub-systems and to control the whole process (Baddeley, 2009).

The phonological loop encodes and stores auditory information and is active whenever you read, listen, speak or repeat words to yourself in order to remember them. The **phonological loop** (also called *verbal working memory*) temporarily stores a limited amount of verbal speech-like information, such as the sounds of words ('phonemes'), for a brief period of time. This is the part of working memory that enables you to hold onto verbal information such as the number of doors in your house when counting them and strings of numbers or words in a standard test of short-term memory. The verbal information is held in a sound-based, or 'phonological', form. It is assumed that you hold onto it by using sub-vocal maintenance rehearsal; that is, by repeating it over and over internally, somewhat like a 'loop' of recording tape that goes around and around, playing the same song over and over again.

To test the phonological loop, silently read the following seven numbers: 5 6 2 8 1 7 3. Next, look away for five seconds and then repeat the list out loud. How did you solve the problem of remembering the numbers in this digit-span test? Most likely, you rehearsed them sub-vocally during the five-second interval. In fact, if you didn't rehearse the numbers, you probably would have been unable to remember them. Without rehearsal,



Source: Baddeley, A., Eysenck, M.W., & Anderson, M.C. (2009). *Memory*, New York: Worth, p. 44.

Figure 6.25 The initial Baddeley and Hitch (1974) model of working memory people can hold only about two seconds' worth of information in their phonological memory system. Because of this time limit, people with slow rates of speech but normal intelligence do worse on short-term verbal memory tasks than people of normal intelligence who speak at a normal rate. Our use of internal, unspoken speech during rehearsal is a crucial feature of the phonological loop and verbal working memory. In fact, if this internal rehearsal is disrupted or eliminated, phonological storage cannot occur. For example, if you were to say out loud, 'good morning, good morning' during the delay period while you were trying to remember the list of numbers in the digit-span test, your ability to internally rehearse would be greatly disrupted, impairing your performance on the task (Gluck, Mercado & Myers, 2008).

Additional evidence concerning internal rehearsal in the phonological loop comes from experiments in which participants are asked to remember lists of words. For example, do you think list 1 or list 2 below would be easier to remember?

List 1: Burma, Greece, Tibet, Iceland, Malta, Laos

List 2: Switzerland, Afghanistan, Nicaragua, Venezuela, the Philippines, Madagascar

Most people would say the first is easier. As the length of the words increases, the number of words you can remember declines; this is known as the *word-length effect*. Shorter words such as *Burma* and *Greece* are easier to rehearse in the phonological loop component of working memory than longer multi-syllable words such as *Switzerland* and *Afghanistan*. Longer words take longer to rehearse. Based on studies of the phonological loop, Baddeley estimated that the average person's phonological loop can retain approximately two seconds' worth of speech task (Gluck, Mercado & Myers, 2008; Gathercole & Baddeley, 1993).

The **visuo-spatial sketchpad** (also called *visual working memory*) temporarily stores a limited amount of visual and spatial information for a brief time. Visual information is anything you can see or visualise, including features of the image. Spatial information refers to the visual location of objects in space. For example, the visuo-spatial sketchpad component enables us to remember exactly where on the kitchen bench we have previously placed a glass when we turn back to it to pour a drink taken

Figure 6.26 The visuo-spatial sketchpad stores information such as the location of a cup that was placed on a bench a second or two earlier, so that everyday tasks such as pouring a hot drink can be undertaken easily.

from the fridge. Similarly, if you are going for a jog and see a dog, the visuo-spatial sketchpad allows you to both recognise the dog's features and to track where the dog is located in case it is the kind that should be avoided. According to Baddeley and Hitch, our visuo-spatial sketchpad is a mental workspace for storing and manipulating visual and spatial information.

The following task is an example of your use of the visuo-spatial sketchpad. Complete all the steps one at a time, without writing anything down. First, picture a 4 by 4 grid (16 squares). Next, imagine the number 1 in the square that is the second column of the second row. Then, put a 2 to the right of that. Then, in the square above the 2, put a 3, and to the right of that put a 4. Below the 4, put a 5, and below that a 6, and then to the left of that a 7. Now, what number is immediately above the 7? To correctly answer this question ('2') you had to use your visuo-spatial sketchpad.

Just as the phonological loop has a storage duration of about two seconds and a limited storage capacity, the visuo-spatial sketchpad also has limited capacities. However, the capacities of both components are independent of one another—reaching the limits of, or 'filling up', one component does not greatly affect the capacity of the other component. Evidence for the independence of these two components has been obtained through dual-task experiments. In a dual-task experiment, participants are asked to perform one task requiring the use of one sub-system while simultaneously performing another task requiring use of the other sub-system. For example, participants may be given a task requiring them to maintain information in the visuo-spatial sketchpad while simultaneously carrying out another task requiring retention of an auditory list of words in the phonological loop (Gluck, Mercado & Myers, 2008).

Of the three components of Baddeley and Hitch's model, the central executive is the most important and most complex. The **central executive** controls attention; integrates information from the phonological loop and visuo-spatial sketchpad, as well as information retrieved from LTM; and coordinates the flow of information between the working memory system and LTM. What is common to all the functions of the central executive is that they involve the manipulation of information temporarily held in the phonological loop and visuo-spatial sketchpad. In manipulating information held in these sub-systems, the central executive is essentially the *working* component of working memory. For example, the central executive directs your attention to activities you are currently undertaking; filters essential from non-essential information; combines information from the other two components; selects, deletes and reorders information; and adds information when required from LTM to guide mental processes and behaviour. When information is no longer needed, it directs its flow to LTM.

Almost everything you think, feel or do during normal waking consciousness is controlled and managed by the central executive. In everyday life, it is involved in planning and goal-setting, helping you decide what to do next, or what *not* to do. When you change your mind about what to do, it will coordinate task switching, enabling you to change tasks smoothly while it controls the flow of information within and between the working memory and LTM systems.

Baddeley (1999) described the central executive as working like the executive supervisor in an organisation, deciding which issues deserve attention (and therefore are processed into LTM) and which should be ignored (and therefore lost). However, the central executive has a limited ability to perform more than one task at a time; for example, it cannot make numerous decisions simultaneously. So, like most executives, it gathers information from its assistants—the phonological loop and visuo-spatial sketchpad sub-systems—and also from the library of stored information in LTM.

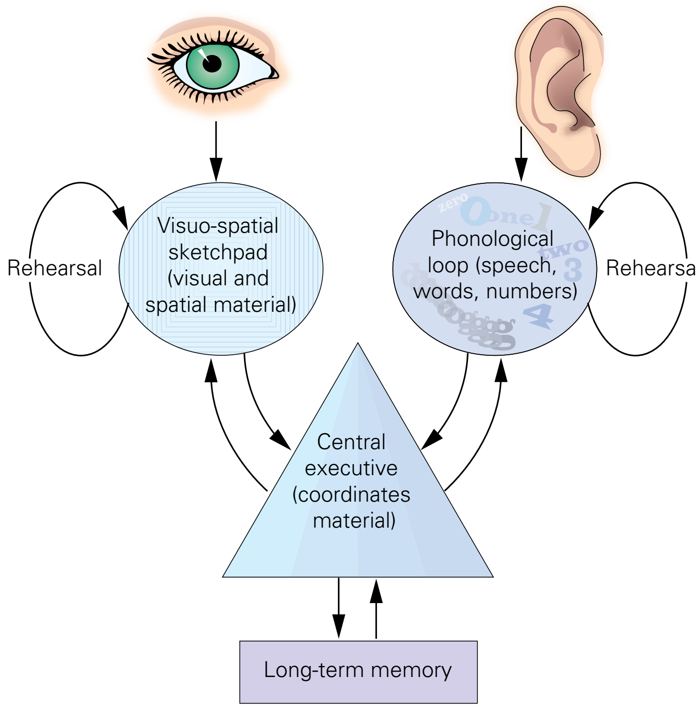


Figure 6.27 A contemporary representation of Baddeley and Hitch's (1974) working memory system

According to Baddeley (2009), a major problem with the working memory model he developed with Hitch is that it does not explain how working memory actually links with LTM. Consequently, in 2000, Baddeley added a fourth component to the model. He called this component the episodic buffer. The **episodic buffer** is a sub-system of working memory that enables the different components of working memory to interact with LTM.

Although not yet fully described, the episodic buffer is assumed to be a limited-capacity temporary storage system that holds about four chunks of information. It is capable of holding information in any form and can therefore combine auditory information from the phonological loop and visual–spatial information from the visuo-spatial sketchpad. It also connects these sub-systems with LTM. As with the other sub-systems of working memory, the episodic buffer is under the control of the central executive. As shown in figure 6.28, the episodic buffer is directly linked to LTM, but it is separate and has its own storage space and processes for storing information.

Baddeley used the term 'episodic' because the sub-system can 'pull together' separate streams of information from elsewhere in working memory and from LTM, and then combine them into scenes, or 'episodes', like memories of a story or movie scene. He used the term 'buffer' because it provides temporary working space where information can be processed into these episodes and edited, or reordered, in an organised and meaningful way. According to Baddeley (2000), these capabilities mean that the episodic buffer provides a 'mental workbench' for cognitive activities such as creating models of the environment as well as new cognitive representations of objects and events that assist problem-solving.

How do the four components of the working memory model interact? Consider the following example. Suppose that you are trying to work out the fastest route to get to a party, and you check the street directory. You would use the phonological loop to sub-vocally rehearse the directions to keep the information active in the loop. You would use the visuo-spatial sketchpad to visualise a possible route. Your central executive would direct the episodic buffer to combine the auditory information from the phonological loop and the visual and spatial information from the visuo-spatial sketchpad. Information retrieved from LTM, such as landmarks you may come across along the route, would also be added. You might then create a mental representation of how you might best get there and your central executive would use all the information involved in planning your journey. When required, the episodic buffer would be used as a temporary mental workbench to make adjustments to the route.

Many psychologists view the episodic buffer as a useful addition to the model of working memory. However, as stated by Baddeley (2009), 'the concept of an episodic memory is still in an early stage of development'. Some of its functions still remain unclear and have not been fully explained in relation to the other components or LTM. Consequently, the episodic buffer still needs to be studied extensively.

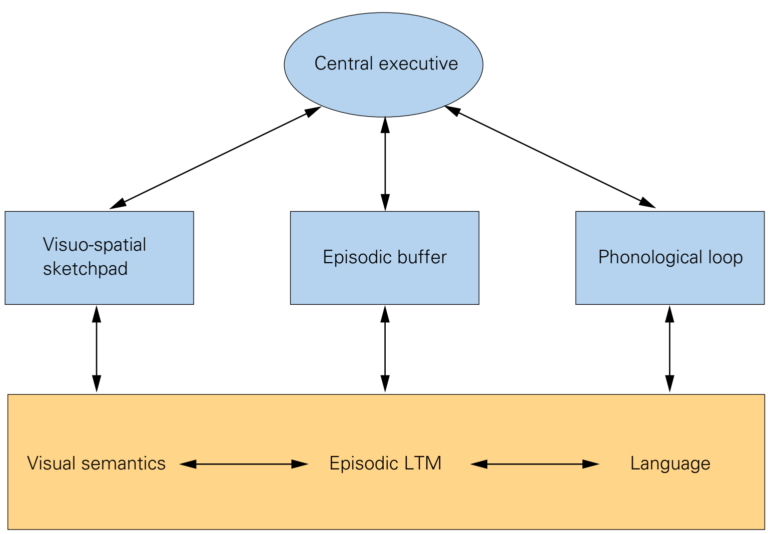


Figure 6.28 The Baddeley (2000) version of the multi-component working memory

Source: Baddeley, A., Eysenck, M.W., & Anderson, M.C. (2009). *Memory*. New York: Worth, p. 58.

Learning Activity 6.14

Review questions

1 Define working memory without reference to Baddeley and Hitch's model of working memory.

2 Briefly explain how Baddeley and Hitch's model describes the structure and function of working memory.

3 Construct a table in which you summarise the key features of the three components of working memory in Baddeley and Hitch's model.

4 Explain the relationship between the three components of Baddeley and Hitch's model with reference to an example.

5 **a** Name and describe the component Baddeley added to the working memory model in 2000.

b Why did Baddeley add this component?

6 Suggest a reason to explain why the phonological loop, visuo-spatial sketchpad and episodic buffer are often described as 'slave systems' to the central executive.

7 Which of the four components of the working memory model is likely to directly transfer or retrieve each of the following types of information to or from LTM?

a words

b images

c sounds

d auditory information other than sounds

8 Give an example that describes the interaction of the four working memory components different from that used in the text.

9 Some psychologists include *both* STM and working memory as separate but interacting sub-systems in memory models, rather than using one term or the other or using both terms interchangeably. They often refer to STM as a limited system involving basic functions such as storage and retrieval, and working memory as the active component of memory. Explain why the inclusion of STM and working memory as separate interacting systems may or may not be appropriate for describing the structure and function of human memory.

Learning Activity 6.15

Visual presentation on working memory

Prepare a diagram that identifies Baddeley's four components of working memory and shows the role(s) of each component and how the components interact. In your presentation, ensure that you

- include appropriate visual representations of all four components and LTM
- use arrows to connect the components and LTM
- label the arrows using key words to identify relationships and processes
- base the diagram on an example of a question or task in the central executive (but not the question used in the text).

Long-term memory

Long-term memory (LTM) is the relatively permanent memory system that holds vast amounts of information for a long time, possibly indefinitely. In all models of memory, it is considered to be a different memory system that primarily interacts with STM, or short-term working memory. LTM differs from STM in several ways. One difference is that information in STM is 'active' and we are consciously aware of and able manipulate the information, whereas information in LTM is 'inactive' and we are not consciously aware of it unless we retrieve it. Generally, the systems also differ in terms of how information is retrieved, the form in which information is stored and the way in which information is forgotten.

Because the amount of information stored in LTM is so vast, it would be inefficient if we had to 'scan' everything every time we needed to locate, or 'search for', a bit of information. Therefore, LTM has to be organised in a way that enables the efficient retrieval of information.

We retrieve information from LTM using **retrieval cues** in much the same way as we use a call number to locate a book in the library or the 'Find' function in computer software. The retrieval of information from LTM can be intentional, such as when you try to recall the name of your Year 7 English teacher, or unintentional, such as when hearing a particular song brings back memories of a special time in your life. In either case, only the specific information relevant to the cue is retrieved, rather than the entire contents of LTM. Most of the time, the retrieval of information from LTM is very efficient. Remarkably, it takes only a few seconds to search through this huge storehouse of information to find the information required.

Information retrieved from LTM is held in STM while it is being used. Once it is no longer required, it can be transferred back to LTM for continued storage. Generally, when information is unable to be retrieved from LTM, it is because of poor organisation of the information during encoding and storage, or failure to use an appropriate retrieval cue. If information is not properly stored, it is difficult to locate and retrieve.

Another way that LTM differs from STM relates to the form in which information is stored in LTM. In STM, information is usually stored in terms of the *physical qualities* of the experience (for example, what we saw, did, heard, tasted or touched), especially sounds. In contrast, LTM primarily stores information *semantically*; that is, in terms of its meaning. This is not to say, however, that we cannot recall what the beach looked like the first time we saw it, or the taste of a favourite sweet (Cowan, 1988). Remembering your grandmother's name, how to get to school or college, how to access your email, how you celebrated your last birthday, what you did last Saturday night, how to ride a bike or who the current premier of Victoria is all depend on LTM.

LTM also differs from STM in the way forgetting occurs. Some psychologists believe that information stored in LTM does not just last longer, but is actually *permanent*. In other words, what goes into LTM seems to stay there forever. If memories in LTM are in fact permanent, this means that 'forgetting' occurs in LTM not because the memory has gone, but because we are unable to retrieve it for some reason (Matlin, 1983; Reynolds & Flagg, 1983). In general, most psychologists have adopted a view that long-term memories are *relatively permanent* or that at the very least they are *longlasting* (Barsalou, 1992).

Figure 6.29 We retrieve information from LTM using cues, much as we use a call number to locate a book in the library.

Types of LTM

Psychologists have distinguished between many different types of LTM and LTM stores or sub-systems, each with distinctly different properties. We consider a commonly described classification system that distinguishes between two types of LTM (or LTM stores) called *procedural* (or *implicit*) *memory* and *declarative* (or *explicit*) *memory*. The classification system also distinguishes between two types of declarative memory. These are called *episodic memory* and *semantic memory*.

Procedural memory

Procedural memory is the memory of actions and skills that have been learned previously and involves knowing 'how to do something'. Examples of using procedural memory include how to type, how to ride a bike and how to log onto the internet, even if you have not done so for a long time. Procedural memory is also called *implicit memory* because the information can be retrieved through performance rather than intentional conscious recall or recognition. It is often very difficult to recall when or how we learned how to perform the sequence of actions required to do something. For example, the daughter of a florist may remember how to correctly arrange flowers in a vase without ever having been given a lesson on how to do it. Her memory of how to arrange flowers has formed through observing her mother perform the task many times. Therefore she would be unable to say specifically when or how she learned how to arrange flowers.

Procedural memories are often difficult to put into words. For instance, imagine you are an experienced hockey player. In the course of a match, you might score a goal after taking a pass

Figure 6.30 Procedural memory is the memory of skills, such as how to blow-dry someone's hair. Declarative memory is the memory of specific facts or events, such as knowing which AFL team is represented by a particular jumper or knowing that the Black Saturday Victorian bushfires occurred in February 2009.

and weaving your way through several opponents. If you were asked about the rapid series of motor behaviours (physical actions) involved in this play, you would probably have a difficult time stating how to perform every single movement involved.

Declarative memory

Declarative memory is the memory of specific facts or events that can be brought into conscious awareness and explicitly stated or 'declared' (unless retrieval fails). Consequently, declarative memory is also called *explicit memory* because it is open to intentional retrieval. Examples of the use of information retrieved from declarative memory include identifying a type of flower, explaining a statistics formula to someone, describing the events of a movie you have seen or remembering what you ate for dinner last night.

When distinguishing between procedural and declarative memory, psychologists often refer to procedural memory or implicit memory as 'knowing how' and to declarative memory or explicit memory as involving 'knowing that'. Two types of declarative memory are commonly described: *episodic memory* and *semantic memory*.

Episodic memory

Episodic memory is the declarative memory of specific events or personal experiences. Episodic memories often include details of the time, place and the psychological and physiological state of the person when the event occurred (Squire & Kandel, 1999). Episodic memory is considered to be like a mental diary, recording the autobiographical episodes we experience. Your memory of the Black Saturday bushfires in Victoria on 7 February 2009, the birth of a younger brother or sister, going to the dentist a week ago or what you ate for breakfast this morning and how the food tasted, are all examples of episodic memory.

Semantic memory

Semantic memory is the declarative memory of information we have about the world. It includes our specialised knowledge in areas of expertise (for example, that in a game of chess, a king can be moved only one space in any direction), academic knowledge of the kind learned in school (for example, that humans are mammals), rules (for example, the spelling rule 'i' before 'e' except after 'c', or the mathematical formula for calculating the area of a rectangle), everyday general knowledge (for example, that October is in spring or that the 2008 Olympic Games were held in Beijing) and the meaning of words (for example, that *assist* means to help).

Semantic memories appear to involve facts that do not depend on a particular place or time but are simply facts. You can access a fact such as 'Broome is in Western Australia' and not have the faintest idea when and where you learned it.

Some psychologists believe that the distinction between semantic and episodic memories is not as clear-cut as others have suggested. They point to memories that seem to be neither purely episodic nor purely semantic but fall into a grey

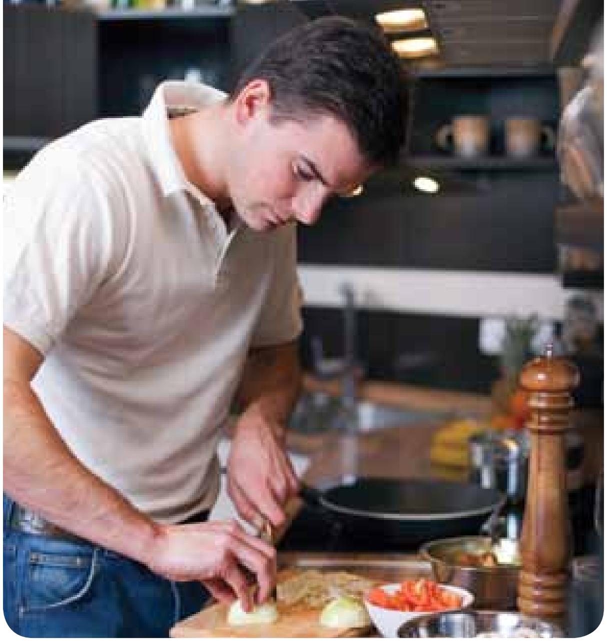


Figure 6.31 Cooking a curry can involve all three types of LTM stores. Procedural memory is involved in knowing how to brown the meat, remembering the recipe involves semantic memory, and your memory of a cooking disaster with curry—when you thought you would surprise your girlfriend by cooking her favourite meal on her birthday—relies on episodic memory.

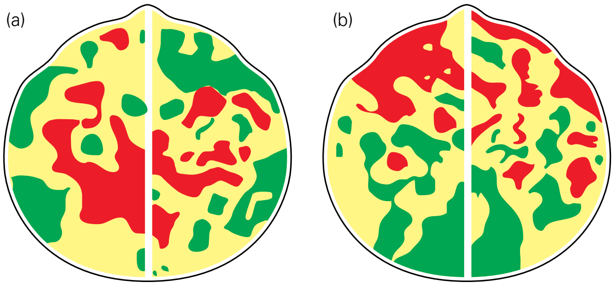


Figure 6.32 Research evidence indicates that different areas of the brain are activated by the use of different types of LTM: (a) shows areas of the cerebral cortex that are activated when semantic memory is used (when a person is thinking about the history of astronomy, which they had read in the past); (b) shows active areas of the cortex when the same person was using episodic memory (thinking about a personal experience that occurred 40 years earlier). Areas shaded in red indicate high levels of brain activity. Areas shaded in yellow indicate low levels of brain activity.

area between. For example, consider your memory for a homework task you may have worked on last night. You probably added knowledge to your semantic memory, which was the likely reason you were asked to do the work. However, you probably also remember where you were studying, as well as what time you started and about when you stopped. You may also remember some minor incidents, such as a burst of noise from a nearby room or having difficulty finding a reference.

Is episodic or semantic memory involved here? Canadian psychologist Endel Tulving (1983) argues that semantic and episodic systems often work together in forming new memories. In such instances, the memory that ultimately forms may consist of an autobiographical episode *and* semantic information. The two might be related, like a container and its contents. Your episodic memory of having studied last night also contains semantic knowledge about what you learned (Santrock, 1991).

Box 6.7

Implicit and explicit memory

Studies with people who have experienced different types of amnesia have led some psychologists to suggest that LTM consists of two separate but interacting sub-systems: explicit memory and implicit memory (Clarke & Squire, 1998).

Explicit memory refers to the memory of information that can be consciously recalled. Consequently, it is memory with awareness. Remembering the PIN of your debit card, your first exam experience, the colours of the Italian flag or when your cat died are all examples of explicit memory. Using explicit memory involves a deliberate and conscious attempt to retrieve previously stored information. The most commonly used tests of explicit memory are recall and recognition. Explicit memories are also called *declarative memories* because, if asked, you can consciously recall the information and can 'declare' or 'state' it.

Implicit memory refers to memories that cannot be consciously recalled, but that affect behaviour

Figure 6.33 Remembering the PIN for your debit card is an example of explicit memory.

Figure 6.34 Knowing how to use chopsticks is an example of implicit memory.

and knowledge involved in performing a particular task. It is memory without awareness. Behaviours you have learned without being aware you have done so are stored in implicit memory. Habits such as crossing your legs when you sit down, or well-learned tasks that you do using automatic processing, such as writing, riding a bike and using chopsticks or a knife and fork, are all examples of implicit memory. It is called implicit memory because your memory of this information is implied by or inferred from your responses that can be observed. Your memory for knowing how to swim breaststroke, for example, would be judged by watching you do it rather than by asking you to state how you do it.

Testing for implicit memory usually involves some kind of cognitive task that draws on past experience, such as filling in the blank letters of a word (Schachter & Buckner, 1998). The task may seem quite unrelated to any previous learning and therefore there is no conscious recall.

Implicit memory is demonstrated by the following example. For efficient typists, keying in the phrase 'most zebras cannot be extravagant' with closed eyes is not a difficult task. However, reciting the seven letters on the bottom row of the keyboard from left to right is much more difficult. Can you do it? This example shows that the knowledge for the location of the letters Z, X, C, V, B, N and M on the keyboard is stored in the typists' implicit memory, despite the inability to consciously recall the location of each key (Hockenbury & Hockenbury, 2006). Implicit memories are also referred to as *nondeclarative memories* because people often find it difficult to 'declare' or 'state' the relevant information. Included within implicit memory is our procedural memory—our memory for knowing how to perform various tasks.

Table 6.4 Sample test items used to assess implicit memory

Word stem completion	ele ____________
Word fragment completion	e_e_h__t
Anagram	lepanthe
Word association	Tusk –

Box 6.8

Landmark events and episodic memory

Events that are significant to us, such as a romantic experience, winning a sports trophy, passing a driving licence test or going to an end-of-year formal, are called *landmark events* because they act as landmarks for our memory. Landmark events can be used to search backwards and forwards through memory to locate details about other events that occurred at about the same time. They also act as *retrieval cues* (memory prompts) for other information. Without a specific landmark event, it can be difficult to locate and then retrieve details from episodic memory.

In one study, students were asked to think aloud as they remembered a specific event, such as a car accident they were involved in or had witnessed, a sports injury, feeling sad or being turned down for a date. The students used several strategies to remember such events. They often used the particular activity, person or time period they believed was involved so as to discover the general context of the memory. For example, when asked about circumstances that made them sad, they 'searched' for activities in which they felt sad (Reiser, Black & Abelson 1985).

Figure 6.35 Significant landmark events assist us to locate details of other events in our lives that occurred at about the same time.

Learning Activity 6.16

Review questions

1 What is long-term memory?

2 a Why is information in LTM often described as 'inactive' information?

b Which other memory system could also be described as storing inactive information? Why?

3 Describe the relationship between LTM and STM (or short-term working memory).

4 What are three key differences between LTM and STM (or short-term working memory)?

5 Distinguish between implicit and explicit memory with reference to an example.

Learning Activity 6.17

Visual presentation summarising types of LTM and their roles in memory

1 Develop an annotated flow chart to summarise the key features of the LTM types.

or

Complete a table such as the one shown below to summarise the key features of the different types of LTM.

Type	Features	Example
Procedural (implicit) memory		
Declarative (explicit) memory – semantic memory – episodic memory		

2 **a** Draw a diagram to show how each of the three LTM stores of procedural memory, episodic memory and semantic memory could be involved in processing information about a competitive tennis match in which you played.

b Using a different colour, add information about the role of short-term working memory when playing the tennis match, including examples of how or when each of the four components described by Baddeley would be involved.

Learning Activity 6.18

Identifying types of LTM

Identify which type of LTM is likely to be involved with each of the following activities:

a describing your first day in Year 7
b slam-dunking a basketball
c recalling the names of Santa's reindeer
d solving a crossword puzzle
e sending a text message on a mobile phone
f placing an order in a fish and chip shop
g describing the plot of a novel
h playing hide and seek
i calculating a mean score
j giving directions to the principal's office
k writing up a prac report
l writing a computer program
m answering a Trivial Pursuit question
n playing Monopoly.

Organisation of information in LTM

Before reading further, recall the 12 months of the year as quickly as you can. About how long did it take you? What was the order of your recall? The answer to these questions is probably 'about five seconds' and 'sequential order' (January, February, March …).

Now, try recalling the months in alphabetical order as quickly as you can. About how long did it take you? Did you make any errors? It is likely that the first task was completed more quickly and with fewer errors than the second task.

These activities, as basic as they are, demonstrate quite clearly that your memory for the months of the year has some organisation to it (Tulving, 1983). One of LTM's most distinctive features is its organisation of information. The task of retrieving information from LTM is vastly different from that of retrieving information from STM (or short-term working memory). In STM the search-and-retrieve task involves scanning only 7 ± 2 items to locate the relevant information. However, LTM stores such a vast amount of information that there is a need for some form of organisation to assist the storage and retrieval processes.

Evidence for the organisation of information in LTM has been available for some time. In a research study conducted more than 65 years ago, participants were asked to recall items from categories (such as types of fish or makes of cars) that they had learned before the experiment. They recalled them in bursts of related items, paused briefly, and then recalled another group of items, and so on (Bousfield & Sedgewick, 1944). The researchers concluded that the way in which participants recalled the items reflected the way the items were organised in LTM. Furthermore, when participants memorised new lists of items that could be categorised, they tended to recall them in related groups also.

In a later experiment, Bousfield (1953) asked participants to memorise a list of 60 words that could be grouped into four categories: animals, vegetables, names and occupations. Even though the words were presented in random order (for example, Janet, pilot, wombat, shearer, carrot, possum, lettuce, Barry), and participants were not made aware that the words could be categorised, they still recalled them in groups or clusters according to particular categories significantly more often than they would be expected to have done by chance. It seemed that the words had been stored in LTM according to organised categories.

Information in LTM is not only organised in meaningful clusters of related categories. Research findings indicate that information is also linked or associated with other information stored in LTM. For example, what is the first word that comes to your mind in response to the word 'red'? When other students have been asked this question, the most frequent responses are 'blue', 'apple', 'colour', 'green' and 'rose'. Even if your response differed from these, it was still based on some kind of logical association that you could probably explain if you were asked. Some other associations that have been made with the word 'red' are 'hair', 'fire engine', 'wine', 'blood', 'anger', 'embarrassment' and 'hot' (Hockenbury & Hockenbury, 2006).

There is also considerable research evidence that suggests that recall from LTM is better when we further organise the information stored there. For example, in one experiment, American psychologists Gordon Bower and Marvin Clark (1969) asked participants to memorise 12 lists of words such as those in the following list.

boy	rag	boat	wheel	dog
cap	pram	house	ghost	milk

The participants were university students enrolled in a psychology course who volunteered to take part in the experiment in their spare time. Half the participants were given instructions to memorise the list in any order (group A), and the other half were asked to 'make up stories' containing all the words in the list; that is, to organise them into a single story (group B). For example, the list could be memorised as, 'The boy with the cap pushed his dog and his boat in his pram, which had a crooked wheel. When he got to his house and saw a rag that looked like a ghost, it scared him so much that he spilled his milk.' The group that organised the words into stories (group B) recalled 90% of the 12 lists of words, whereas group A recalled only 15%. These results suggest that recall from LTM was improved by organising the information.

Learning Activity 6.19

Evaluation of research by Bower and Clark (1969)

Evaluate the experiment by Bower and Clark (1969). You may present your evaluation as an annotated diagram; for example, as a flow chart. You are required to do the following.

1. Construct an operational hypothesis that could have been tested by the procedures used in the experiment.
2. Identify the IV(s) and DV(s) in the experiment.
3. Name the experimental design.
4. Identify the experimental conditions.
5. Identify the characteristics of the participants in the experiment and how they were selected.
6. Briefly state the results obtained.
7. If there is a difference in the mean scores for the two groups and $p < 0.05$, what does this indicate about the results? Would the results be meaningful if $p < 0.01$? Explain your answer.
8. Briefly state the conclusion made based on the results obtained.
9. Identify a potential extraneous or confounding variable that could impact on the results obtained and explain how it was or could be controlled.
10. Comment on the external validity of the experiment and the extent to which the results can be generalised.

Learning Activity 6.20

Practical activity on organisation of information in LTM

Spend five minutes learning the following 30 words using whatever technique you prefer. When five minutes has passed, count backwards by threes from 108 until you get to 0. Then, on a blank sheet of paper, recall as many of the 30 words as possible. Compare your list of recalled words to the original list. How many words did you correctly recall?

Words to be learned

painting	pineapple	eucalypt
apple	violet	geology
beans	poppy	biology
lettuce	cabbage	strawberry
chemistry	daisy	sketching
sculpture	banana	wattle
carrot	physics	rose
potato	poetry	psychology
orchid	pear	pine
oak	music	maple

1. From the data gathered, is there any evidence to indicate that the information was organised in LTM? If so, explain how the information was organised.
2. Summarise your class results, ensuring you can compare the type of organisation with the number of words correctly recalled.
3. On the basis of the results, comment on the most effective organisation of information and compare this with theoretical expectations.

Semantic network theory

Psychologists have long-accepted that information stored in LTM is both organised and associated with other information held in the LTM system. However, different theories and models have been developed to describe and explain *how* the vast amount of information is stored and organised in LTM. One of the more widely accepted theories is the semantic network theory first developed by American psychologist Alan Collins and computer scientist Ross Quillian in 1969. The theory emphasises organisation of information in terms of connections ('network') based on meaning ('semantic').

Semantic network theory proposes that information in LTM is organised systematically (hierarchically structured) in the form of overlapping networks (or 'grids') of concepts that are interconnected and interrelated by meaningful links. According to this model, each concept, called a *node*, is linked with a number of other nodes. Thus, when we retrieve information, the activation of one node causes other related nodes to be activated also. Figure 6.36 shows how a small segment of a possible semantic network for animals might be arranged in LTM. Each concept in the network, such as *bird* or *canary*, is organised into a hierarchy in which one concept is a sub-category of another. For example, note how the concept of *animal* is broken down into *bird* and *fish*. Bird and fish are then broken down further into specific examples of each. At each node, certain characteristics of that concept are stored. For instance, the characteristics associated with fish could include fins, swimming, gills and scales. In reality, LTM contains thousands of concepts, each with very many connections. For example, the network for animals that includes fish could overlap with the network for proteins, which could also include fish as well as nuts, cheese, meat and so on. This system of storing information in terms of meaning is quite an effective means of storage, or 'filing' system, and enables efficient and effective retrieval of information. For example, if we locate *canary*, we not only know that canaries can sing and are small, but we also know, by moving upwards in the hierarchy, that they have wings, fly, have feathers, breathe, eat, move and have skin. This helps make the information-storage system efficient because it minimises the duplication in storage of information, given that every characteristic of each animal does not need to be stored separately with that animal.

According to semantic network theory, the retrieval of information from LTM begins with someone searching a particular 'region' of memory and then tracing associations for links among memories (concepts) in that region, rather than randomly searching the vast information stores in LTM. This is like the operation of a search engine on the internet, which systematically locates websites with words you key in, or when you look for a book in a library. You would use the catalogue to give you a retrieval cue (a book number) to help you locate the book you wanted.

In 1975, Collins published a revision of the theory with American colleague Elizabeth Loftus. Their revision of the theory was a less rigid version of the model and introduced the concept of spreading activation. *Spreading activation* proposes that activating one node during retrieval increases the likelihood that associated nodes become activated. For example, a specific retrieval cue will activate one or more nodes with which it is associated in LTM, which in turn will activate other nodes (related memories) to which they are linked. The shorter the link between nodes in the

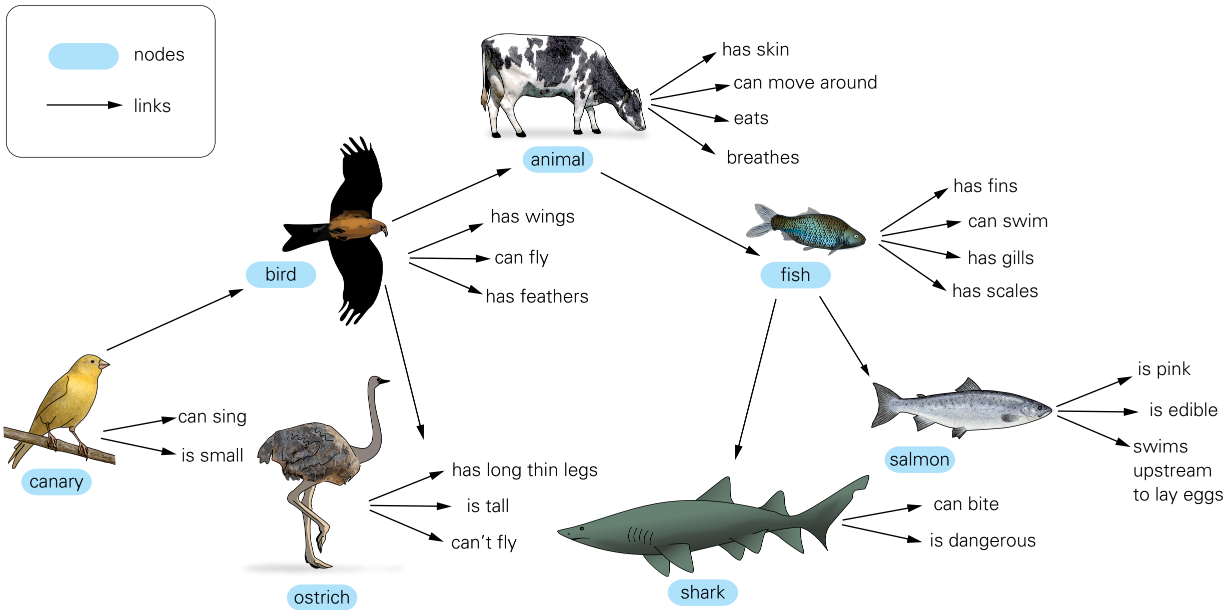


Figure 6.36 According to semantic network theory, LTM is organised into semantic networks in which concepts or nodes (such as canary, bird and animal) are interconnected by links. The shorter the link between two concepts, the stronger the association between them. The figure shows only a small segment of a possible network. Other information has been left out so that the network is kept simple; for example, other characteristics that we know about animals, fish, birds and so on.

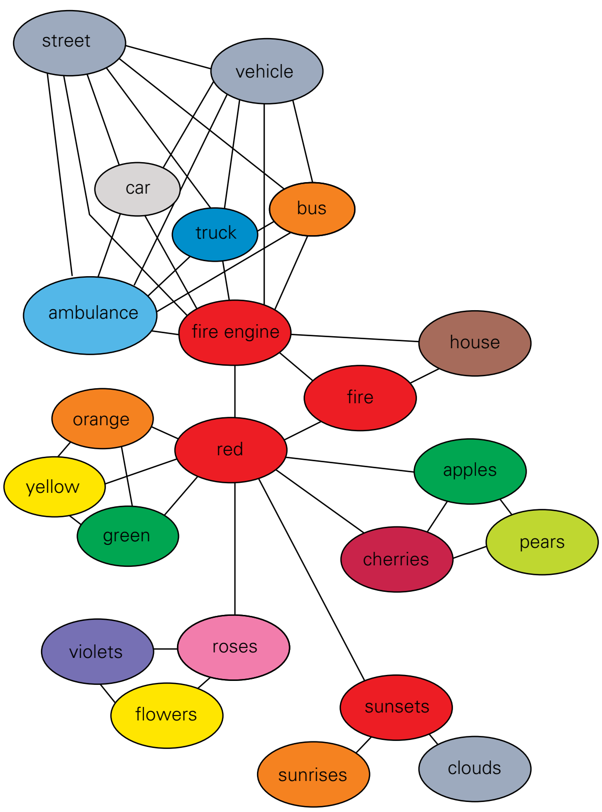


Figure 6.37 A semantic network published by Collins and Loftus (1975) to illustrate *spreading activation* within a semantic network in which similar concepts are connected through their associations. For example, when you see a fire engine, all the nodes that represent features of a fire engine are activated, resulting in your recognising that the object is a fire engine, rather than, say, a pear or a dog. Note that seeing a fire engine activates nodes for other vehicles. Therefore, you will also more quickly recognise other vehicles than, say, fruits or animals.

network, the stronger the association between them and the less time it takes to activate (and therefore retrieve) related concepts to which they are linked. Longer links between nodes indicate a weaker association between them and thus the longer it takes to activate (and therefore retrieve) the information that is further away. Activation of one node stimulates activation of other linking nodes across the network. The more nodes that are activated, the quicker the retrieval of information from LTM. If information had to be retrieved from LTM in a sequential search process, as described in models of STM or working memory, it might take days, even years, to find a given memory.

Box 6.9

Comparing semantic network theory with a map

When considering semantic network theory, it may help to think of concepts as *towns* on a map and the links, or associations, between them as *roads*. Following this analogy (comparison), we store new concepts by building new roads between the towns. The thousands of towns are interconnected by kilometres of roads (links) to form a vast interconnected network. Just as you follow different roads to go from town to town, you follow different associative pathways to go from concept to concept. The longer the road connecting two towns, the longer it takes to activate and retrieve a concept (Schwarz & Reisberg, 1991).

Learning Activity 6.21

Review questions

1 Why is organisation necessary in LTM?

2 According to semantic network theory:

- **a** How is information organised in LTM?
- **b** How does retrieval of information from LTM occur?
- **c** What is meant by spreading activation and what role does this play in LTM retrieval?
- **d** Is spreading activation possible in the STM (or working memory)? Explain your answer.

3 Use your answers to question 2 to write a definition of semantic network theory.

4 Draw a small segment of a possible semantic network for the concept of *flower* or *book*.

Learning Activity 6.22

Visual presentations summarising the structure and function of human memory

1 Construct a table that summarises the main distinguishing features of the sensory memory, short-term working memory and LTM systems. Headings in the table should include:

Name of memory system
Main function(s)
Type of information
Storage duration
Storage capacity
Organisation of stored information
Level of processing
Relationship to other systems
Other distinctive features.

Ensure the table includes the episodic buffer.

2 Create a flow chart to show the flow of a specific example of incoming sensory information as it moves through a model of memory that integrates the Atkinson–Shiffrin model, the Baddeley (2000) model and the Craik and Lockhart framework. The flow chart should include a representation of maintenance and elaborative rehearsal and the information must be shown as being both stored and then retrieved from LTM for use.

Serial position effect

There is considerable research evidence in support of the view that memory comprises at least two distinguishable storage components or systems, most commonly referred to as LTM and STM or working memory. Evidence for this comes from studies of patients with amnesia or brain damage and experimental research that has demonstrated the serial position effect.

To test whether STM is a component of memory that is distinguishable and possibly separate from LTM, psychologists have studied research participants' memory for lists of words, numbers, images and various other types of information. Typically, participants are presented with a list of about 15 words for a short period of time, such as 30 seconds. Then, participants are required to recall as many words as possible in any order using *free recall* rather than *serial recall*; that is, in any order rather than the order in which the words were presented.

These types of studies usually obtain similar results. The words in the list that are recalled seem to depend on their serial position; that is, where the words are located in the list. This research finding is called the serial position effect. The **serial position effect** is a finding that free recall is better for items at the end and beginning of the list than for items in the middle of the list. More specifically, the recall of items tends to be best for items at the end, and then the beginning, and worst for items around the middle. When retention of all the items is plotted on a graph, the result is a U-shaped curve, as shown in figure 6.38.

The **primacy effect** describes superior recall of items at the *beginning* of a list. The **recency effect** describes superior recall of items at the *end* of a list. Together with the relatively low recall of items from the middle of the list, this pattern makes up the serial position effect. Experiments testing the serial position effect with different kinds of information, such as numbers or even sketches of objects, have consistently found a similar U-shaped curve with a strong recency effect (Page & Norris, 1998; Buchner, Irmen & Erdfelder, 1996; Tremblay & Jones, 1996).

What causes the serial position effect? A widely accepted explanation is in terms of differences between STM and LTM. Many researchers have argued that if recall occurs immediately after the list is learned, the last few items are remembered best because they are still in STM. The first few items in a list are remembered well probably because they received more attention and rehearsal than other items and are therefore transferred into LTM. Items around the middle of a list are presented too late to be adequately rehearsed and transferred into LTM and too early to be held in STM without rehearsal, so they are more likely to be forgotten (unless they are distinctive in some way). Many experimental investigations provide evidence in support of an explanation that distinguishes between STM and LTM.

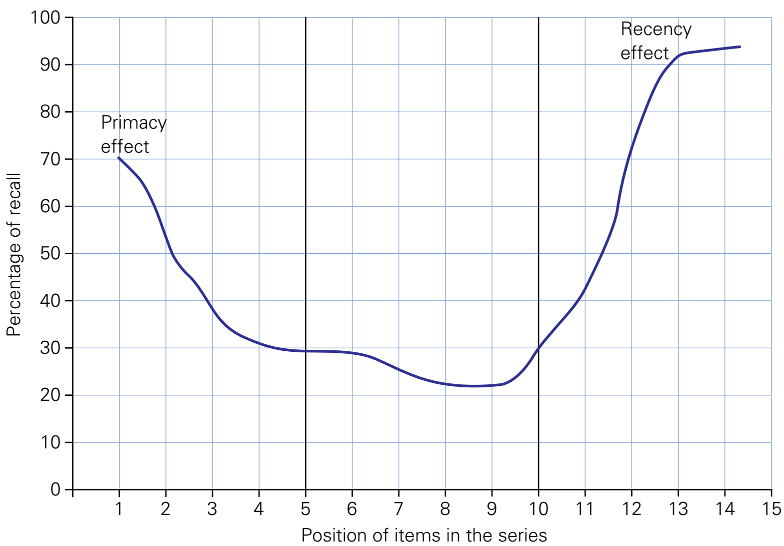


Figure 6.38 The serial position effect is illustrated in this graph. When a list of items must be recalled, recall is better for items presented at the end and the beginning of the list than for items in the middle of the list. Items from the end of the list are *most* likely to be recalled, and those from the middle of the list are *least* likely to be recalled.

Figure 6.39 Grant Hackett is more likely to remember the names of the fans he has just written (recency effect) and those he first wrote (primacy effect) than those in between.

One of the best-known studies was conducted by American psychologists Murray Glanzer and Anita Cunitz in 1966. They conducted an experiment in which participants were asked to memorise a list of 15 words. As shown in figure 6.40, the serial position effect was clearly found when the participants were asked to recall the list immediately after learning it. Recall was better for items at both the beginning and the end of the list. But when the participants were asked to recall the list after a delay of 30 seconds—beyond the limits of STM—the serial position effect was not entirely observed. According to Glanzer and Cunitz (1966), recall was better at the beginning of the list, probably because those items were rehearsed more and were therefore more likely to have been stored in LTM. However, as for words at the end of the list, where no recency effect was evident, recall was not as good probably because the participants could not hold the last items in STM long enough.

The findings of numerous research studies on the serial position effect have not only enabled psychologists to more confidently identify LTM and STM (or working memory) as *different* components, systems or sub-systems when referring to the *structure* of memory, but also to describe LTM and STM as *interacting* when referring to their functions in memory. The serial position effect also has implications for advertisers. In research in which participants watched a series of television commercials, recall was worst for commercials presented in the middle of a series than for commercials presented at the beginning or at the end of a series. These findings suggest that for advertisers to gain the maximum impact from television commercials, the placement of their commercial at the beginning or at the end of a series of advertisements would have greater impact on viewers' memories (Pieters & Bijmolti, 1997).

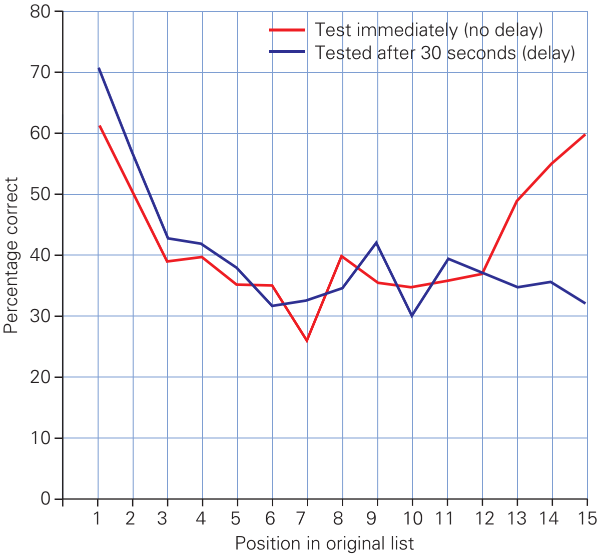


Figure 6.40 The serial position effect is clearly evident when testing recall immediately after learning a list of items (that is, with no time delay). However, when recall is delayed for 30 seconds, participants tend to forget the latter items and no recency effect is evident.

Learning Activity 6.23

Review questions

1 a Describe the serial position effect.
  b What are the primacy and recency effects and why do they occur?
  c Why are items in the middle of a serial list recalled least?
2 Explain why the serial position effect can be used as evidence:
  a for LTM and STM (or working memory) as interacting components, systems or sub-systems
  b against the view of memory as a unitary ('single') system without distinguishable components, systems or sub-systems.
3 What implications does the serial position effect have for:
  a a prosecutor or barrister presenting their case to a jury?
  b three politicians before an election, each delivering a brief policy speech one after the other on television?
  c a potential employee deciding on their interview time when allowed to choose from an interview schedule?
4 You have just begun casual work at the local supermarket. On your first day, you are introduced to 15 other employees of the store, one after the other. According to the serial position effect, which names are you most likely to remember and why?

Learning Activity 6.24

Practical activity on the serial position effect

The aim of this practical activity is to produce the serial position effect by asking participants to recall a list of 15 random words. The word list could consist of common nouns that are each four letters in length, such as *seat, pipe, door, pond* and so on. All relevant ethical guidelines must be followed.

During the experiment the words should be read aloud to the participants one at a time, allowing a pause of about two seconds after each word. The task for participants is to memorise the list of words without writing them down, then immediately after the presentation recall the words in any order by writing them down. They should be allowed as much time as required to recall the words.

The written responses by participants will provide the data for plotting a line graph. By making a graph of the percentage recall rate of each word, a comparison can be made with the graph in figure 6.40 for the no-delay condition.

1 Construct an operational hypothesis about the serial position effect.
2 At what level would you set the *p* value for a test of significance? Explain why you would use this value rather than a higher or lower value.
3 Analyse the data in terms of the frequency of recall of information in different serial positions. What conclusion(s) can be drawn?
4 To what extent are your results consistent with theoretical expectations or results obtained from other similar studies?
5 Evaluate the experimental design. Identify one or more relevant extraneous or confounding variables and suggest improvements to the experimental design in a way(s) that would minimise the influence of the variable(s).

Learning Activity 6.25

Matching exercise

Match the key terms on the left with the correct definitions on the right. You may check your responses by referring to the answers on page 823.

1 encode	a a sub-system of memory that can store about five to nine bits of information
2 sensory memory	b creating meaningful associations between new and existing information
3 short-term memory (STM)	c the finding that immediate recall of items in a list of items is better for items at the beginning and end of the list than it is for items in the middle
4 long-term memory (LTM)	d organising bits of information into a larger single unit of information
5 maintenance rehearsal	e a component of working memory that enables interaction with LTM
6 chunking	f memory for meaning without reference to time and place of learning
7 serial position effect	g mental repetition in order to retain information in STM
8 elaborative rehearsal	h memories for motor skills and other actions
9 procedural memory	i a sub-system of memory that stores vast amounts of information for a long time
10 semantic memory	j memory that briefly holds exact replicas until they can be processed
11 central executive	k locating and recovering stored information from memory so we are consciously aware of it
12 explicit memory	l integrates information from the other three components of working memory
13 retrieval	m memories that can be intentionally recalled
14 working memory	n information in LTM that is organised as overlapping grids of concepts linked by meaning
15 semantic network	o where conscious information is manipulated, thought about and processed
16 episodic buffer	p to represent information in a useable form for storage in memory

Neural basis of memory

It is now well established in psychology that memories are not stored in any one specific brain location. Rather, memories are stored throughout the brain and linked together through neural tracts or pathways, often described as 'memory circuits', consisting of interconnected neurons. This does not mean that all areas of the brain are equally involved in memory. Different brain areas and structures are active as we encode, store and retrieve different types of information. Certain brain areas are also more or less involved in different memory processes. For example, the temporal lobes have an important role in declarative explicit memories ('knowing that'), but are less important for procedural implicit memories ('knowing how'). In this section, we consider some of the brain areas and structures involved in memory. We start with what happens in the brain at the neuronal level when we form memories.

Role of the neuron in memory formation

Among the most influential studies on how brain neurons change when a new memory is formed are those conducted by Eric Richard Kandel, an Austrian-born American psychiatrist and neuroscientist. Working independently or with various colleagues over the past 50 years, Kandel has identified changes in the structure and functioning of neurons in the brain when forming the memory of a newly learned experience. Kandel's research findings on the neural basis of memory were recognised through the award of the Nobel Prize in Physiology or Medicine in 2000.

Kandel's best-known studies were conducted with *Aplysia californica*, a very large seaweed-munching sea slug found along the coast of California in America. The main reason for studying *Aplysia* is that it has a far less complex nervous system than that of humans and other mammals. For example, it has an extremely simple nervous system consisting of about 20 000 neurons, compared to the trillions of neurons in the brain of humans and other mammals such as monkeys and cats. Some of its neurons are also the largest in the animal kingdom. For example, they are so big that they can be seen with the naked eye. According to Kandel (2001), the large neurons can not only be easily observed because of their size, they can also be observed for days without any difficulty. They can also be easily stimulated to observe neuronal changes or removed one at a time for biochemical analysis.

Figure 6.41 Eric Kandel was awarded the Nobel Prize in Physiology or Medicine in 2000 for his research findings on the neural basis of memory.

Many of Kandel's studies with *Aplysia* involved using a very thin electrode (or 'probe') to mildly stimulate a part of the body called the *siphon*. The siphon is like a tail and the stimulation caused it to reflexively contract (see figure 6.42). An *Aplysia* would also immediately withdraw its delicate gill in case whatever shocked its siphon also shocked the gill. If Kandel did this again a moment later, an *Aplysia* would withdraw its gill even more quickly. If he came back an hour later and stimulated the siphon again, the withdrawal of the *Aplysia's* gill occurs as slowly as it did the first time, as if *Aplysia* can't remember what happened an hour earlier. However, with repeated stimulation of the siphon, an *Aplysia* withdrew its gill less and less. This indicates a simple form of learning called *habituation*; that is, it learns that stimulation of the siphon represents no danger to the gill, an anatomical structure enabling it to breathe and therefore vital for survival. Kandel also observed that if an *Aplysia* is tested in the same way over a series of days or weeks, each day it habituates faster than it did the day before. This suggests that *Aplysia* develop an enduring memory that can last for days or even weeks. By studying what happened in neurons during the tests, Kandel was able to identify changes in the structure and

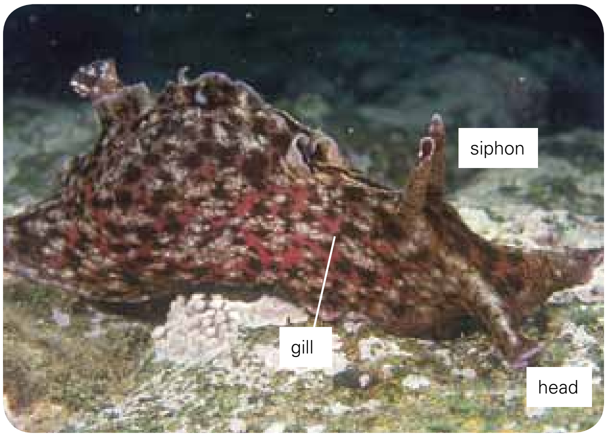


Figure 6.42 *Aplysia californica*

functioning of neurons involved with the learning and memory that was observed to take place (Kandel, 2007).

According to Kandel (2001), when *Aplysia* acquire a new memory through repeated stimulation, significant changes occur in neurons involved in the process. One change that occurs is in the way the slug's neurons *function*. There is an increase in the amount of the *neurotransmitter* produced and released by the neurons; that is, the specific chemical substance used by neurons to communicate. A second change that occurs is in the *structure* of the slug's neurons. Neurons are interconnected by extensions, or 'branches', at either end called *axons* (which send the message) and *dendrites* (which receive the message). The number of these branches increases as they become 'bushier' through the growth of smaller 'offshoots' (called *dendritic spines*), thereby strengthening the connections between the neurons. A third change involves the synapse. A *synapse* is the small space between the axon of one neuron and the dendrite of another, and neurons communicate by sending neurotransmitters across these synapses. When a memory is formed, new synaptic connections form (called *synaptic growth*) and this has the effect of further strengthening the connections between the neurons, making it easier for them to transmit to each other the next time. These changes allow the neurons involved in the particular memory circuit, or 'pathway', to communicate more easily. The more the neurons in a circuit are activated through use, the 'easier' it becomes for information to travel through the circuit. Collectively, these changes are called long-term potentiation. *Long-term potentiation* (*LTP*) refers to the longlasting strengthening of synaptic connections of neurons resulting in the enhanced functioning of the neurons.

In sum, Kandel's research findings indicate that any experience that results in memory produces physical changes in the brain at the neuronal level, strengthening connections between neurons involved in the process, thus making communication easier the next time. These changes create and strengthen a memory circuit for information that has been learned. With short-term memory storage, there is only an increase in the release of neurotransmitter. With long-term memory storage, all structural and functional changes occur. Each time the memory is recalled, the neurons in this circuit are activated. As the structural and functional changes in the neurons strengthen the communication links in this circuit, the memory becomes established as a long-term memory. Of course, it is difficult to generalise the findings of research studies with sea slugs to humans. It is also difficult to study long-term

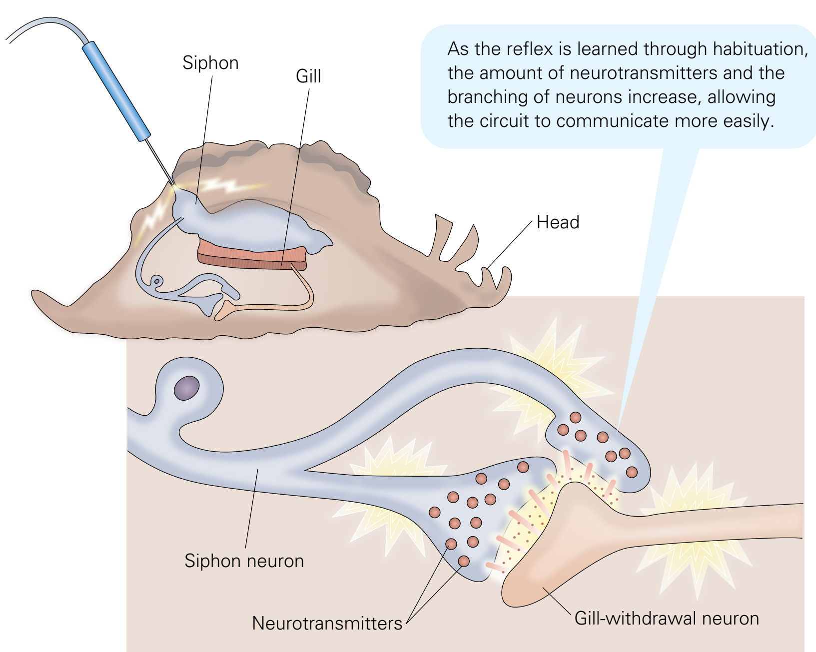


Figure 6.43 Neuronal activity as an *Aplysia* forms a memory of what has been learned.

potentiation in humans because of the complexity of our brain and its neural circuits. However, research studies have found that long-term potentiation associated with memory formation occurs in fish, chicks and mammals such as mice, rats, rabbits, cats and squirrels (Kandel, 2007; Breedlove, Rosenzweig & Watson, 2007; Kandel, 2001).

Learning Activity 6.26

Review questions

1. Why did Kandel choose *Aplysia californica* for his experiments?
2. Give a reason, other than ethics, to explain why Kandel cannot conduct his experiments with human participants.
3. Name the technique used by Kandel to trigger the gill-withdrawal reflex.
4. What key assumption did Kandel make about the relationship between learning and memory?
5. Is an *Aplysia* capable of forming STM? Explain your answer.
6. Outline Kandel's research procedure.
7. In other experiments, Kandel stimulated the tail of an *Aplysia* then immediately followed it with a squirt of water to the siphon. Eventually, each *Aplysia* responded reflexively to the squirt of water alone. It was no longer necessary to first stimulate the tail. Explain whether this procedure involves another form of learning by *Aplysia*.
8. What structural and functional changes occurred in neurons of *Aplysia* during Kandel's experiments?
9. Explain the role of neurons in memory formation.
10. Explain the meaning of long-term potentiation and its relevance to memory.
11. Describe two limitations of Kandel's research findings.

Learning Activity 6.27

Visual presentation on the role of the neuron in memory

Use diagrams and/or images to visually represent the role of the neuron in memory formation, as described by Kandel's theory.
In your presentation, ensure that you:

- include a diagram of at least two adjacent neurons, with labels for key structures and substances and brief descriptions of their functions in memory
- include a flow chart or other suitable diagram summarising Kandel's research procedure to promote learning in *Aplysia*
- explain the role of the neuron in memory proposed by Kandel on the basis of his research findings
- refer to long-term potentiation in a logical part of your presentation.

Point-form may be used for all descriptions and explanations. PowerPoint and other suitable software or media may be used.

Learning Activity 6.28

Visual presentation on the role of the neuron in memory

Working in a group of four or five, prepare a role-play that demonstrates and explains the formation of a new 'memory circuit' with long-term potentiation when something is learned.

Roles of the hippocampus and temporal lobe

Just above each ear and about 4 centimetres straight into the brain is the **hippocampus**. As shown in figure 6.44, it is tubular and curved, somewhat like the shape of a sea horse (after which it is named). In humans, it is about 3.5 cm long and we have two of them: one in the lower region of the temporal lobe of each hemisphere.

In 1957, the publication of a case study drew the attention of psychologists throughout the world to the importance of this brain area in memory. The case study documented memory problems experienced by American patient H.M. The patient, whose real name was Henry Molaison, subsequently participated in hundreds of research studies on memory until his death in 2008 at age 82. However, until his death, he was known only by the initials H.M. to protect his privacy.

In 1953, when Molaison was 27 years old, he agreed to brain surgery to treat the severe epilepsy from which he had been suffering since the age of ten. As with split-brain patients, Molaison's epilepsy was unresponsive to anti-convulsant medications and other treatments. It was also extremely debilitating and he had difficulty holding even a simple job. At the time, doctors knew that, in many patients with epilepsy, seizures started in either the right or left hemisphere, usually in the medial temporal lobe. The **medial temporal lobe** is the inner surface area towards the middle ('medial') of the temporal lobe that includes the hippocampus, the amygdala and other cortical tissue. Because Molaison's seizures were so severe, and because the precise origin could not be determined, the neurosurgeons decided to remove the medial temporal lobe from each hemisphere—altogether about 5 cm of tissue from each lobe (Gluck, Mercado & Myers, 2008).

Medically, the surgery was successful. Molaison's seizures declined in their frequency and severity, and could also be controlled with medication. His personality was basically unchanged and many cognitive functions remained unaffected. Molaison could conduct a conversation as normally as most people do, as long as he was not distracted. He had a good vocabulary, normal language skills and slightly above-average intelligence. However, there was a huge cost. The surgery left him with serious memory problems.

Molaison could remember events that occurred well before his surgery, but could not remember things he experienced *after* his surgery. For example, Molaison could remember events experienced during adolescence and childhood as well as knowledge acquired before the surgery. He could explain the rules of baseball and describe the members of his family. However, he was incapable of forming new long-term episodic (personal events) memories or semantic (general knowledge) memories. For example, he could no longer remember what he had eaten for breakfast when asked shortly afterward, or why he was in hospital. He had to be reintroduced to his doctors every time he visited them, including his neuropsychologist who tested him regularly for some 50 years.

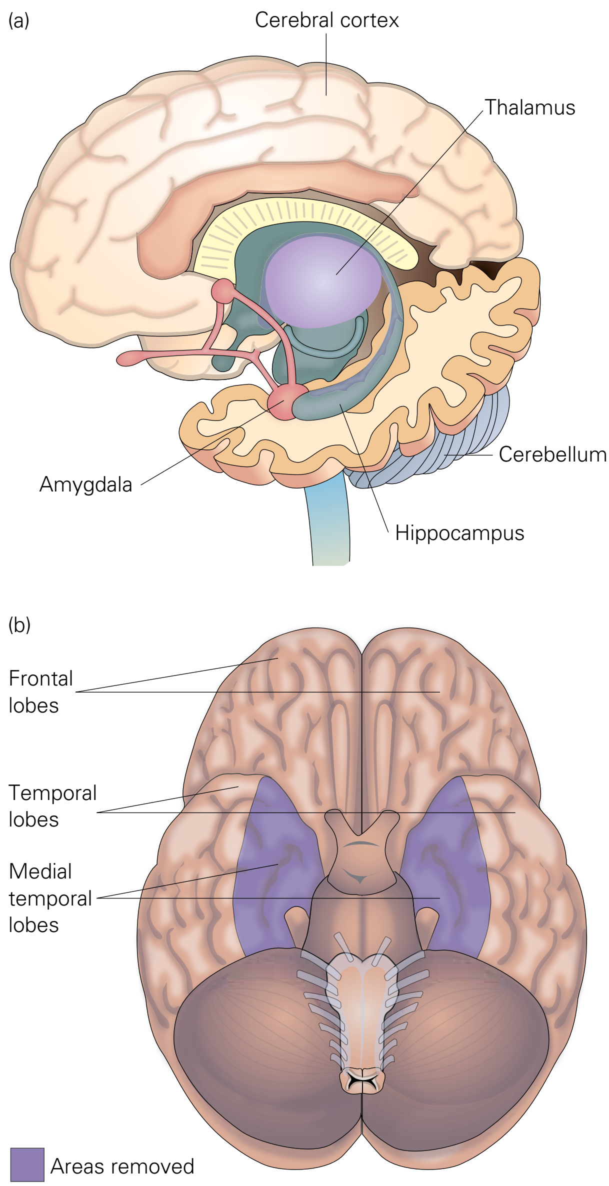


Figure 6.44 (a) The hippocampus and medial temporal lobe area; (b) Henry Molaison had the hippocampus and adjacent structures of the medial temporal lobes in each hemisphere surgically removed to treat his debilitating epileptic seizures. As a result, he was incapable of forming new long-term episodic or semantic memories.

He had almost no knowledge of current events because he forgot the news almost as soon as he had seen or heard something. He had no idea of what time of day it was unless he had just looked at a clock, and each time he was told his uncle died he reacted with surprise and became just as upset as when he was first told.

Molaison's short-term working memory was normal. In addition, he could still learn new motor skills or amuse himself doing crossword puzzles. As long as he paid attention to a task and thought about or actively rehearsed it, he could retain information in short-term working memory (and therefore conscious awareness) for as long as required. However, as soon as he was distracted and turned his attention to something else, he immediately forgot about it—the information vanished without a trace and could not be recalled thereafter (Ogden & Corkin, 1991).

Molaison's case provides evidence that the hippocampus and medial temporal lobe are involved in the formation of new long-term memories, but they are not storage sites for established long-term memories. In particular, the hippocampal area of the temporal lobe has an important role in formation or encoding of new declarative explicit memories (semantic and episodic) but not in the formation or retrieval of implicit procedural memories. It also provides evidence that LTM involves distinctive, or relatively 'independent', storage and retrieval processes. Damage to this area does not seem to seriously affect retrieval of procedural memories, but formation and retrieval of declarative memories are affected. Given that damage does not affect short-term storage or working memory in any significant way, this provides evidence that STM (or working memory) is different from LTM and that the hippocampal area of the temporal lobe is not involved in short-term storage.

Although surgery to remove both medial temporal lobes is no longer performed as a treatment for epilepsy, case studies of patients with injury or disease to the hippocampal area in both lobes indicate that they experience the same type of amnesia (called anterograde amnesia) and difficulties forming new long-term explicit memories. Removal of the hippocampal area in the temporal lobes of other mammals such as rats, rabbits and monkeys results in the same types of memory problems. Furthermore, experimental research using neuroimaging techniques has also provided evidence of these roles of the hippocampal area (Gluck, Mercado & Myers, 2008; Zola-Morgan & Squire, 1993).

Why is it that removal of hippocampal areas resulted in Molaison being unable to form new explicit memories for facts and experiences but remember old ones? Some psychologists have proposed that the hippocampus acts as a kind of 'memory formation area' where the brain temporarily holds and processes components of the information to be remembered. For example, an episodic memory of a rock concert you attend will have different components, such as its location, who you were with, visual images of the various band members, their sounds and so on. These different components need to be integrated, or linked together, in the hippocampus to form a single episodic memory. When the memory is formed, the different components will then be gradually transferred to cortical areas in the brain specialised in the long-term storage of that specific type of information. It is suggested that this can also explain why Molaison could retrieve old memories. The memories were located elsewhere in the cortex and had already been formed, with well-established circuits linking the components. Consequently, these old memories were not dependent on the hippocampal area (Schacter, Gilbert & Wegner, 2009; Gluck, Mercado & Myers, 2008).

There are also other theories that explain the role of the hippocampus in terms of memory formation, particularly in the transfer of new memories of events and specific knowledge from STM or working memory to LTM. However, many of these theories are based on yet another theory about a process known as *consolidation*.

Consolidation theory

Some research evidence suggests that new information transferred from STM (or working memory) to LTM requires a period of time for *consolidation*, or '*strengthening*', in order for it to be encoded and permanently stored. **Consolidation theory** proposes that structural, or 'physical', changes to the neurons in the brain occur when something new is being learned, and immediately following learning. These neuronal changes occur for a period of time after learning takes place, as the new information consolidates (or sets) in memory. The resulting structural changes in the neurons and their connections are said to form the memory of what has been learned. Consolidation theory also proposes that if memory formation is disrupted during the *consolidation phase* (strengthening of the neurons and neural connections supporting the memory), information may not be embedded in LTM and will therefore be lost. If disruption does not occur, the information becomes a permanent part of LTM, at least until retrieved. Consolidation of information appears to be a gradual process, and the material being remembered is vulnerable to disruption for at least 30 minutes, although consolidation of memories can proceed for as long as several years in people and for weeks in lower-order animals, such as mice, rats and rabbits (Zimbardo, 1992).

The consolidation of information during transfer from STM to LTM can be compared to writing your name in wet concrete. Once the concrete has ‘set’ (the information consolidated in LTM), your name (the information) is relatively permanently ingrained. But while it is setting (the process of consolidation), it can be interfered with (altered) or erased (completely lost).

It is believed that the hippocampus and medial temporal lobe area in each hemisphere play an important role in consolidation. For example, their surgical removal to treat Henry Molaison’s epilepsy may explain why he was incapable of forming new long-term episodic or semantic memories—the process of consolidation was unable to occur due to the lack of structures that coordinate the ‘strengthening’ of the neurons and neural connections involved in the new memories (Schacter, Gilbert & Wegner, 2009; Gluck, Mercado & Myers, 2008).

Evidence in support of consolidation comes from studies of people who have experienced brain trauma resulting in memory loss; for example, after being knocked unconscious as a result of an accident, after acquiring certain diseases affecting the brain (such as encephalitis) or after receiving electroconvulsive shock therapy (ECT) as part of the treatment used in severe cases of depression (Squire & Handel, 1999) (see box 14.5 in chapter 14). These people are frequently unable to report any memory of the events immediately before the accident or treatment, and in many instances they cannot remember anything that occurred during a period of about 30 minutes before the brain trauma.

Other evidence for consolidation theory has come from research using animals. In one well-known study, researchers were interested in learning whether rats that were given ECT at various intervals after learning to run a maze would be able to remember the task they had learned (Hudspeth, McCaugh & Thompson, 1964). Hudspeth and his colleagues administered ECT to the rats in group A immediately after they had learnt the task, to group B 20 seconds after learning, to group C 30 minutes later and to group D 60 minutes after learning. The results showed that consolidation of information occurred *within* about 60 minutes of the rats learning the task. None of the rats in group A remembered the task they had learned. Those in groups B and C showed partial retention (but group C’s retention was on average greater than group B’s), and all the rats in group D remembered the task completely.

It has been proposed that after a memory is activated and retrieved from LTM, it needs to be consolidated again in order to be stored back in LTM. This is process is known as *reconsolidation*. According to American psychologists Michael Gazzaniga and Todd Heatherton (2006), evidence for reconsolidation has been obtained in studies with rats that were injected with drugs which interfered with memory storage after a memory had been activated. The rats were unable to reliably or accurately recall the information that was once stored in LTM. This suggests that memories for past events can be affected by new circumstances once they are retrieved, so that the newly reconsolidated memories may differ from their original versions. For example, this would be similar to what would happen if you took a book out of the library and some pages were torn out of the book before it is returned. The book that is placed back on the shelf is slightly different to the one that was taken out—the information contained in those torn-out pages is no longer available for retrieval. The reconsolidation process repeats itself each time memory is activated and placed back in storage, which may explain why our memories for events can change over time. Reconsolidation theory has received considerable attention, because it not only has implications for what it means to remember something but also opens up the possibility that bad memories could be erased by activating them and then interfering with reconsolidation.

Box 6.10

Brain trauma and memory loss

In some cases of serious car crashes and other events causing severe head trauma, the jarring of the brain can cause a loss of memory for events before *and* after the impact. Sometimes whole days or months cannot be remembered, particularly if the person is unconscious for a period of time. Eventually, any permanent memory loss is usually confined only to the contents of STM during the time of the trauma since the information was never stored in LTM. This type of memory loss was evident in the case of a flight attendant who survived a fall from a Yugoslavian aeroplane that blew up in the sky after a terrorist bomb exploded. The flight attendant suffered brain damage and spinal injuries and was paralysed from the waist down after falling more than 4000 metres. After regaining consciousness, she remembered boarding the aeroplane and waking up in the hospital, but could not remember any of the events in between (Loftus, 1980).

Activities such as boxing can also create brain trauma. Punches and other blows to the head can damage neurons and blood vessels in the fragile brain tissue, causing the 'punch-drunk' symptoms often seen in boxers. One study that examined the brain tissues of 15 boxers at autopsy found brain damage of the type that could interfere with memory processes in all of them (Corsellis, Bruton & Freeman-Brown, 1973).

Figure 6.45 The boxer who received this blow may have sustained damage to fragile brain tissue that could interfere with memory processes. Years of this type of punishment can also lead to brain damage that results in 'punch-drunk' behaviour.

Scientists watch as bird's brain changes

Scientists have seen brain cells in an adolescent finch change as it listened for the first time to the warble of an adult bird.

Previous studies have pointed to a link between structural changes in the brain and sensory input.

But whether these changes lead to learning remained uncertain.

To find out, scientists at Duke University in North Carolina peered directly into the brain of an anaesthetised immature bird with a laser-powered microscope.

As it heard the song of a mature male from the same species, they witnessed a dramatic transformation in connective tissue, called dendritic spines, that link nerve cells in the brain.

The experiment has been lauded with unlocking insights into the learning process and proving that just a single experience could rapidly shape a juvenile brain and alter the way it functioned.

Whether in birds or humans, acquiring the ability to perform certain acts is critically important for survival.

'Many skills, including communication skills, require great precision if you want to stay in the gene pool,' Duke professor Richard Mooney said.

'A male songbird has to learn to sing precisely or he won't attract a mate.'

However, the change they witnessed was not the one they had anticipated.

'We expected to see the building of new spines and the loss of old spines accelerate,' Prof Mooney said.

He said it was because it could take weeks or months for a juvenile to master the adult song.

As a result, the scientists assumed that the brain would remain highly malleable, or 'plastic', during that period.

Instead they saw exactly the opposite: hearing a tutor song rapidly stabilised previously dynamic synapses, according to the study, published in the journal *Nature*.

The findings also suggested that the window of opportunity for picking up the all-important mating song slammed shut after a certain age.

'Juveniles in which spines were already highly stable weren't able to learn from their tutors,' lead author Todd Roberts said.

The work could help efforts to restore plasticity to cerebral nerves, called synapses, after a stroke or other brain damage.

Source: Scientists watch as bird's brain changes. AFP, (*HeraldSun*, 2010, 18 February).

Learning Activity 6.29

Review questions

1 What roles are the hippocampus and temporal lobe believed to have in memory? Explain with reference to different types of memory or memory systems and research evidence.

2 Briefly describe consolidation theory.

3 Briefly explain why the hippocampus is believed to be involved in consolidation.

4 Use consolidation theory to explain why a rugby player who is knocked unconscious during a game may be unable to remember how he was knocked unconscious.

5 Construct a relevant operational hypothesis for the experiment conducted by Hudspeth, McCaugh & Thompson (1965).

6 a Briefly describe reconsolidation theory.

b Explain how reconsolidation may account for retrieval of distorted memories.

c Reconsolidation theory suggests that a drug could be developed to erase unwanted or inappropriate memories. Suggest how a drug might be used for memory erasure with reference to reconsolidation theory.

d Give an example of an ethical issue that may be relevant to intentional memory erasure.

Learning Activity 6.30

Media response

Read the article 'Scientists watch as a bird's brain changes' above and answer the following questions.

1 Briefly describe the study reported in the article.

2 Comment on the possibility of learning and memory occurring when anaesthetised.

3 Assuming learning and memory took place, what research evidence supports the observation of neuronal changes during learning and memory? Explain with reference to the evidence.

4 Is it possible that the scientists observed memory consolidation taking place? Explain with reference to consolidation theory and neurological structures and processes believed to be involved in memory formation.

Amnesia resulting from brain trauma and neurodegenerative diseases

Many causes of memory failure or loss have a neurological basis, which results from some sort of damage or injury to the brain, usually in a specific structure or area of the brain associated with memory. The term **brain trauma** is an 'umbrella' term that is used to refer to any brain damage that impairs, or interferes with, the normal functioning of the brain, either temporarily or permanently. The damage may be due to an *inflicted brain injury* caused by an intentional blow to the head or by violent shaking of the head sufficient to rupture veins or cause some other kind of injury. Alternatively, the damage may be due to an *acquired brain injury* at some time after birth caused by an accident, a stroke, brain infection, long-term alcoholism, drug abuse, brain surgery, or by a neurodegenerative disease of the brain such as Alzheimer's disease (Brain Injury Australia, 2010).

A **neurodegenerative disease** is a disease characterised by a progressive decline in the structure, activity and function of brain tissue. Essentially, neurons within the brain tissue ('neuro') gradually become damaged or deteriorate ('degenerate') and lose their function, hence the term 'neurodegenerative'. With neurodegenerative diseases, the gradual deterioration is typically age-related. For example, *Alzheimer's disease* is an age-related neurodegenerative disease linked to damaged neurons, resulting in memory failure and loss as well as a range of other problems. It is age-related because it is more common in older people and the problems usually worsen with age, particularly memory failure and memory loss.

Memory loss due to any reason is called amnesia. The term **amnesia** is used to refer to loss of memory, either partial or complete, temporary or permanent. Brain trauma caused by either an inflicted or acquired head injury commonly results in some kind of amnesia. The severity of the injury determines the specific characteristics of the amnesia. However, there is typically a temporary loss of consciousness followed by a period of confusion. The period forgotten generally shrinks over time, often leaving some 'residual' amnesia of only a few seconds to a minute for events immediately preceding the injury. The duration of the post-traumatic amnesia varies. For example, in one study of patients with severe head injuries, it was found that 10% of patients had durations of less than one week, 30% had durations of two to three weeks, and the remaining 60% had durations of more than three weeks (Whitty & Zangwill, 1966). Sometimes certain events, such as the visit of a relative or some unusual occurrence, are retained as 'islands of memory' during this amnesic period. Amnesia caused by a head injury commonly ends quite abruptly, often after a period of natural sleep (Kolb & Whishaw, 1996).

There are many different kinds of amnesia, each of which has a different pattern of symptoms. For example, case studies have been reported of people who become amnesic for the meaning of nouns, but not verbs, and vice versa. There are other case studies of people who become amnesic for animals, but not people, or who become amnesic for human faces but not for other objects. Sometimes only short-term or working memory is affected, while in other cases people have difficulty learning new information, have difficulty accessing information from LTM, or have no sense of the present. Two particular types of amnesia, each of which is associated with different kinds of memory loss, are called *anterograde amnesia* and *retrograde amnesia*. We examine each kind of amnesia with reference to brain trauma and neurodegenerative diseases.

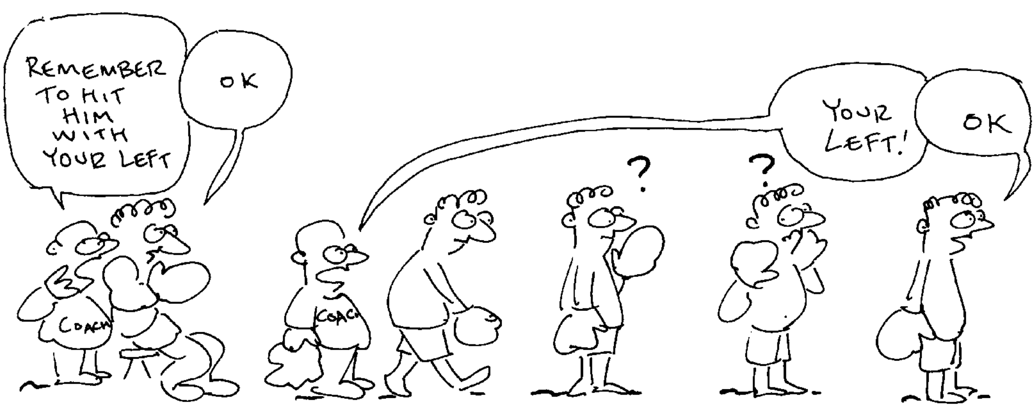


Figure 6.46

Anterograde amnesia

If brain damage causes loss of memory only for information or events experienced *after* the person sustains brain damage, it is called **anterograde amnesia** (*antero* means forward: in this case, forward in time). In general, the memory of information or events experienced prior to the damage still remains. People with anterograde amnesia can talk about the things that happened before the onset of their amnesia, but they cannot remember what has happened since; for example, they have difficulty learning new information such as the names of people they subsequently meet, regardless of how frequently they see them.

Anterograde amnesia is one of the symptoms experienced by people with Alzheimer's disease or Korsakoff's syndrome. **Korsakoff's syndrome** is a neurodegenerative disease involving severe memory disorders associated with damage to brain structures and areas involved with memory, such as the hippocampus and thalamus (both of which are in the medial temporal lobe area). Korsakoff's syndrome occurs mainly in chronic, or long-term, alcoholics and is linked to the prolonged loss of thiamine (vitamin B) from their diets. Alcoholics who obtain most of their calories from alcohol and neglect their diet most often have this thiamine deficiency. Although Korsakoff's syndrome is considered to be a neurodegenerative disease, the symptoms may appear suddenly within the space of days.

Someone with Korsakoff's syndrome typically appears quite normal. They have relatively normal IQs, are alert and attentive, appear motivated, can make witty remarks and play chess or a game of cards. However, many people with the disease have anterograde amnesia and therefore have difficulty with or an inability to form new memories. Nor do they tend to be aware that they have memory problems. They often don't remember new information for more than a few minutes; for example, they can read a magazine and, after a few minutes, read the magazine as if it were new. Sometimes someone with Korsakoff's syndrome may forget what they've done an instant before. For example, they may read the same page of a magazine over an over again, sometimes for hours, because they are absolutely unable to remember what they have read. Or, you might meet the person, have a conversation, go into another room for a moment and on returning observe that they will have absolutely no recollection that you had already met and spoken with them (Kolb & Whishaw, 1996).

People with Korsakoff's syndrome may also have extensive loss of past memories (retrograde amnesia), particularly of their adult life. However, they can usually remember quite accurately the past events they experienced long before the serious onset of their disease, such as events that occurred during their childhood and adolescent years. It is often difficult for researchers and therapists to determine what someone with Korsakoff's syndrome can and cannot truly remember. This is because it is quite common for someone with Korsakoff's syndrome to *confabulate*; that is, to fill in a gap in memory by falsifying ('making up') stories about past events that they seem to accept as true, rather than admit memory loss.

Not all alcoholics develop Korsakoff's syndrome. Treating a person with Korsakoff's syndrome with a thiamine supplement can prevent further deterioration of memory functions, but it will not reverse the damage (Breedlove, Rosenzweig & Watson, 2007).

Retrograde amnesia

If brain damage affects memory for information or events experienced *before* the person sustains the damage, it is called **retrograde amnesia** (*retro* means backwards: in this case, backwards in time). The memory loss may extend back a few moments, days, weeks or sometimes years. Retrograde amnesias are usually of a temporary nature and are often caused by a blow to the head, such as one received in a car accident, a boxing match or a sporting accident. Retrograde amnesia is also experienced by people with severe depression who have been treated by *electroconvulsive therapy (ECT)* (Andreason & Black, 1996).

One case of retrograde amnesia was reported by English neurologist Ritchie Russell (cited in Baddeley, 1997). The case involved a 22-year-old greenkeeper who was thrown from his motorcycle in August 1933. There was a bruise in the left

Figure 6.47 Bodyguard to Diana, Princess of Wales, Trevor Rees-Jones (in the brown jacket) was the sole survivor of a car accident in which Diana was killed. It was hoped that he would be able to explain what happened but the head injuries he received left him with retrograde amnesia. His eyewitness testimony would be vital to solving the mystery surrounding the accident, but Rees-Jones has been unable to recall any details.

frontal lobe area and slight bleeding from the left ear, but no fracture was seen on X-ray examination. A week after the accident he was able to converse sensibly, and the nursing staff considered that he had fully recovered consciousness. When questioned, however, he said that the date was February 1922 and that he was a schoolboy. He had no recollection of five years spent in Australia, two of which were spent working on a golf course. Two weeks after the injury he remembered the five years spent in Australia, and remembered returning to England, but the previous two years were a complete blank. Three weeks after the injury he returned to the village where he had been working for two years. Everything looked strange, and he had no recollection of ever having been there before. He lost his way on more than one occasion. Still feeling a stranger to the district, he returned to work. He was able to do his work satisfactorily, but he had difficulty in remembering what he had actually done during the day. About ten weeks after the accident the events of the past two years gradually returned and finally he was able to remember everything up to within a few minutes of the accident.

Typically, people who experience retrograde amnesia find that their inability to remember information and events leading up to the brain trauma gradually disappears. The period of time for which the memory is lost shrinks as the person gradually recovers their memory. However, people who have experienced retrograde amnesia typically find that their memory for the period immediately before the accident is never recovered.

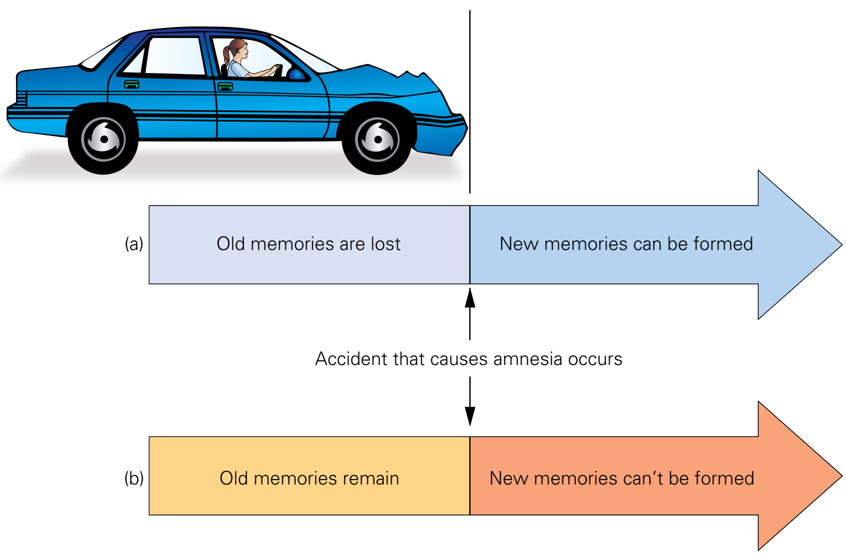


Figure 6.48 (a) In retrograde amnesia, the person loses some or all memories formed before the brain damage occurred; (b) in anterograde amnesia, the person cannot form new memories for events that occur after the brain damage.

Box 6.11

What is it like to be amnesic?

Some idea of the experience of being moderately memory-impaired is given by clinical psychologist Malcolm Meltzer, who suffered brain damage as a result of *anoxia*, or lack of oxygen to the brain, following a heart attack. Fortunately he recovered sufficiently to return to work and write about his experience.

Meltzer suffered a heart attack at the age of 44 and emerged from a six-week coma with memory problems. He recognised his family, but not all of his friends. He knew who he was, and what his job was. Initially he thought that he had two children, although he had only one, and he believed that his age was 33 years. When returning home from hospital, the route seemed unfamiliar, but his house was familiar. Once inside his home, he could not remember where things were kept, and had to relearn skills such as how to use the stereo, change a razorblade and set the alarm clock. He seemed to have lost access to the 'scripts' for everyday activities. Meltzer reports,

> *The feeling engendered by this inability to do things done in the past was that of incompetency. When should bills be paid? What is used to fix a broken chair? When should oil be changed in the car? … Which are good places to go for a vacation? How do you get there? Where do you stay? What have you enjoyed and not enjoyed in previous vacations?*

Melzer also suffered from more general cognitive processing problems.

> *Organisation of thinking was hampered … I had trouble keeping the facts in mind, which made it difficult to organise them … Comparing things along a number of variables is difficult to do when you cannot retain the variables or retain the comparison after you have made it.*

Spatial memory was also disturbed.

> *Even inside a building, getting lost was commonplace, and sometimes it took days for me to figure out and remember how to get out of the building. In taking walks, even in the familiar neighbourhood I could get lost.*

Such problems clearly interfered with his life. Interpersonal relationships were also affected by his memory impairment.

> *Having conversations could become a trial. Often in talking with people I was acquainted with, I had trouble remembering their names or whether they were married or what our relationship had been in the past. I worried about asking where someone's wife was and finding out that I had been at her funeral two years ago … Often if I didn't have a chance to say immediately what came to mind, it would be forgotten and the conversation would move to another topic. Then there was little for me to talk about. I couldn't remember much about current events or things I read in the paper or saw on TV. Even juicy titbits of gossip might be forgotten. So in order to have something to say, I tended to talk about myself and my 'condition'. My conversation became rather boring.*

Even recreation became difficult.

> *Movies and TV-watching became work. If it is a story, the trouble is remembering the beginning of the story or who the characters are … In terms of sports on TV there is trouble remembering which team is which, which team is ahead, which players did the scoring, and how it all relates to their past performance.*

Despite these difficulties, Meltzer persevered and with help was able to improve sufficiently to return to work and produce at least one journal article, which provides valuable insight into the problems of coping with even relatively mild amnesia.

Source: Baddeley, A.D. (1999). *Essentials of human memory.* East Sussex, UK: Psychology Press.

Learning Activity 6.31

Review questions

1. What is amnesia?
2. Explain the meaning of the phrase 'amnesia resulting from brain trauma and neurodegenerative disease'.
3. Why are Alzheimer's disease and Korsakoff's syndrome considered to be neurodegenerative diseases?
4. Distinguish between amnesia that may result from an inflicted brain injury or an acquired brain injury.
5. Distinguish between anterograde amnesia and retrograde amnesia, with reference to an example.
6. Voula was involved in a car accident as a passenger. She was not wearing a seatbelt and hit her head on the front windscreen when the two cars collided. She was unconscious for a short period of time. Brain scans showed there was no permanent brain damage; however, Voula experienced memory problems for some time after the accident.
   a. If Voula experienced anterograde amnesia, what memory problems is she likely to experience?
   b. If Voula experienced retrograde amnesia, what memory problems is she likely to experience?

Learning Activity 6.32

Media response

Watch one of the movies *Memento* or *The Bourne Identity* and write a 200–250-word critical commentary on how accurately the specific type of amnesia is portrayed. Include a psychological description and explanation of the amnesia and refer to the likely accuracy of amnesic symptoms depicted in the movie.

Figure 6.49 The 2001 movie *Memento* with Guy Pearce in the lead role portrays anterograde amnesia.

Figure 6.50 The 2002 movie *The Bourne Identity* with Matt Damon in the lead role portrays retrograde amnesia.

Dementia and Alzheimer's disease

Dementia is an umbrella term used to describe a variety of symptoms of a large group of illnesses or neurodegenerative diseases that cause a progressive decline in a person's mental functioning. The most common symptom is serious loss of mental capacity, including memory loss, a decline in intellectual ability, poor judgment, poor social skills and abnormal emotional reactions. It is often described as progressing in stages, with memory loss typically being one of the first signs of its onset. Memory loss is persistent and progressive as the dementia progresses, not just occasional. It may affect the ability to continue to work or carry out familiar tasks. It may mean having difficulty finding the way home. Eventually it may mean forgetting how to dress or how to bathe. In the final stage, people with dementia may completely shut out the outside world. For example, they might sit in a chair or lie in a bed staring straight into thin air, or they might have their eyes closed. Similarly, they might not respond when someone walks into the room or talks to them.

Dementia usually develops over a number of years, gradually worsening. It is not a normal part of the ageing process. Most people who age do not develop dementia. More than 60 known diseases or illnesses, many of which are neurodegenerative, can cause dementia symptoms. When caused by neurodegenerative factors, the symptoms are usually irreversible. Some of these are summarised in box 6.12. The most common form of dementia is Alzheimer's disease, accounting for about 50% to 70% of all dementia cases (Dementia Care Australia, 2010; Alzheimer's Australia, 2010).

Box 6.12

Types of dementia

There are many different type of dementia, each with different causes and overlapping symptoms. The most common types are described below.

Type of dementia	Description
Alzheimer's disease	The most common form of dementia, it involves progressive degeneration of the brain's neurons, resulting in loss of memory, impaired decision-making, confusion and personality changes.
Vascular dementia	A broad term for dementia associated with problems of circulation of blood to the brain. It is the second-most common form of dementia.
Dementia with Lewy bodies	Abnormal structures called Lewy bodies develop inside neurons in the brain. This is caused by the degeneration and death of neurons in the brain. The name comes from the presence of abnormal spherical structures called Lewy bodies inside the cells—it is thought these may contribute to the death of brain cells. People with this type of dementia tend to have visual hallucinations or experience stiffness or shakiness, and their condition tends to fluctuate quite rapidly, often from hour to hour or day to day. These symptoms make it different from Alzheimer's disease.
Frontotemporal lobar degeneration (FTLD)	A group of dementias whereby there is degeneration in one or both of the frontal or temporal lobes of the brain.
Parkinson's disease	A degenerative disease of the central nervous system, characterised by tremors, stiffness in limbs and joints, and speech impediments. Some people with Parkinson's disease may develop dementia in the late stages of the disease.
Korsakoff's syndrome (alcohol-related dementia)	A dementia caused by too much alcohol, especially combined with a poor diet low in Vitamin B (thiamine).
Huntington's disease	An inherited, degenerative brain disease that affects the mind and body. It usually appears between the ages of 30 and 50, and is characterised by intellectual decline and irregular involuntary movements. Other symptoms include memory disturbance, personality change, slurred speech and impaired judgment. Dementia occurs in the majority of cases.

Source: Dementia Care Australia (2010). *What is dementia?* www.dementiacareaustralia.com/.

Alzheimer's disease is a neurodegenerative disease characterised by the gradual widespread degeneration of brain neurons, causing memory loss, a decline in cognitive and social skills, and personality changes. Currently Alzheimer's disease is the fourth largest cause of death in Australia.

Postmortems of people with Alzheimer's disease show that the brain has the appearance of having 'rusted'. Deposits of 'plaque' bound together in 'blobs' and tangles of brain fibres are visible, along with damaged connections between neurons. These seem to build up over time as neurons shrink and eventually disappear ('die') at a greater rate then normal. The large number of neurons affected in this way disrupts communication within the brain. As Alzheimer's disease progressively affects different areas of the brain, certain functions or abilities are lost.

It is estimated that about 100 000 Australians suffer from Alzheimer's disease. The disease affects one in 25 people over 60, one in eight people over 65, and one in four people over 80. It also affects some people in their mid 50s. It is estimated that the number of people with Alzheimer's disease will increase by 40% in the next decade (Mental Health Research Institute, 2010).

There is currently no single or simple diagnostic test for Alzheimer's disease. An accurate diagnosis can only be made after death when an autopsy involving microscopic examination of brain tissue is conducted. Because physical signs are not readily detectable in the living patient, a person's memory, general knowledge, intellectual and personal skills are assessed to determine the rate of mental deterioration.

However, there is no one symptom that is reliable, making diagnosis even more difficult (MHRI, 2010; Baddeley, 1999).

People with Alzheimer's disease become gradually worse. The specific symptoms experienced will differ for each person. However, memory loss, confusion, unusual irritability and impaired decision-making are early symptoms of the disease, and continue to feature prominently as the disease progresses. Early memory problems often involve typical incidents of forgetfulness experienced by most people from time to time, such as forgetting where something was left or having difficulty finding the right word when talking. With

Figure 6.51 Because people with Alzheimer's disease suffer severe memory impairment, they may benefit from a 'prosthetic environment'. Strategically placed labels enable this person to locate his personal belongings.

Alzheimer's disease and most other dementias, however, memory loss is persistent and progressive, not just occasional. Memory loss typically involves:

- *Events*—the person may forget part or all of an event.
- *Words or names*—the person progressively forgets words and names of people and things.
- *Written and verbal directions*—the person progressively loses the ability to follow directions.
- *Stories on TV, in movies or books*—the person progressively loses the ability to follow stories.
- *Stored knowledge*—over time, the person loses known information such as historical or political information.
- *Everyday skills*—the person may progressively lose the capacity to perform tasks such as dressing and cooking.

Severe personality changes are also associated with Alzheimer's disease. For example, someone who was formerly quiet and polite may become obnoxious, swearing a lot and continually making insulting sexual comments to friends and strangers alike. Alternatively, someone who was caring and outgoing may become apathetic and socially withdrawn.

In the latter stages of Alzheimer's disease, lapses in memory and judgment make it increasingly difficult for the person to perform everyday activities such as cooking, eating, cleaning, using the toilet and taking medication. Eventually patients reach the stage where they are unable to care for themselves and they are likely to need the help of carers or even full-time nursing.

As well as experiencing a general decline in cognitive abilities, a patient in the later stages of the disease may be unable to recognise their own family members or regular carers, or may even forget their own identity (Baddeley, 1999). Both the loss of past memories, and difficulties in retaining newly learned information because of problems with STM or working memory, distinguish Alzheimer's disease from other amnesia disorders.

Postmortem pathology reports indicate the presence of abnormally high levels of the protein amyloid in the brains of people with Alzheimer's disease. Amyloid is not normally found in the brain. It is neurotoxic—it poisons brain cells, interfering with normal brain function and ultimately causing the brain cells to die. The protein is insoluble and cannot be metabolised by the brain. Its abundance also has the effect of causing the development of abnormal structures commonly called *plaques* and *tangles*. The plaques are dense deposits of the protein and other cell materials outside and around the neurons. The tangles are twisted fibres that build up outside the neuron. The area of the brain that appears most affected is the hippocampus and related areas of the midbrain. Autopsies have revealed that up to three-quarters of the neurons in these areas may be lost in Alzheimer's patients, and the remaining neurons are often damaged. Furthermore, the brains of people with Alzheimer's disease have greatly reduced levels of the neurotransmitter called *acetylcholine*. There are two large clusters of neurons in the brain that use acetylcholine to facilitate the transmission of neural messages to other neurons. These occur in areas associated with intellectual functioning, particularly memory and learning.

Currently there is no cure for Alzheimer's disease. However, the use of medications that increase the supply of acetylcholine in the brain in the early or middle stages of Alzheimer's disease can slow the rate of development of the symptoms.

Neuroimaging techniques such as PET and MRI are frequently used to identify the extent of brain damage resulting from Alzheimer's disease. The computer-generated images produced by PET and MRI make it possible to identify the parts of the brain that have deteriorated. The images in figure 6.52 show the marked deterioration in brain areas associated with Alzheimer's disease.

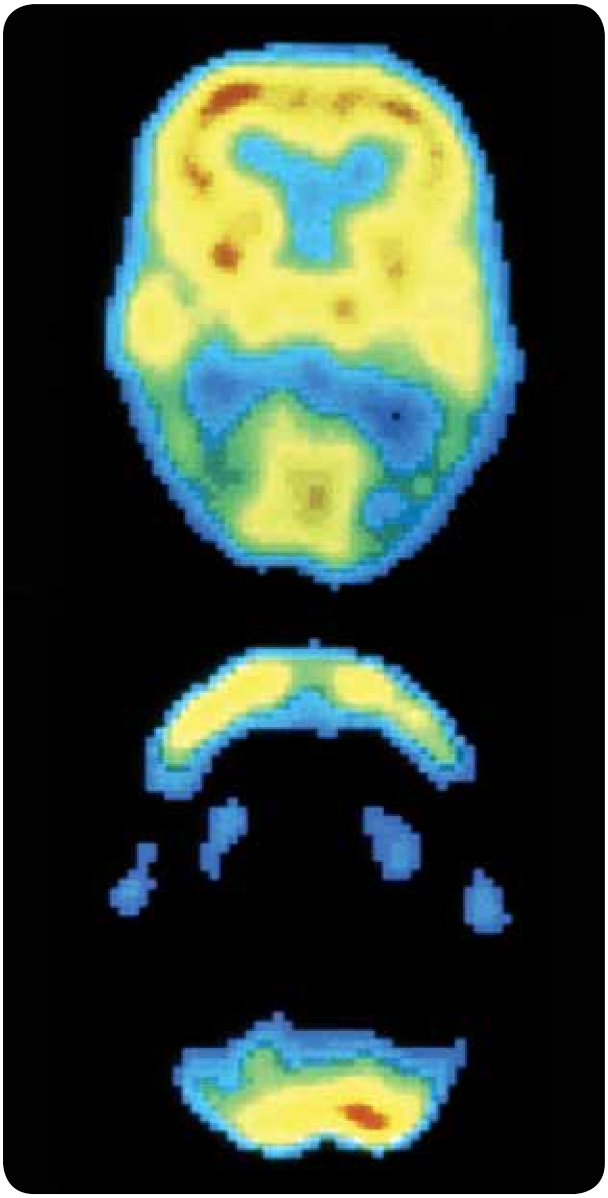


Figure 6.52 (a) A PET scan of a normal brain (at top). High levels of brain activity are indicated by the red and yellow areas. (b) A PET scan of a brain with Alzheimer's disease (at bottom). Note the reduced areas of activity compared to the scan of the normal brain. The lack of activity is most significant in the temporal and parietal lobes, which indicates their involvement in memory.

Learning Activity 6.33

Review questions

1 Explain what dementia is with reference to an example of a dementia other than Alzheimer's disease.

2 a What is Alzheimer's disease?
  b What are some of the common symptoms of Alzheimer's disease?
  c Why is Alzheimer's disease irreversible?
  d Why is Alzheimer's disease attributable to neurological factors?
  e Why does Alzheimer's disease ultimately lead to an earlier death?

3 Consider the list on page 349 outlining memory loss typically experienced by someone with a dementia such as Alzheimer's disease. For each item in the list, identify
  a the type of LTM
  b the type of amnesia.

Memory decline over the lifespan

Many people believe that decline, or deterioration, of memory (and other mental abilities) occurs alongside the gradual decline in physical abilities that takes place as people get older; that is, that memory decline is a natural part of ageing in the same way as is physical decline. A limited understanding of the changes in the brain as part of the normal ageing process and in age-related diseases such as Alzheimer's disease reinforces this belief about memory decline. But does growing 'old' necessarily mean a decline in memory?

Generally, results of research studies indicate that there may be some naturally occurring decline in some aspects of memory among older people; however, memory decline is not an inevitable consequence of ageing. For some older adults, their memory is as sharp as that of a 20-year-old. Others, however, experience memory impairments in one or more memory systems. If a decline in memory is experienced through ageing, effects are more likely to be experienced in short-term (working) memory and explicit declarative memories (episodic and semantic) than in procedural memory.

Effects of ageing on short-term (working) memory

The impact of age on STM seems to depend on the nature of the task. In general, if the task is relatively simple, such as remembering a list of words, STM is not affected by age. However, if the task is more complicated, requiring simultaneous storage and manipulation of information in working memory, or when attention must be divided between tasks, then age-related factors may impact on effective STM functioning (Whitbourne, 2001). For example, in one research study, older and younger participants were given a short list of unrelated words and asked to report them in alphabetical order. This task involved both storage and manipulation of information. The mean recall for the younger participants was 3.2 correct words. For the older participants, the mean recall was 1.7 correct words (Craik, 1990).

These findings may have implications for the safety of elderly drivers. For example, keeping track of all the cars at a four-way intersection, deciding who has right of way and when they should enter the intersection is a complex working memory task. Retaining all the relevant information about each car's location, recalling information from LTM to working memory about relevant road rules and right of way, and making a decision about when to enter the intersection requires both storage and manipulation of information simultaneously. This

Figure 6.53 Age is a factor that may impact on effective STM functioning, especially if the task is complex. Driving involves simultaneously storing and manipulating information in working memory, which may explain why some elderly drivers are hesitant when they drive.

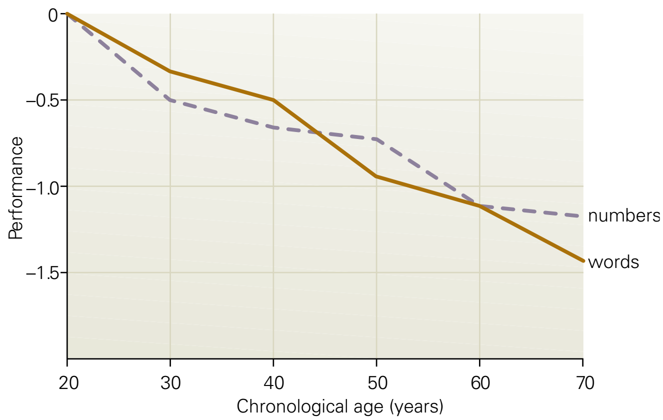


Figure 6.54 The effect of age on short-term (working) memory. The zero score on the *y*-axis represents the mean level of performance of younger research participants on both arithmetic and word tasks. As we age, our ability to process information is less efficient.

may explain why some elderly drivers are hesitant with their driving.

Neuroimaging studies have shown that beyond 60 years of age, there is a decrease in the activation of areas of the frontal lobes of the brain believed to be involved in short-term (working) memory. In addition, the nervous systems of older people are less efficient at receiving and transmitting information, and therefore the rate or speed at which information is processed in short-term (working) memory is slower (Rypma & D'Esposito, 2000). In particular, as shown in figure 6.54, the ability of older people to process both numbers and words in short-term (working) memory seems to be less efficient (Salthouse, 1992).

Effects of ageing on long-term memory

Psychologist K. Warner Schaie (1996) argues that researchers should not conclude anything about age-related LTM decline without clarifying the specific type of memory being discussed. Research findings indicate that some LTM types are more likely to be affected by age than others. For example, most studies of episodic memory have found a steady decline for memories of personal experiences as people age. Episodic memory can start to decline as early as age 30 or as late as age 50.

Swedish psychologist Lars-Goran Nilsson and his colleagues (1996) reported results from a longitudinal (long-term) study they conducted on age and memory, starting in 1988. This type of research involves studying an age-stratified sample of participants for an extended period of time and testing them periodically. Nilsson and his colleagues measured three types of LTM in 1000 randomly selected Swedes, ranging in age from 35 to 80, with 100 participants aged 35, 100 aged 40, 100 aged 45 and so on up to age 80. Their results showed the hypothesised age differences in episodic memories; that is, older participants performed worse than younger participants on 26 different measures of episodic memory. There was, however, hardly any decline in the retrieval of information from procedural memory. Procedural memories seemed to remain intact over time. Furthermore, semantic memory appeared to be fairly resistant to ageing as well. The semantic memory tests used by Nilsson tapped general knowledge that most people would know regardless of their education.

Although many semantic and procedural memories are not easily lost, older people take longer to learn new information and skills—including information that would be stored as semantic and procedural memories respectively. It seems that older people do not encode new information with as much detail or as precisely as young people. Furthermore, the speed and fluency of retrieval of information from semantic memory particularly can decline with age (Baddeley, 1999). However, provided the information is well-learned and/or practised often, its maintenance in and retrieval from LTM is not necessarily affected as a result of age alone.

Psychologists have proposed several explanations for the memory changes that tend to occur as people age. One explanation is a lack of motivation. Older adults who have 'seen the world', established careers and raised families may have little or no interest in memorising apparently meaningless material such as nonsense syllables, word lists and number series typically used in a psychology experiment (Perlmutter, 1978). There is, however, less age-related decline in memory for tasks in which a person is motivated to remember to do something that is planned; for example, to take a cake out of the oven when it has baked, to take medication at the appropriate time or to attend a family celebration.

A second explanation is that as people get older they tend to lose confidence in their memory. When American psychologist Jane Berry and her colleagues (1989) gave research participants a test that measured their beliefs about their own memory skills, they found that 60- to 80-year-old adults were less confident than 18- to 30-year-olds (see figure 6.55). Memory of certain information may in fact decline at least slightly with age, but a lack of self-confidence can worsen the problem. The person who fears that they will not remember directions, an appointment or an old friend may not even try (Kassin, 1996).

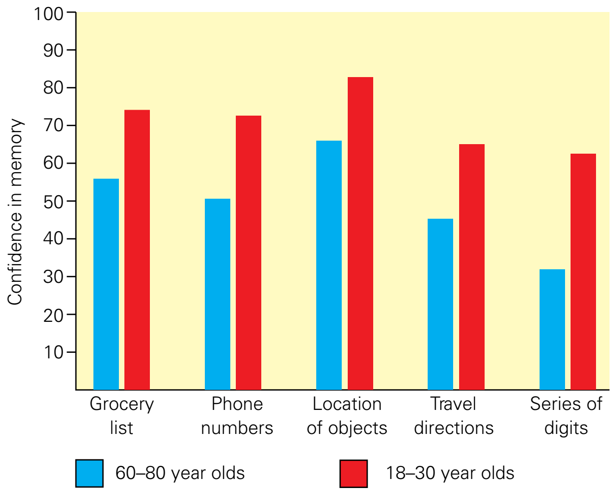


Figure 6.55 Participants were asked to rate how confident they were on a scale of 0–100 in their ability to perform various memory tasks. Older participants were consistently less confident than the younger participants.

A third explanation is that the inability of some older people to access information from LTM may be more to do with the kind of measure of retention used than with their age. For example, when research participants are asked to recall previously learned information, older participants perform significantly worse than younger participants. But when recognition is used to measure retention of previously learned information, the difference in performance between older and younger participants is significantly less. Recall seems to be much more affected than recognition where the presence of retrieval cues means much less effort is required to access the relevant information (Light, 1996).

In one study, American psychologist Harry Bahrick and his colleagues (1975) tested 392 adults ranging in age from 17 to 74 years to find out if they could remember the names and faces of their secondary school classmates. Some research participants had just finished secondary school, whereas others had finished up to 47 years earlier. The researchers found that participants became less able to *recall* names as they got older—even with the benefit of class photos as cues. But their ability to *recognise* names and photos or to match names and photos differed little in relation to age (see figure 6.56).

Probably the most widely researched hypothesis and the explanation that accounts for most of the memory decline associated with age is the slowing of central nervous system functioning. As people age, their central nervous system functioning slows, and people are usually unable to mentally

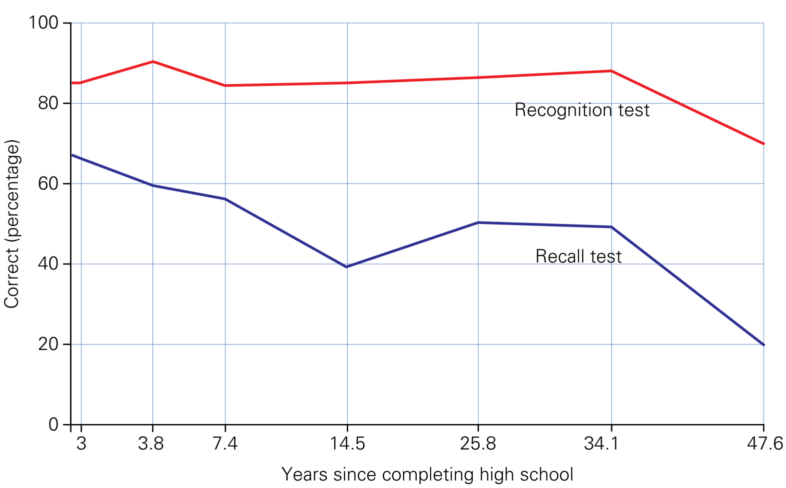


Figure 6.56 A test of recognition showed little decline over time in participants' ability to identify high-school classmates, even though they had left school 47 years before. A test of recall, however, showed a significant decline in their ability to remember the same names and faces.

process information with the speed and efficiency that they once did. This slowing down of neural processes, called *cognitive slowing*, can impair performance in tasks involving memory as people age (Bashore, Ridderinkhof & van der Molen, 1997).

One explanation for cognitive slowing, especially in relation to memory processes, involves the frontal lobes. A normal part of the ageing process is a reduction in the size of the frontal lobes. This shrinking is thought to be responsible for the many cognitive changes that tend to be experienced as people age. These include memory decline and difficulties maintaining attention on a task for an extended period of time. Research to test this explanation used neuroimaging to record frontal lobe activity while participants performed three different kinds of memory tasks. The first task involved recognition of previously learned words, the second involved recall of words previously learned and the third involved deciding whether what they had seen on a video was the same as a written description of the event. The results showed a consistent pattern. Older people whose frontal lobes showed reduced activity performed poorly on all three memory tasks compared with younger people. However, older people whose frontal lobes were highly active performed as well as young people on all three tasks (Roediger, 2003). Thus, it seems that the maintenance of cognitive abilities into old age may depend to some extent on the condition and functioning of the frontal lobes of the brain.

Learning Activity 6.34

Review questions

1 Construct a table to summarise memory decline associated with age in STM or working memory and in the different kinds of LTM.

2 Use your table to write a one-paragraph description on age and memory decline.

3 What are four explanations of age-related decline in memory?

Learning Activity 6.35

Essay comparing theoretical explanations of memory

Write an essay of about 500–600 words in which you compare two theories that explain how information is stored in memory and factors that influence storage. For example, you may compare any two of the 'models', 'theories' or 'frameworks' in this chapter. References may be used to obtain information for your essay.

In your essay, ensure that you:

- outline key structural and functional features of memory according to each theory
- discuss similarities and differences between the two theories on how information is stored
- discuss similarities and differences between the two theories on factors influencing storage
- discuss the extent to which each theory refers to neurological factors involved in memory
- accurately define and explain key concepts
- use appropriate examples to demonstrate your understanding of key concepts
- structure the information in a logical way
- express your information in a clear and concise way
- accurately cite and reference all material using appropriate conventions.

Chapter 6 true/false quiz

Indicate whether each item is true or false by writing ‘T’ or ‘F’ in the blank space next to each statement.

1 ______ Memories are stored throughout the brain.

2 ______ Maintenance rehearsal is a more active and effortful process than elaborative rehearsal.

3 ______ Declarative memories are explicit memories.

4 ______ The serial position effect provides evidence for distinctive short-term and long-term storage systems.

5 ______ The Atkinson–Shiffrin (1968) model includes the echoic sensory register.

6 ______ Alzheimer’s disease is neurodegenerative.

7 ______ We are consciously aware of information in LTM.

8 ______ Korsakoff’s syndrome is caused by ageing.

9 ______ Long-term memories are retrieved from the hippocampus.

10 ______ Sensory memory encodes incoming sensory information.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 6 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Memory is best described as
- **A** a unitary system through which information flows back and forth.
- **B** the storage and retrieval of information acquired through learning.
- **C** a multi-store system in which all information is active.
- **D** three independent systems called sensory memory, short-term memory and long-term memory.

Q2 Which type of long-term memory storage is likely to be involved when a person recalls how to play a computer game after not having played it for some time?
- **A** procedural
- **B** episodic
- **C** declarative
- **D** semantic

Q3 Dementia is
- **A** an illness or disease that is a normal part of ageing.
- **B** iconic memory.
- **C** the phonological loop.
- **D** irreversible when neurodegenerative.

Q4 On recovering consciousness, a cyclist who was knocked unconscious in an accident is unable to recall events that occurred in the half hour or so before he was knocked out. How would his amnesia be explained by consolidation theory?
- **A** lack of sufficient time for consolidation of sensory information in short-term memory
- **B** lack of attention during the half hour before the brain trauma
- **C** lack of processing by the hippocampus in the parietal lobe
- **D** lack of time for completion of changes in neurons involved in the formation of long-term memory

Q5 A feature of short-term memory or working memory that distinguishes it from both sensory memory and long-term memory is that
- **A** short-term memory is like a mental 'working area' for processing information in conscious awareness.
- **B** information in both sensory memory and long-term memory can be rehearsed, whereas information in short-term memory cannot be rehearsed.
- **C** short-term memory can store information for only a limited period of time, whereas both sensory memory and long-term memory can potentially store information for an unlimited period of time.
- **D** information in sensory memory and long-term memory has been encoded, whereas information in short-term memory has not been encoded.

Q6 Long-term potentiation is best described as

A the long-lasting strengthening of synaptic connections resulting in enhanced functioning of neurons.
B habituation in *Aplysia*.
C the formation of a long-term memory.
D the potential to form a long-term memory.

Q7 Most theories of long-term memory storage propose that information in long-term memory is stored primarily in a form that is

A an exact sensory replica of the original information.
B echoic and iconic.
C semantical.
D disorganised.

Q8 A neurodegenerative disease is best described as

A a brain trauma.
B an inflicted or acquired brain injury.
C a brain-related disorder associated with people of the older generation.
D a progressive decline in the structure and/or function of neurons in the central nervous system.

Q9 One way of prolonging the duration of information well beyond its normal limit in short-term or working memory is through

A encoding.
B rehearsal.
C recall.
D consolidation.

Q10 Kandel's research on the role of the neuron in memory indicates that

A there is an increase in the amount of synapses produced by neurons, thereby enabling them to flow more freely within a memory circuit.
B when a memory is forming, new neurotransmitters grow and interconnect the neurons to form a pathway for the information.
C neurons change in structure and function when a memory is forming.
D neurons assemble in a formation that creates a neural pathway for the memory.

Q11 Semantic network theory proposes that information in long-term memory is

A organised in different levels depending on the depth of processing.
B organised systematically, but the information is not necessarily related within each part of a network.
C organised in the form of overlapping networks of nodes that are interconnected and interrelated by meaningful links.
D not organised.

Q12 The levels of processing framework focuses on memory as a _____ system.

A multi-store
B inflexible
C single
D shallow or deep

Q13 The process of organising smaller, separate bits of information into groups of related bits of information in order to increase the storage capacity of short-term memory is called

A grouping.
B maintenance rehearsal.
C chunking.
D elaborative rehearsal.

Q14 Information in the middle of a 15-item word list that has just been learnt is least likely to be recalled shortly after because this information is

A still in short-term memory.
B confused with information that precedes it and information that follows it.
C still in long-term memory.
D learned too late to be adequately rehearsed and too early to be held in the STM without rehearsal.

Q15 The process of representing information in a form that can be used by memory is best described as

A rehearsal.
B encoding.
C information-processing.
D automatic processing.

Q16 Which of the following activities is the best example of the use of information retrieved from implicit memory?

A distinguishing between a shark and a dolphin
B telling a friend about how the weekend was spent
C riding a bike
D recalling a word for a crossword puzzle

Q17 The serial position effect used to describe superior recall of items at the end of a list is called the __________ effect.

A recency
B primacy
C serial
D recall

Q18 What is required for information to be transferred from a sensory register to short-term or working memory?

A attention
B encoding
C rehearsal
D organisation

Q19 Which specific type of long-term memory store is likely to be involved when a person recalls their first day as a VCE student?

A procedural
B episodic
C declarative
D semantic

Q20 Which memory system or sub-system stores information for the shortest duration?

A short-term memory
B working memory
C echoic memory
D iconic memory

The answers to the Chapter 6 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Briefly explain how we become consciously aware of information stored in long-term memory.

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____

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1 mark

Question 2

According to Craik and Lockhart’s levels of processing framework, maintenance rehearsal produces __________________________ processing, whereas elaborative rehearsal produces __________________________ processing.

2 marks

Question 3

Distinguish between structural features and control processes in the Atkinson–Shiffrin multi-store model with reference to relevant examples.

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2 marks

Question 4

Consider Baddeley and Hitch's model of working memory.

a Describe two roles of the central executive.

2 marks

b Name the two other components in the model and the component subsequently added by Baddeley (2000).

1 mark

Question 5

Explain the roles of the hippocampus and temporal lobe in memory, with reference to research evidence.

2 marks

The answers to the Chapter 6 short-answer questions are available at www.OneStopScience.com.au.

7 Forgetting

Have you ever forgotten when someone's birthday was, the location of a place you've been to before or the time you were supposed to meet a friend? Have you ever sat for an exam, unable to remember something you know you know? Why is some information unable to be retrieved? Is this information completely lost from memory or is it that we cannot access it at this point in time? What causes us to forget? You know that brain damage is one explanation of why some people forget. However, there are also psychological theories of forgetting which explain forgetting from LTM when there is no brain damage. In this chapter, we focus on these theories.

Forgetting refers to the inability to retrieve previously stored information. When you forget something, it means that it is unavailable to you at the time you are trying to remember it. The information may still be stored in your memory, but for some reason you cannot retrieve it when you want to.

Figure 7.1

Although forgetting results in the loss of information and many skills, if you did not forget, your mind would be cluttered with so much information that you would have great difficulty retrieving and selecting the information you needed. Remembering might take hours instead of seconds! Furthermore, if you think about it, would you really like to be able to remember *everything*? With a perfect memory you could recall not only what you wanted to, but also all the life experiences that are perhaps best forgotten. Like remembering, forgetting has an adaptive purpose and contributes to our survival and our sanity (Squire & Kandel, 1999).

The forgetting curve

Every day of your school life you are exposed to considerable amounts of new information that you are expected to retain. However, the nature of memory storage is such that not all of the information you have been exposed to will necessarily be retained and therefore be available if you are required to retrieve it in an exam.

The first person to scientifically study forgetting was German psychologist Hermann Ebbinghaus in the late 1800s. To measure the *amount* of information retained and the *rate* at which information is forgotten, Ebbinghaus (1985, cited in Baddeley, 1999) learned a series of lists comprising 13 three-letter nonsense syllables, such as *qel* and *nuz*, until he could recite them all without error on two successive occasions. Nonsense syllables were used because they were

Figure 7.2 Hermann Ebbinghaus (1850–1909)

all equally difficult to learn and because they don't have a specific meaning or personal associations like words do. Using this process, Ebbinghaus avoided the potential influence of past experience on the information being learned.

Ebbinghaus tested his recall for each list of nonsense syllables after a specific period of time had elapsed from the initial learning. He first learned one list, then tested his recall after a specific delay period. Then he learned another list and tested his recall after a different delay period, and so on. The delay period ranged from 20 minutes to 31 days. Using this method, Ebbinghaus was able to measure the amount (quantity) and rate (speed) of forgetting.

Ebbinghaus found that 20 minutes after the initial learning, he could recall 58% of the nonsense syllables. After one hour, his retention was 44%. A day later he could recall 34% and a week later his recall had fallen to around 21%. Ebbinghaus plotted his results on a graph. The curve that was generated by these data has become known as the forgetting curve (see figure 7.3).

The **forgetting curve** shows the pattern (*rate* and *amount*) of forgetting that occurs over time. Generally, the graph shows that forgetting is rapid soon after the original learning, then the rate of memory loss gradually declines, followed by stability in the memories that remain. More than half the memory loss occurs within the first hour after learning. Virtually all the material that will be forgotten is lost in the first eight hours (about 65%). In addition, information that is not quickly forgotten seems to be retained in memory over a long period of time.

Since Ebbinghaus' pioneering research, there have been numerous other experiments using many different kinds of information to be learned; for example, learning a new skill similar to flying a plane (Fleishman & Parker, 1962), a new language (Bahrick, 1984), cardio-pulmonary resuscitation (McKenna & Glendon, 1985) and the subject matter of psychology (Conway, Cohen & Stanhope, 1991). The results consistently indicate a characteristic pattern of forgetting demonstrated by the typical forgetting curve shown in figure 7.3; that is, the rate of forgetting is rapid at first, but eventually slows to reach a point where further forgetting is barely noticeable.

However, when the initial learning takes place over more extended periods of time, such as over weeks or months, more information is retained, but the rate at which information is lost remains the same (figure 7.4).

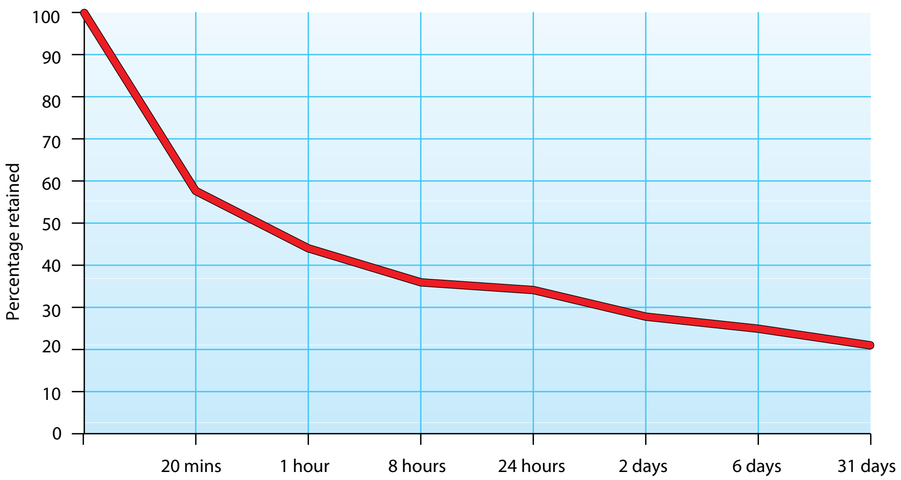


Figure 7.3 A forgetting curve shows the rate and amount of forgetting that occurs over time. Note that more than half of the learned information is forgotten in the first hour.

The pattern of forgetting evident in the forgetting curve tends to occur for a wide variety of materials under many conditions. However, the more meaningful the material, the slower the rate of forgetting. The amount and rate of forgetting are also influenced by how well the information was initially encoded—the better the initial learning, the longer the material is likely to be retained. When material is well learned, the rate of retention is about the same, regardless of the degree of difficulty of the material and the learning ability of the individual. Slow learners and fast learners both forget at about the same rate, and easily learned material does not appear to be retained longer than more difficult material.

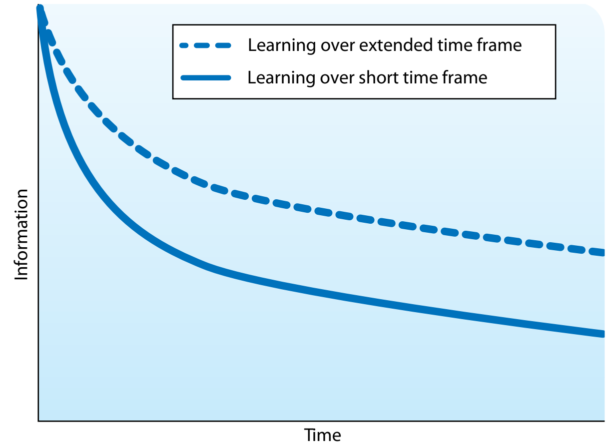


Figure 7.4 The rate at which information is forgotten follows a standard pattern, with rapid initial loss of information followed by more gradual later decline. Increasing initial learning time (the dotted line) increases retention, but forgetting occurs at the same rate. In other words, increased learning shifts the curve upwards but does not change the rate of forgetting.

Learning Activity 7.1

Review questions

1 How is forgetting defined in psychology?

2 In what way(s) is forgetting from both STM (or working memory) and LTM adaptive?

3 What effect could a participant's past experience have on the results of an experiment on forgetting?

4 **a** What is a forgetting curve?

b Describe the pattern of forgetting indicated by a typical forgetting curve, ensuring you refer to the rate and amount of forgetting over time.

5 What factors can affect the rate and amount of forgetting?

6 Samir has booked in for his learner permit test in four weeks. He intends to spend every second night in the next four weeks learning the road rules. What impact would you expect this approach to learning over an extended period will have on both the rate and amount of forgetting after the test?

Learning Activity 7.2

Practical activity on the forgetting curve

This experiment enables you to develop a forgetting curve from your own data. The procedure is based on one of Ebbinghaus' experiments.

You will require one volunteer participant who is informed that this is an experiment on learning and memory that will take about 30 minutes initially and then about 15 minutes of their time on five further occasions over the next week. For each of the six occasions (conditions), the participants will be required to learn a list of 12 nonsense syllables (such as those in the table on the following page), and then will be tested for their recall after a specific period of time has elapsed, as follows:

list 1 – 20 minutes
list 2 – 1 hour
list 3 – 8 hours
list 4 – 24 hours
list 5 – 2 days
list 6 – 6 days

The six different lists of nonsense syllables should be prepared before conducting the experiment. You should also construct a relevant operational hypothesis beforehand. All relevant ethical guidelines should be followed.

Procedure

- Give the participant list 1. Instruct the participant to learn all the nonsense syllables until they can recall all of them on two consecutive occasions without error. Once the participant has learned the list, engage them in a distracting activity for 20 minutes so they do not rehearse the syllables. For example, give the participant a CD (with headphones) and ask them to write down the words of the song to which they are listening.
- After 20 minutes have elapsed the participant is tested by asking them to write down as many of the nonsense syllables as they can, in any order.
- Organise another occasion with the participant so that they can learn the second list of nonsense syllables until they can recall all of them without error, as per the first list. Test the participants for their recall of the list one hour after the initial learning.
- Repeat the learning and testing procedures for the next five lists, testing them again at eight hours, at 24 hours, at two days, and finally six days after learning each list respectively. The scores on these tests of recall are the data to be plotted on the forgetting curve.
- Thank the participant for their contribution to the experiment and debrief them about the purpose and relevance of the experiment at the conclusion.

Results

- Combine your individual data with those collected by other members of your class.
- Calculate the mean number of nonsense syllables recalled after each period of time.
- Prepare a graph of your participant's results. On the same graph, plot the class results.

Interpretation of the results

- Comment on the rate and amount of information lost by:
  - the individual participant you tested
  - the group of participants tested.
- Do the group results support the hypothesis? Explain with reference to the graph.
- Do the results reflect theoretical expectations; that is, to what extent are the data consistent with the data on the rate and amount of forgetting described by the forgetting curve?
- Suggest reasons that a test of statistical significance was applied to the results and it was found that $p < 0.05$. What does this mean?
- Describe two extraneous or potential confounding variables that may have affected the results.
- What ethical issues are raised by this research? How were these addressed?

Example of a list of 12 nonsense syllables to be learned

leb	fim	rup	hur
dup	jal	gop	kir
gis	lut	lek	pem

Box 7.1

How good is your memory?

The self-rating questionnaire shown opposite was developed by British psychologist and prominent memory researcher Alan Baddeley. He uses questionnaires such as this to determine memory lapses in everyday life and in people experiencing memory problems from head injuries.

The questionnaire lists some of the memory lapses that people experience from time to time. How often do they happen to you? In order to complete the questionnaire, refer to the response key and then rate yourself by writing the appropriate number in the box beside each item.

Response key

1 Not at all in the last six months
2 About once in the last six months
3 More than once in the last six months but less than once a month

4 About once a month
5 More than once a month but less than once a week
6 About once a week
7 More than once a week but less than once a day
8 About one a day
9 More than once a day

Questionnaire	Response
1 Forgetting where you have put something; losing things around the house.	
2 Failing to recognise places that you are told you have often been to before.	
3 Finding a television story difficult to follow.	
4 Not remembering a change in your daily routine, such as a change in the place where something is kept, or a change in the time something happens. Following your old routine by mistake.	
5 Having to go back to check whether you have done something that you meant to do.	
6 Forgetting when something happened; for example, forgetting whether something happened yesterday or last week.	
7 Completely forgetting to take things with you, or leaving things behind and having to go back and get them.	
8 Forgetting that you were told something yesterday or a few days ago, and maybe having to be reminded about it.	
9 Starting to read something (a book or an article in a newspaper or magazine) without realising you have read it before.	
10 Letting yourself ramble on about unimportant or irrelevant things.	
11 Failing to recognise by sight close relatives or friends whom you meet frequently.	
12 Having difficulty picking up a new skill; for example, learning a new game or working some new gadget after you have practised once or twice.	
13 Finding that a word is on the tip of your tongue—you know what it is but cannot quite find it.	
14 Completely forgetting to do things you said you would do, and things you planned to do.	
15 Forgetting important details of what you did or what happened to you the day before.	
16 When talking to someone, forgetting what you have just said—maybe saying: 'What was I talking about?'	
17 When reading a newspaper or magazine, being unable to follow the thread of the story; losing track of what it is about.	
18 Forgetting to tell somebody something important; perhaps forgetting to pass on a message or remind someone of something.	
19 Forgetting important details about yourself; for example, your birthday or where you live.	
20 Getting the details of what someone has told you mixed up.	
21 Telling someone a story or joke that you have told them already.	
22 Forgetting details of things you do regularly, whether at home or at work; for example, forgetting details of what to do, or forgetting at what time to do it.	
23 Finding that the faces of famous people seen on television or in photographs look unfamiliar.	
24 Forgetting where things are normally kept or looking for them in the wrong place.	
25 a Getting lost or turning in the wrong direction on a journey, during a walk or in a building where you have often been before. **b** Getting lost or turning in the wrong direction on a journey, during a walk or in a building where you have only been once or twice before.	
26 Doing some routine thing twice by mistake; for example, putting two lots of tea in the teapot, or going to brush or comb your hair when you have just done so.	
27 Repeating to someone what you have just told them or asking them the same question twice.	
Total	

To score the questionnaire, add up the numbers you wrote in the 'response' box. According to Baddeley, a total score of 27–58 means that your memory is generally good, 58–116 means it is average and 116–252 means it is rather below average. He suggests, however, that you 'should not be alarmed if your score is below average'. In his view, this may simply mean that you lead a very busy life that puts considerable demands on your memory. Statistically, the greater the number of situations in which memory lapses are possible, the greater the number of lapses you will report overall.

Source: adapted from Baddeley, A.D. (1997). *Human memory: Theory and practice.* Hove: Psychology Press.

Measures of retention

How can you find out whether information has been retained in memory? Teachers typically use tests and exams. But is your performance on a test or an exam an accurate or reliable indicator of how much information, if any, you have retained in memory? There are different types of questions teachers can ask, including multiple-choice questions, true/false questions, fill-in-the-blank questions, short-answer and essay questions. Research findings suggest that the amount of information that will be retrieved from memory depends, at least partly, on the type of retrieval question asked. Three main kinds of measures are used to determine how much information has been retained: *recall*, *recognition* and *relearning*.

Recall

Suppose that you were asked to name Walt Disney's seven dwarfs. In order to correctly complete this task, you would have searched through your long-term memory, tried to locate the information required, and either have produced or not produced the correct information.

This approach to measuring the amount of information retained in memory is a test of recall. **Recall** involves being asked to reproduce information with the fewest possible cues to assist retrieval. In an experiment using recall as a **measure of retention**, participants might be required to learn a list of randomly selected words. Then, after a period of time they may be required to write, in any order, as many of the words from the list as they can. This method is called free recall. **Free recall** is involved when participants are simply asked to remember as much information as they can, in no particular order. If participants were asked to recall a list of words in the order in which the words were presented, researchers would be asking for *serial recall*.

During recall, you use a general cue to retrieve information associated with the cue, by searching through your long-term memory storage system to find something that matches the cue (Best, 1999). However, this general cue often does not provide enough of a hint for you to locate the relevant information because the list of possible matches is often quite large. Therefore, the more specific the cue, the more likely you are to locate and retrieve the relevant correct information stored in your long-term memory. For example, a cue for the seven dwarfs question might be the first letter of each of their names; that is, B, D, D, G, H, S and S.

Cued recall makes use of more specific cues to aid retrieval. If you could not name all seven dwarfs, it doesn't necessarily mean that the information required is not stored in your long-term memory. The required information may be stored but not immediately accessible. However, if you used a different method of retrieval, you may have been able to access the correct information.

Recognition

You may be able to recognise the names of the seven dwarfs if the following question was asked: Which of the following are names of Walt Disney's seven dwarfs?

- Bashful
- Grumpy
- Sleepy
- Dopey
- Doc
- Happy
- Pop
- Goofy
- Sneezy
- Grouchy

Recognition involves identifying the correct information from among alternatives, such as in the question above. Generally, we can retrieve more information when tested by the recognition method than we can with the recall method, because the recognition method provides more cues that assist in the location and retrieval of information from long-term memory.

Research findings support the view that recognition is a more sensitive measure of memory than recall. In one study, researchers asked university students to recall the names of the seven dwarfs with no cues. Participants were able to correctly identify a mean of 69% of the names. When they were given a list of alternatives from which to select the names of the seven dwarfs, the accuracy rate increased to a mean of 86% (Meyer & Hilterbrand, 1984). Consequently, recognition is considered to be a more sensitive measure of memory than recall for testing information stored in long-term memory. For example, if you were asked to write down the names of all the students in your school Year 6 class, your list would probably not be very long. However, if you were presented with a long list of names that included all the names of those in your Year 6 class, it is likely that you would be able to recognise more names than you could recall.

Generally, irrespective of the kind of information, you can typically recognise more than you can recall. Consider those situations when you have found yourself recognising someone but not being able to recall their name. On these occasions, remembering a person's name is a recall task, while remembering their face is a recognition task because the face is a cue that aids retrieval. One psychologist who studied memory processes for many years described the difference between recognition and recall as follows: 'In recall we ask, *What is the item*? and in recognition we ask, *Is this the item*?' (Houston, 1986).

In an exam situation, students typically prefer multiple-choice questions or true/false questions to an essay or 'short-answer' questions that have no information to assist their retrieval of information. Multiple-choice and true/false questions involve recognising the correct response from among a small number of alternatives (cues), whereas essay and short-answer questions require recall, when there are few cues. Generally, research findings indicate that students perform better on multiple-choice and true/false questions than on essay and short-answer questions when tested on the same material. However, there are exceptions, such as when incorrect alternative answers ('distracters') on multiple-choice questions are extremely similar to the correct answers, or when students expect an essay question or short-answer question in an exam and use study techniques suited to that particular type of question.

Figure 7.5 Police line-ups make use of the greater sensitivity of the recognition method.

Relearning

Most people have times when they are unable to recall or to recognise information that has been stored in long-term memory. Even though they are unable to retrieve this information, it does not necessarily mean it has been forgotten. For example, in chapter 3, you learned about the role of Wernicke's area (in the brain) in relation to our use of language. Despite now being unable to recall or recognise the specific role of Wernicke's area, it may be possible to measure some memory of it by using the relearning method. **Relearning**, or the *method of savings*, involves learning information again that has been previously learned and stored in long-term memory. If information is learned more quickly the second time, it is assumed that there must be some information retained (or 'saved') from the first learning experience, whether the individual realises it or not. Of the three measures of retention, relearning is considered to be the most sensitive.

Typically, relearning something takes less time than it did to learn it originally. You may have discovered this for yourself when studying for an exam. You may believe you have forgotten some or all of the material, yet with even a small amount of reviewing you remember the information relatively quickly. By 'restudying', a weak association regains its original strength in your memory. It is as if the previous experience has prepared us for remembering the material better when we encounter it again.

Ebbinghaus (1885) was the first researcher to scientifically study relearning. Acting as his own research participant, Ebbinghaus memorised lists of nonsense syllables such as *jax*, *qir* and *kuv* under various conditions of practice. Nonsense syllables consist of two consonants with a vowel in between. They are usually pronounceable, but have no recognisable meaning. Nonsense syllables are often used in memory research instead of words so that retention is not affected by the words having some sort of meaning or association with other words already in memory (that is, a potential extraneous variable). When Ebbinghaus measured his memory for what he had learned, he found that even if he could not remember a single item from the original list, he could relearn the list much more quickly a second time than he had learnt it initially. He assumed therefore that some information had been retained from the initial learning.

Relearning is also called the method of savings because it can be used to measure the amount of information 'saved' from previous learning. For example, suppose you were a participant in an experiment and it took you *ten* trials (presentations) to learn a list of 12 nonsense syllables. If in a subsequent experiment, perhaps six months later, it took you *five* trials to relearn the same list, then the savings would be 50% because it took you half as long to learn the information.

In this example, the savings are calculated using the formula:

$$\text{Savings} = \frac{\text{(no. of trials for original learning)} - \text{(no. of trials for relearning)}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

In the previous example, the savings would be calculated as:

$$\frac{10-5}{10} \times \frac{100}{1} = 50\%$$

A savings score can also be calculated on the basis of the *time* taken to relearn information. In this case, the formula would be:

$$\frac{\text{(time for original learning)} - \text{(time for relearning)}}{\text{(time for original learning)}} \times \frac{100}{1}$$

Figure 7.6 This woman has not spoken French since learning it at school. However, it will take less time for her to relearn it than it took to learn it originally, showing that some of the information has been 'saved' in long-term memory.

Relative sensitivity of measures of retention

Recall, recognition and relearning differ in their relative sensitivity as measures of retention. The *sensitivity* of a measure of retention refers to its ability to assess the amount of information that has been stored in memory. For example, a very sensitive measure of retention would be more likely to detect information that has been learned and stored in memory at some time in the past than would a measure that is not very sensitive. Research evidence indicates that recall tends to be the least sensitive measure of retention, that relearning tends to be the most sensitive measure of retention, and that recognition tends to be less sensitive than relearning but more sensitive than recall.

In one of the better-known experiments on the sensitivity of the three measures of retention, Nelson (1978) used 24 university students as research participants. The students were required to participate in the study to meet one of their psychology course requirements. The experiment consisted of three stages: the initial learning stage, a stage in which recall and recognition of the initial learning were tested, and finally a relearning stage. At the beginning of the experiment, participants were not informed about their expected involvement in the second and third stages of the experiment.

In the first stage, participants were given a series of 20 number–word pairs to learn, such as '48–party' and '95–horse'. These are called paired-associates. The second stage of the experiment occurred four weeks later, when the participants were required to participate in the testing and relearning stages of the experiment. In the testing stage, participants were required to complete two different types of tests of their memory of the number–word pairs; activities they had not expected. Each participant was first given a test of recall. This test involved presenting the participant with the number (the cue), such as 48, then asking them to recall the target word associated with that cue, such as 'party'. Following the test of recall, each participant was given a test of recognition. Participants were presented with a number from their original list paired with all 20 of the target words. This was something like a multiple-choice question with 20 possible correct answers. Following the test of recognition, participants were given a distraction task for ten minutes.

The third stage of the experiment involved relearning ten of the previously learned paired associates that had been incorrectly recalled during the test of recall, as well as ten new paired associates. Participants were then given a test of recall on both the relearned information and the new information. They were then debriefed about the experiment and allowed to leave.

The results showed that a mean score of 48% of the target words were correctly recalled and 69% were correctly recognised in the testing (second stage) stage of the experiment. Furthermore, the percentage of target words correctly recalled during the relearning stage was significantly higher for old items (88%) than for new items. These findings further demonstrate that relearning is more sensitive than recognition, as a measure of retention.

These results were found to be statistically significant at $p \leq 0.001$. Therefore, the difference in the mean percentage score obtained in each test condition is considered to be a significant and acceptable difference; that is, each percentage score is likely to be due to the types of measure of retention used rather than due to chance factors.

Table 7.1 Measures of retention

Method	Description	Example
Recall		
Free recall	Providing information in no particular order with no retrieval cues	Name the last three prime ministers of Australia.
Serial recall	Providing information in the order in which it was presented with no retrieval cues	Name the last three prime ministers of Australia in order from the most recent to the least recent.
Cued recall	Providing a cue to assist the retrieval of information	Name the last three prime ministers of Australia. Their recognition initials are KR, JH, PK.
Recognition	Identifying correct information from among a list of alternatives	Identify the last three prime ministers of Australia from the following list: Holt, Howard, Menzies, Curtin, Keating, Hawke, Fraser, McMahon, Rudd.
Relearning (method of savings)	Determining the amount of information saved when learning information again that has been previously learned	Time how long it takes to learn the last seven prime ministers of Australia. Time yourself two weeks later on the same task to test the amount of time saved in learning the information a second time compared with the first time.

Learning Activity 7.3

Identifying measures of retention

For each of the following examples, identify one or more measures of retention that could be used: free recall (FR), serial recall (SER), cued recall (CR), recognition (RG) or relearning (RL).

- remembering a friend's mobile phone number with no cues
- playing 'Hangman'
- using photos from a trip to describe your experiences
- identifying a friend who appears in a news report
- remembering the directions to a friend's house
- writing out the words of a song from memory
- reading back over your textbook before an exam
- writing out the words of a song with the music of the song playing in the background.

Learning Activity 7.4

Review questions

1 Explain the meaning of the term measure of retention.

2 Briefly describe the three different measures of retention, with reference to examples not used in the text.

3 List the three measures of retention in order of sensitivity.

4 Choose one concept you have studied this semester and write a question requiring the recall method and a question requiring the recognition method.

5 **a** Describe two ways of measuring retention using relearning (the method of savings).

b Ahmed took 30 minutes to learn a list of ten Spanish words when they were first given to him. When he had to relearn them before a test the following week, it took him five minutes.

i Using a method of savings formula, calculate the amount of retention of information from the first learning session to the second learning session.

ii Explain what this figure means in terms of Ahmed's retention of Spanish words.

6 **a** In relation to research results, what does statistically significant mean?

b If the findings of an experiment had a *p* value of ≤ 0.01, what conclusion(s) could the researcher draw?

7 What ethical issues could be raised with the Nelson (1978) research (see page 369), using today's ethical standards?

Learning Activity 7.5

Practical activity on relative sensitivity of recall and recognition

The aim of this experiment is to compare the sensitivity of recall and recognition as measures of retention. Two groups of randomly selected volunteer participants are required. Group 1 is given a recall task and group 2 a recognition task.

First, both groups are allowed four minutes to memorise a list of 15 nonsense syllables (for example, *cej*, *fup*, *xip*), which are presented on a sheet of paper. Then each group is given a test using either recall or recognition.

Participants in group 1 (recall) are required to use free recall to write on a blank sheet of paper, in any order, as many syllables as can be remembered. Group 2 (recognition) participants are given a sheet with the 15 nonsense syllables mixed with 15 previously unseen nonsense syllables. The participants are required to circle the nonsense syllables they recognise.

Participants in both groups are allowed as much time as they need to retrieve the nonsense syllables. Their response sheets provide the data for the experiment. All relevant ethical guidelines should be followed.

- Construct an operational hypothesis that could be tested by this experiment.
- At what level would you set the *p* value for a test of significance? Explain why you would

- use this value rather than a higher or lower value.
- Analyse the data in terms of differences in mean scores of the two groups.
- Compare your research findings with theoretical expectations, or results obtained for other similar studies.
- If there is a difference in the mean scores for the two groups and $p \leq 0.05$, what does this indicate about the results? Would the results be more meaningful if $p \leq 0.01$? Explain your answer.
- Evaluate the experimental design. Identify any relevant extraneous or potential confounding variables and suggest improvements to the experimental design.
- Identify relevant ethical issues.

Theories of forgetting

Psychologists have developed a number of theories to explain why we forget. For instance, forgetting may occur because (1) the right retrieval cue or prompt is not used, (2) there is interference from competing material, (3) there is some underlying motivation to not remember, or (4) memory fades through disuse over time. Each of these explanations can help us understand why we fail to remember at one time or another. But no single theory alone is able to explain all instances of forgetting.

Retrieval failure theory

If you have ever experienced a 'mental blank' in an exam or in a job interview, only to recall the exact information you needed at some later point in time—for example, when discussing the questions with your friends at the end of the exam or interview—then you have had firsthand experience of retrieval failure.

Most of the time, we can retrieve information from LTM with relative ease. For example, for the next five seconds, think of as many different types of animals as you can. Next, recall five words that rhyme with 'mum', then three things you did yesterday, three things that are round and four types of food that you like. In completing these tasks, you were able to retrieve information from the various storage systems in your LTM using a retrieval cue that assisted you to locate relevant information.

A **retrieval cue** is any stimulus that assists the process of locating and recovering information stored in memory. Basically, a retrieval cue acts as a prompt or a hint that guides the search and recovery process within memory. Being asked a question is an example of a cue. A question focuses your search for information in LTM in specific areas, much like the call number on a library book or a URL for a website. For example, a question such as 'who was at the party last Saturday night?' focuses on the specific information among all the information associated with the party. Other cues are less direct and might not even be recognised as memory prompts. For example, the smell of a particular perfume or aftershave lotion, the look of someone's face, a photograph, an emotional

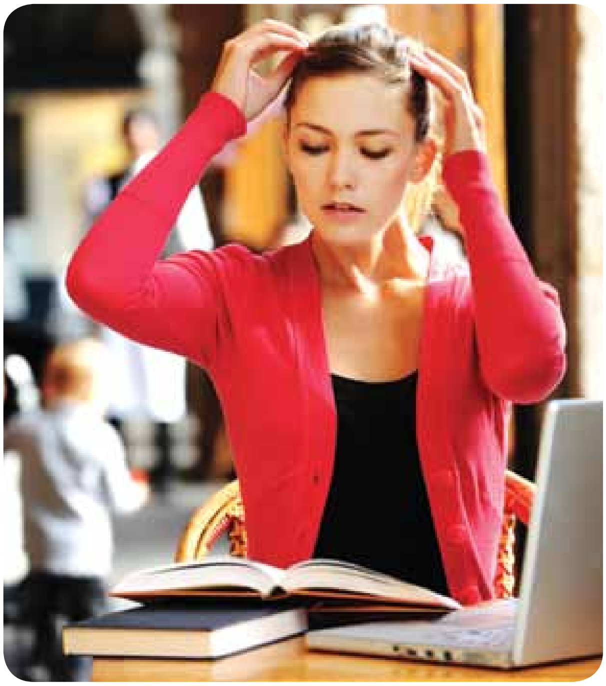


Figure 7.7 There are a number of explanations as to why we forget: using the wrong retrieval cue, interference from competing information, motivated forgetting (when to remember would cause stress) or memory fading because it hasn't been used regularly (and so can't be accessed).

Figure 7.8 Using the right retrieval cue may prompt recall, indicating that information has not actually been forgotten.

state or a particular situation or place may each act as a cue that can unintentionally trigger a specific memory or related group of memories.

According to **retrieval failure theory** we sometimes forget because we lack or fail to use the right cues to retrieve information stored in memory. This explanation of forgetting suggests that memories stored in LTM are not actually forgotten, but are temporarily inaccessible or unavailable because of an inappropriate or faulty cue. This theory is often referred to as *cue-dependent forgetting*. It provides a useful explanation for why we sometimes fail to retrieve information even when we're sure we 'know' the information. For example, you might have forgotten where the Olympic Games were held in 2004, but if you went through the letters of the alphabet, the letter *A* might be a cue for the retrieval of the name *Athens*. One of the most frequent experiences of retrieval failure is the tip-of-the-tongue phenomenon.

Learning Activity 7.6

Practical activity on using retrieval cues

This 'single-participant' practical activity demonstrates the importance of retrieval cues. You need a blank sheet of paper and a pencil. Follow the instructions exactly.

Part A

Instructions

Spend three to five seconds reading each of the sentences below and read through the list only once. As soon as you are finished, cover the list and write down as many of the sentences as you can remember (you need not write 'can be used' each time). Please begin now.

A brick can be used as a doorstop.
A ladder can be used as a bookshelf.
A wine bottle can be used as a candleholder.
A saucepan can be used as a drum.
A record can be used to serve potato chips.
A guitar can be used as a canoe paddle.
A leaf can be used as a bookmark.
An orange can be used to play catch.
A newspaper can be used to swat flies.
A TV antenna can be used as a clothes rack.
A sheet can be used as a sail.
A boat can be used as a shelter.
A bathtub can be used to wash clothes.
A torch can be used to hold water.
A rock can be used as a paperweight.
A knife can be used to stir paint.
A pen can be used as an arrow.
A barrel can be used as a chair.
A rug can be used as a bedspread.
A telephone can be used as an alarm clock.
A book can be used as a ruler.
A balloon can be used as a pillow.
A shoe can be used to drive nails.
A coin can be used as a screwdriver.
A lampshade can be used as a hat.

Source: adapted from Bransford, J.D., & Stein, B.S. (1984). *The IDEAL problem solver.* New York: Freeman.

Now that you've recalled as many sentences as you can, turn to page 377 where the practical activity continues.

Tip-of-the-tongue phenomenon

You have probably experienced the feeling of trying to recall a person's name, or the name of a place or an object, that you're sure you know and are certain you are just on the verge of remembering but can't quite recall it right then. You know that you know the answer and can almost, but not quite, bring it forth. Psychologists call this tip-of-the-tongue phenomenon.

Tip-of-the-tongue (TOT) is a state, or 'feeling', that occurs when you are aware of knowing something, and confident you will eventually remember it, but you are not able to retrieve it from memory at that point in time. When the sought-after information is eventually recalled, it tends to occur suddenly, seeming to 'pop' out of a memory, often when you are not consciously thinking about it.

The apparent gap in memory that occurs in a TOT state is particularly intriguing because even though we can't say the word, we seem to have some information about the word we are searching for; for example, we can often tell how many syllables it has, the beginning and ending letters, or what it rhymes with. Furthermore, we can often confidently eliminate words that are incorrect because they don't have the proper sound or length. These observations suggest that TOT involves a *partial retrieval process* in which bits of information can act as retrieval cues for the required information, helping to 'home in' on this information. Furthermore, the observation that specific bits or types of information assist retrieval indicates that information in LTM is stored in an *organised way* and in a *variety of forms*.

One of the earliest investigations of the TOT state was conducted by American psychologists Roger Brown and David McNeil (1966). They used a simple technique for producing the TOT state in their research participants. The technique was to give participants dictionary definitions of uncommon objects and ask for the name of the defined object. For example, a definition such as:

> *A small boat used in shallow water in the Orient that is rowed from behind using a single oar.*

Attempts to recall this name will produce a TOT state in many people. Brown and McNeil were not interested in people who knew and could immediately recall the correct answer. Neither were they interested in cases in which the participant had no idea of the correct name. Their interest was to re-create the TOT state and analyse attempts by participants to recall the name during TOT.

The participants experiencing TOT were usually able to recall some information about the name ('It starts with s' or 'It sounds like Siam'), or recall a word related to the name ('It looks like a junk'), even though they usually knew a related word was not the one they were trying to retrieve. And then moments later, for some participants, the word would pop into memory, indicating that it was there all the time but could just not be retrieved at that moment. Perhaps all information stored in long-term memory is still there, but just cannot be retrieved until the right cue is used to call it out of storage. For instance, both phonetic (the sound of the word) and semantic (the meaning of the word) features of a word can assist its recall. Through remembering such features, you will probably recall the word that has caused you so much frustration (Lahey, 1992). Interestingly, it has been found that people are often able to tell beforehand if they are likely to remember something (Nelson, 1987).

The tip-of-the-tongue phenomenon is significant because it illustrates several aspects of the retrieval process. First, it seems that retrieving is not an all-or-nothing process. Often, we can remember parts of what we want to retrieve. Second, in many instances, information is stored in LTM but is not accessible without the right retrieval cue. It seems that information in LTM is stored in a variety of forms and that a certain type of cue is required for a certain type of information. Third, TOT experiences indicate that information stored in LTM is organised and connected in relatively logical ways. As we mentally struggle to retrieve the seemingly inaccessible information, logically connected bits of information are frequently triggered. In many instances, these related pieces of information act as additional retrieval cues, helping us access the sought-after memory (Hockenbury & Hockenbury, 2006). (The name used in the example is *sampan*.)

Learning Activity 7.7

Examining the tip-of-the-tongue phenomenon

Which of the definitions in the list below cause you to think that you have the answer on the tip of your tongue? Skip over the ones that do not cause that feeling. If you know the word or name immediately, or if you think you don't know it, then you are not in a TOT state.

For the TOT definitions (when you feel you know the answer but cannot think of it immediately), do the following. Write down all the words or names that come to mind even if you know that they are not correct. If the correct word or name comes to you as you do that, underline the answer in your list. If the answer does not come to you (1) try to guess the letter that the word or name starts with, (2) try to identify how many syllables it has, and (3) try to think of one or two words that sound similar to the one you're trying to recall.

1. The arched upper surface of the human foot between the toes and the ankles
2. The former premier of Victoria after whom the bridge near the Docklands is named
3. A meeting of people who seek to receive a message from the dead
4. Deer's flesh as food
5. Reddish-purple colour
6. A jewelled ornament worn in the hair by women
7. The highest waterfall on Earth
8. The lead singer of the rock group The Doors
9. The main site of the Sydney 2000 Olympic Games
10. The American term for tomato sauce.

The answers to these questions are on page 823. You may wish to conduct a practical activity on TOT using these questions, or questions you devise.

Learning Activity 7.8

Review questions

1. Define the term retrieval cue with reference to examples of different types of retrieval cues.
2. **a** What is retrieval failure theory?
   b Why is retrieval failure sometimes called cue-dependent forgetting?
3. Give an example of retrieval failure not referred to in the text.
4. Briefly describe the tip-of-the-tongue (TOT) phenomenon.
5. What is the significance of TOT in relation to memory? Explain with reference to what TOT indicates about the retrieval process and LTM storage.
6. Explain whether TOT provides evidence for the semantic network theory.

Interference theory

Suppose you take an interest in chess and read articles about the opening moves of three chess champions. It would be relatively straightforward to memorise those moves and recall them, but suppose you then learn the opening moves of three more champions, and then three more. Recall soon becomes difficult, partly because the similar memories interfere with the retrieval of one another. This can also happen when you try to remember other kinds of information such as a string of telephone numbers, formulas or grocery list items. Experiences of this kind highlight a second reason for forgetting—that memories can interfere with one another.

Interference theory proposes that forgetting in LTM occurs because other memories interfere with the retrieval of what we are trying to recall, particularly if the other memories are similar. The more similar the information, the more likely it is that interference will occur. Furthermore, if learning of the similar information occurs close in time, interference is more likely. There are two main kinds of interference: *retroactive interference* and *proactive interference*.

Figure 7.9 In retroactive interference, new information (Aunt Grace's address) interferes retroactively with older information (number of pennies).

Retroactive interference

The effect of retroactive interference can be illustrated by a simple learning activity in which you try to learn some telephone numbers. Once you have finished reading this paragraph turn to page 377, box 7.2, and immediately cover the three telephone numbers in the right column with your hand. Memorise the telephone number in the left column until you can recite it with no errors. Cover all the numbers and in the next 30 seconds think of all the Australian cities or towns you can that begin with the letter *M*. This will prevent you from rehearsing the telephone number. After about 30 seconds, try to recall the number you learned.

You were probably able to recall the telephone number you learned without too much difficulty. Now, interference can be demonstrated. Again, do not look at box 7.2 until you have read all of the following directions. Rehearse the original telephone number so that you are sure you know it. Then cover it and spend 30 seconds memorising the three telephone numbers in the right column. These numbers are new information and you should try hard to learn them. After 30 seconds have elapsed, cover *all* the numbers and try to recall the original telephone number you learned from the left column.

If interference occurred, you probably found it more difficult to remember the original phone number. Your ability to remember the old number may have been interfered with by your learning of the three new phone numbers. When new information interferes with the ability to remember old information, psychologists refer to the interference as **retroactive interference**.

The standard experimental design for investigating retroactive interference is shown in table 7.2. An experimental group first learns A, then learns B, and finally attempts to recall A. The control group learns A, but not B, and then attempts to recall A. If the experimental group has greater difficulty recalling A than the control group, then retroactive interference is said to have occurred. The later learning of B has interfered with recall of the early learning of A.

Although most research studies on retroactive interference have been conducted under controlled conditions in laboratories, it seems that it is a common cause of forgetting in everyday life. For example, suppose you are at a party and you meet someone named Matthew. Ten minutes later you meet someone named Michael. You move away to talk to other people and after about an hour you again bump into Matthew, but by mistake you call him Michael. The second name has interfered with the first. Similarly, if you are required at school to memorise a poem, you might find that your ability

Table 7.2 Experimental design for retroactive interference

Group	First task	Second task	Third task
Experimental	Learns A	Learns B	Test for retention of A
Control	Learns A	Unrelated activity or rest	Test for retention of A

to recall stanzas you learned earlier will be affected by the stanzas you learned later. With retroactive interference, new learning interferes with the retrieval of previously learned material.

Proactive interference

Interference also works in the opposite direction. Information learned previously can interfere with our ability to remember new information. This effect is called **proactive interference**. You may have experienced the effects of proactive interference if you have an older sibling who attended the same school as you. When teachers incorrectly call you by your older sibling's name, proactive interference may be responsible for the teacher's error. Of course, this is more likely to occur if you and your sibling are of the same sex, close in age and look alike.

Proactive interference is demonstrated by the following experiment. Suppose you agree to participate in research in which you are asked to learn a list of words. You are asked to come back the next day and recall the list. Then you are required to learn a second list of words similar to those on the first list. Once again, you return the next day and attempt to recall the second list. This continues through to the end of a series of 20 lists. Each day, you recall the list from the preceding day and learn the list to be recalled the next day. What do you think will happen to your ability to recall as you progress through the lists? When compared to your recall of the first list, will your recall of later lists improve, stay about the same or worsen?

As shown in figure 7.10, experimental evidence indicates that your recall of the lists is likely to worsen as you progress through them. The more lists you have learned previously, the poorer your recall of a newly learned list is likely to be. It is as though all those previously learned items distort and confuse your attempt to recall the newest list. This suggests that everything we have learned previously is a potential source of interference.

However, an experiment by Wickens and his colleagues (1963) shows that the other information in memory must be *similar* to the information you are trying to recall in order to interfere with its retrieval. The researchers asked one group of participants (group A) to memorise six lists of three-digit combinations (for example, 286, 519, 473). A second group of participants (group B) was asked to memorise five lists of combinations of three letters and then to memorise a list of three-digit combinations like that used for group A. As can be seen in figure 7.11, the participants in group A became progressively worse at recall as they memorised more and more lists of three-digit combinations. The previously memorised lists interfered with the recall of each new list. By the sixth list, their performance was quite poor. Similarly, figure 7.11 shows that the participants in group B became progressively less successful at recalling the letter combinations due to the build-up of interference. Note, however, that the memory performance of group B increased significantly when they memorised the sixth list consisting of digit combinations. This indicates that the letters were dissimilar enough to the digits so as to not interfere with their recall. According to interference theory, interference primarily comes from memories of *similar* information.

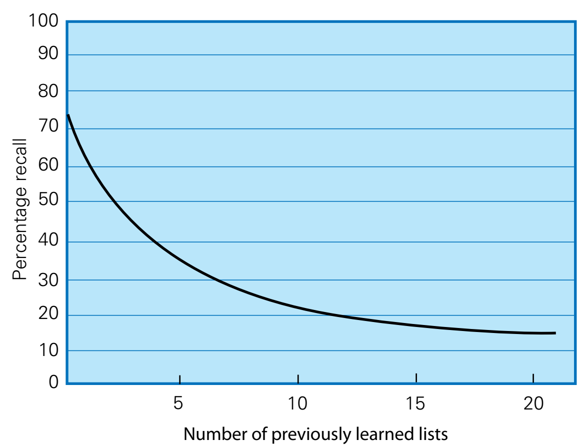


Figure 7.10 The effect of proactive interference on previously learned lists of words. Generally, recall of the lists worsens as the number of previously learned lists increases.

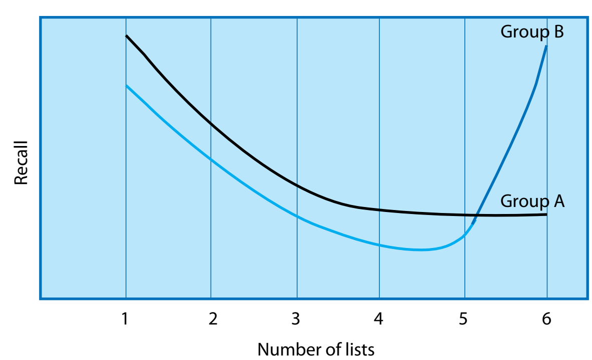


Figure 7.11 Results of an experiment on the effects of interference on retrieval of similar information.

Box 7.2

Telephone numbers

The telephone numbers below are for the activity on page 375.

First learn this number:

9591 6283

Then learn these numbers:

9835 2719

9540 1072

9361 7408

Learning Activity 7.6 (continued)

Practical activity on using retrieval cues

Part B

(Continued from page 372.)

Instructions

On a separate sheet of paper, use the words at right as retrieval cues to recall as many sentences as you can, without referring back to either the original list of sentences or the first list you recalled.

When you have recalled as many words as you can, refer back to the original list and check your responses. Record the number of sentences you were able to correctly recall in both the free recall condition (the first condition) and the cued recall condition (the second condition).

torch
sheet
rock
telephone
boat
coin
wine bottle
book
pen
balloon
ladder
record
bathtub

TV antenna
lampshade
shoe
guitar
leaf
brick
knife
newspaper
saucepan
barrel
rug
orange

Source: adapted from Bransford, J.D., & Stein, B.S. (1984). *The IDEAL problem solver.* New York: Freeman.

What does this activity demonstrate about the role of retrieval cues in memory?

Table 7.3 shows the design of a standard proactive interference experiment. If the experimental group has more difficulty remembering **B** than the control group does, then proactive interference is said to have occurred. The learning of **A** has interfered with recall of the later learning of **B**. Note the differences between the experiments in tables 7.2 and 7.3. In both retroactive and proactive interference experiments, however, task similarity is a very important variable.

Table 7.3 Experimental design for proactive interference

Group	First task	Second task	Third task
Experimental	Learns A	Learns B	Test for retention of B
Control	No activity	Learns B	Test for retention of B

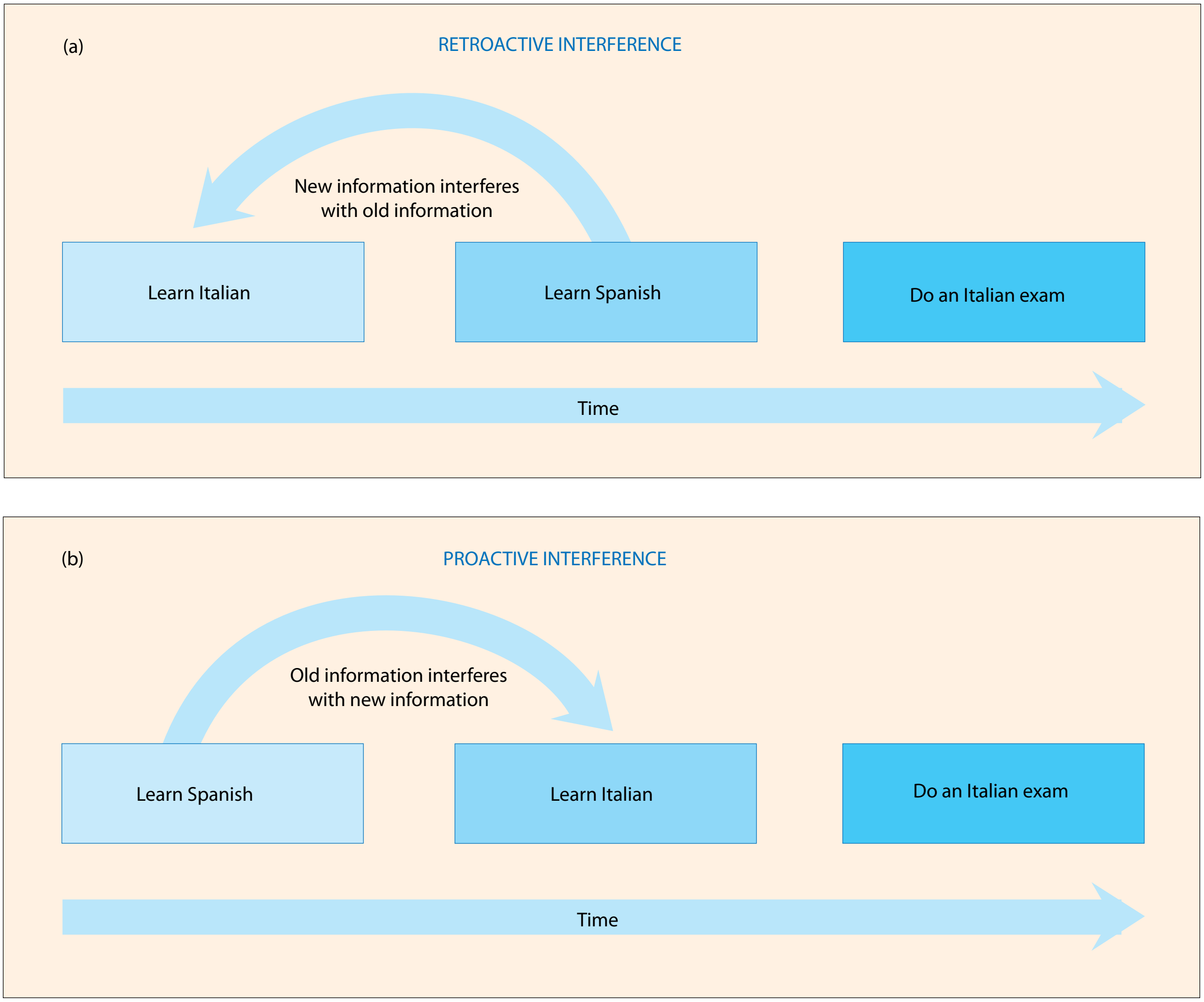


Figure 7.12 This diagram illustrates the distinction between retroactive and proactive interference. It shows how interference can play a role in forgetting information that is being learned for an exam. However, for interference to occur there must be a high degree of similarity between the information learned in Italian and Spanish.

Learning Activity 7.9

Review questions

1 Briefly describe the interference theory of forgetting.

2 Define retroactive interference and proactive interference.

3 Explain the key feature that distinguishes retroactive interference from proactive interference.

4 What two suggestions could be given to a VCE student studying for exams to help them minimise forgetting that may result from interference?

5 A friend of yours who is studying VCE French and Italian comments: 'Sometimes I find that studying for Italian actually makes it harder to remember the material I previously studied for French. Am I just imagining this or could this really happen?' Describe a response you could give with reference to one or more theories of forgetting.

6 **a** Can forgetting caused by interference be explained in terms of retrieval failure? If so, how? If not, why not?

b Can forgetting caused by retrieval failure be explained in terms of interference? If so, how? If not, why not?

Learning Activity 7.10

Analysing retroactive and proactive interference

Psychologists refer to interference by *later* learning as retroactive interference and to interference by *previous* learning as proactive interference.

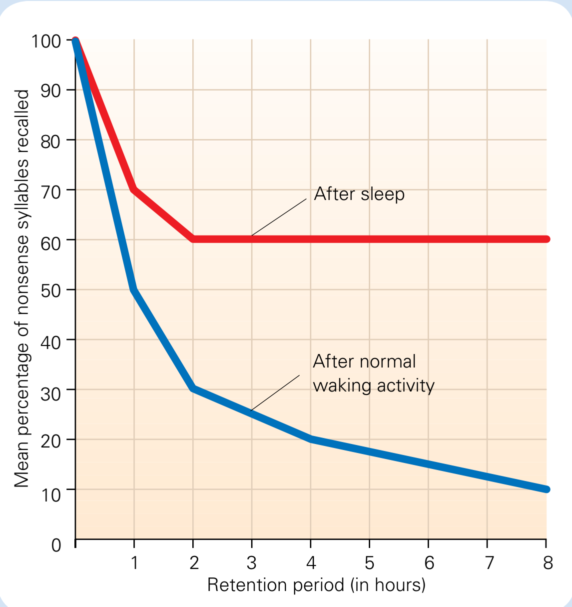
1 Suppose you meet Harry and Emma on your first day of a vacation at a Gold Coast resort. First, Harry tells you his room number. You listen carefully and commit it to memory. Later, Emma tells you her room number and you memorise it. That evening you try to go to Emma's room but discover that you can't remember which of the two numbers it is. You then try to recall Harry's number and realise you are also unsure about this.
   a Which type of interference would cause you to forget Emma's room number? What information caused the interference?
   b Which type of interference would cause you to forget Harry's room number? What information caused the interference?

2 Suppose you have been employed as an organisational psychologist to give advice on increasing productivity at a factory that assembles computers.
Design an experiment to investigate whether training the same employees to do two different assembly tasks produces proactive interference. Present an outline of your experimental design in a flow-chart format. Ensure that you name the type of experimental design to be used and that you give a reason for your choice of experimental design.

Learning Activity 7.11

Data analysis

The graph below shows the results of an early study conducted on sleep and memory. The researchers were interested in finding out whether it was better for recall of newly learned information to go to sleep immediately after learning.



In order to prevent interference effects, Jenkins and Dallenback (1924) had two groups of first-year psychology students at their university learn a list of nonsense syllables. Immediately after the learning, group A participants were required to go to sleep, whereas group B participants continued with their usual activities for 30 minutes before going to sleep. When tested for recall on the nonsense syllables at different times after awakening, it was found that retrieval was lower for group B.

1 Which data in the graph shows the results for group B? Explain your answer.
2 Suggest an explanation of the results in terms of interference.
3 Construct an operational hypothesis for the experiment.
4 Suggest two extraneous or confounding variables that may not have been adequately controlled and explain your choice of each variable.
5 Write a possible conclusion for the experiment, ensuring you refer to your answers above.
6 Explain whether or not the experiment has external validity.

Learning Activity 7.12

Practical activity on retroactive interference

This experiment enables you to test the theory of retroactive interference (when recently learned material interferes with the retrieval of previously learned material).

You will require one participant who volunteers to participate but is not fully informed of all the procedures (so as not to influence the results of the experiment). The experiment uses the three lists of words presented in the table below. Construct an operational hypothesis before you begin the experiment. Your hypothesis should be consistent with theory on retroactive interference. All relevant ethical guidelines should be followed.

Read list A to the participant five times. Each word should be read aloud in a monotone voice, allowing two seconds between each word and five seconds between beginning to read the list again. After the fifth reading, ask the participant to count backwards by fours for 30 seconds, starting from 6500. The participant should write down the numbers. (This is a distraction task to prevent rehearsal.) Then ask the participant to recall as many of the words in list A as they can, and record their score.

Word lists

List A	List B	List C
middle	funny	fearful
mixed	clumsy	aware
sleepy	afraid	soiled
stylish	creased	comic
honoured	conscious	absent
untrue	severe	cautious
mongrel	stained	awkward
piercing	missing	exhausted
useless	careful	folded
muddy	tired	extreme

Repeat the learning procedure using list B. At the end of the fifth reading, do not present the distraction task, but present list C to participants using the same learning procedure used for list A and list B. After list C has been learned, continue with the distraction task for a further 5 minutes. Then ask the participant to recall list B.

The degree of retroactive interference can be measured by subtracting the participant's recall score for list B from their recall score for list A, dividing the difference by the list A score, and converting it to a percentage through multiplication by 100. This is shown by the following formula:

$$\text{Retroactive interference (\%)} = \frac{A - B}{A} \times \frac{100}{1}$$

The data for each participant can be combined with those collected by other class members so that comparisons can be made. The data should be analysed and the experiment evaluated with reference to the following tasks.

1. Identify both the IV and DV in the experiment.
2. What is the control condition? What is the experimental condition?
3. What type of experimental design was used?
4. At what level would you set the *p* value for a test of significance? Explain why you would use this value rather than a higher or lower value.
5. What conclusion(s) can be made from the results? Do the results support your hypothesis?
6. Compare your research finding with theoretical expectations or results obtained from other similar studies.
7. What generalisation(s) can be made from the results? Explain your answer.
8. Evaluate the experimental design. Identify any relevant extraneous or confounding variables and make suggestions for improvements to the experimental design.

Motivated forgetting

When someone has experienced a traumatic event, such as the break-up of an important relationship, an assault, or witnessing a serious accident or violent crime, others often try to comfort them with words such as, 'Don't think about it'. What they usually mean is, 'Try not to bring the memories into conscious awareness, and bury the memory of the event deep in LTM'. Their hope is that by not consciously thinking about the experience, the emotional distress associated with it will be reduced. Is it possible to prevent the recall of traumatic events into conscious awareness? Can we either consciously or unconsciously block the memory of certain experiences?

Motivated forgetting describes forgetting that arises from a strong motive or desire to forget, usually because the experience is too disturbing or upsetting to remember. Two types of motivated forgetting have been identified: *repression* and *suppression*.

Repression involves unconsciously blocking a memory of an event or experience from entering conscious awareness. This explanation is based on the theories of Sigmund Freud that individuals sometimes unconsciously prevent a memory from entering conscious awareness because it is to psychologically painful or unpleasant to remember the specific information. According to Freud, repression is a form of self-protection or self-defence (called a *defence mechanism*) from the anxiety or distress associated with the experience. Because retrieval of a memory can bring back unpleasant thoughts and feelings associated with the experience, the individual avoids these through unconscious processes that result in the repression of the memory.

According to Freud, repressed information is not lost from memory. However, it is not easily accessible during normal waking consciousness. He suggested that repressed information has a way of signalling its existence in dreams, or when a person pauses, fumbles for words, or blushes when certain topics are raised. Freud believed a repressed memory can be retrieved when some of the unpleasant emotion associated with the related experience is 'diffused' (lessened). He demonstrated this with some of his own patients. For instance, he devised specific therapeutic techniques, such as the use of hypnosis, to help his patients retrieve their repressed memories so that they could learn how to deal with the emotions the memories produced in the 'safety' of the therapeutic setting. Freud believed it was important to do this because repressed memories often unconsciously influenced the individual's behaviour and personality in sometimes troublesome ways.

Figure 7.13 According to Freud, we repress—or block out—memories that are too emotionally painful or stressful to remember.

In one case study, a psychologist kept a detailed personal diary recording daily events in his life over a six-year period. When he later tried to recall these experiences, he remembered more than half of the positive experiences but significantly fewer (about one-third) of the negative experiences (Erdelyi, 1985). In another study, researchers surveyed women who, as children, had been taken to hospital because they had been sexually abused. Of the women surveyed, 38% could not recall the incident as adults (Williams, 1994).

Unlike repression, **suppression** involves being motivated to forget an event or experience by making a deliberate conscious effort to keep it out of conscious awareness. Although the person remains aware of the experience and knows that the associated event actually did occur, they consciously choose not to think about it. When we suppress memories, the goal is to consciously put the information out of our mind.

There have been mixed research findings on whether it is actually possible to deliberately forget information; however, research using brain-imaging techniques now suggests it may be possible. For example, one team of researchers used *f*MRI to observe the working brains of different participants while they deliberately tried to forget a list of words they had previously learned. The *f*MRI images of each participant were compared with *f*MRI images from a control condition during which the same participants did not try to forget the words. The results showed that participants remembered fewer words when they actively tried to not think about them than they did in the control condition when they neither tried to recall the words nor tried to forget them. In addition, the *f*MRI images showed a higher level of activation in the left and right frontal cortical lobes (brain areas apparently involved in the suppression of memories), which resulted in reduced activation of the hippocampus (the brain area involved in recalling information). The researchers concluded that if people don't want to think about something and they actively try not to think about it, they are less likely to remember it (Anderson & others, 2003).

Our motivational needs not only prevent retrieval of certain memories, but also can even change the tone and content of memories that we do retrieve. For example, Kihlstrom and Harackiewicz (1982) studied early recollections of participants and found, through comparing the participants' recollections with those of others, that many traumatic memories were selectively reworked as neutral or even pleasant by the participants during recall. This evidence suggests that we may reconstruct our early childhood so that we remember the 'good old days' not necessarily the way they were, but the way we would like them to have been.

Many psychologists accept that memory can be affected by an individual's conscious or unconscious needs, fears, anxieties and desires. Anxiety, for example, can dominate a person's thinking to the point where it seems impossible to remember certain information such as an answer to an exam question. As explanations of forgetting in general, however, motivated forgetting through repression, and to a lesser extent suppression, has been of limited value as it applies only to very specific experiences.

Box 7.3

Case study on motivated forgetting

Perhaps among the most striking and unusual forms of motivated forgetting arises in *psychogenic amnesia*. Consider the case of A.M.N., a 23-year-old insurance worker (Markowitsch & others, 1998).

A.M.N. discovered a small fire in his basement and left the house to call for help. He did not inhale smoke, and he smashed the cellar door and immediately ran out of the house. That evening, he appeared dazed and frightened, and the next morning, when he awoke, he no longer knew what his profession was or where he lived. After three weeks, he entered the hospital. On examination, it became clear that his memories extended only until the age of 17. He barely recognised his partner, whom he had known for three years, and did not recognise his friends or co-workers. After three weeks of therapy, he reported one of his earliest memories as a child; at the age of four, he saw a car crash that set another car in flames; he was then witness to the driver's screams and his death in the flames, with his head pressed against the window. Since that time, fire had been A.M.N.'s worst fear. Despite this, A.M.N. showed normal psychological and physical development and, throughout his life, showed no evidence of psychological illness. A full examination revealed no obvious evidence of brain damage, although greatly reduced metabolism was discovered in memory-related areas. Eight months later, at the time of the report, A.M.N.'s deficits in personal memory remained.

Figure 7.14 In some cases, a recent stressful event, such as a house fire, can cause profound memory loss.

Cases like this illustrate several characteristics of psychogenic amnesia. *Psychogenic amnesia* is triggered by severe psychological stressors. For A.M.N., a particular event triggers a massive reaction. The stressful event can cause a profound loss of memory but without any observable neurobiological causes. In striking contrast, memory for public events and general knowledge is often intact. Unlike in A.M.N.'s case, amnesia can be *global*, in that it affects the entirety of a person's history. Indeed, in a form of psychogenic amnesia known as *psychogenic fugue* state (Hunter, 1968), people forget their entire history, including who they are. In such cases, people are often found wandering, not knowing where to go or what to do. Triggering events include such things as severe marital discord, bereavement, financial problems or criminal offense. A history of depression and also head injury make a person more vulnerable to fugue states, when coupled with acute stress and trauma. Fugue typically lasts a few hours or a few days and, when the person recovers, they remember their identity and history once again. However, they often have persisting amnesia for what took place during the fugue.

Source: Baddeley, A., Eysenck, M.W., & Anderson, M.C. (2009). *Memory*. Hove, East Sussex: Psychology Press, pp. 229–230.

Box 7.4

Infantile amnesia

What's your very first memory? Usually, our earliest memories are for events that took place between the ages of three and five (Bruhn, 1990; Sheingold & Tenney, 1982). Some researchers have found evidence for first memories as early as age two to three, especially for distinct events such as the birth of a sibling or a hospitalisation (Usher & Neisser, 1993). And occasionally, adults report early memories from ages as young as one year. However, such recollections often turn out to be a matter of memory reconstruction. For example, we may hear a story about ourselves as an infant or a toddler so often that we believe that we can remember it (Loftus, 1993).

As a general rule, when we try to remember events from our first few years of life, we draw a complete blank. This loss of memory for our experiences during infancy is called *infantile amnesia*. A number of different explanations of infantile amnesia have been proposed.

One explanation of infantile amnesia is in terms of Freud's theory of motivated forgetting. In Freud's view, the experiences of infancy are repressed, banished from conscious memory, because the infant's sexual impulses and fantasies are too psychologically threatening to be consciously remembered. A problem with the Freudian psychoanalytic explanation is that we don't just have amnesia for threatening or disturbing memories. Rather, we have amnesia for *all* memories, including pleasant experiences and commonplace events. So although Freud's

Figure 7.15 When this girl reaches adolescence, will she be able to recall her delight on Christmas Day as a three-year-old?

ideas are intriguing, memory researchers are not inclined to put much value on Freud's explanation of infantile amnesia (Neisser, 1992).

Another explanation of infantile amnesia is in terms of language development. For example, New Zealand psychologists Gabrielle Simcock and Harlene Hayne (2002) have proposed that young children can probably remember events they experienced between the ages of two and three but are unable to describe them in words. Their inability to translate their experiences into language prevents these experiences from being encoded in LTM.

A third and more widely accepted explanation of infantile amnesia involves brain development. Some researchers believe that the hippocampus does not mature until we are about two years of age. Consequently, during infancy, our hippocampus is simply unable to encode and store events and other experiences in LTM. Other late-maturing brain structures, such as the cerebral cortex, may also play a role in the formation and/or storage of memories (Hockenbury & Hockenbury, 2006; Kalat, 1995; Nelson, 1995).

Decay theory

Decay theory is based on an assumption that when something new is learned, a physical or chemical *memory trace*, sometimes called an *engram*, containing stored information is formed in the brain as the information is consolidated in LTM. According to decay theory, forgetting occurs because a memory (or the memory trace) fades through disuse as time passes, unless it is reactivated by being used occasionally. The memory decay process is like the gradual fading of a photograph or the progressive erosion of the inscription on a tombstone.

Decay theory is probably the earliest theory of forgetting and involves an explanation of forgetting in physiological terms. It is an explanation that is perhaps the most commonly believed in the wider community. Like the other theories, this theory can help explain some of our forgetting. For example, in one research study, a pattern of rapid then more gradual deactivation of neural pathways in the hippocampus (part of the brain believed to be involved in the consolidation of memory) was observed. This has been proposed as a possible physiological basis for the decay of memories stored in LTM (Anderson, 1995). For instance, it appears that the mere passage of time (but not time alone) may also contribute to forgetting both in sensory memory and in STM (or working memory). It does not appear, however, that decay simply due to the passage of time is a common cause of forgetting in LTM. For example, many people have vivid memories of things they have not thought about for years. Most people can, in time, also recall material that was apparently 'lost'. Consider the situation of an old friend you haven't seen for a long time whom you run into

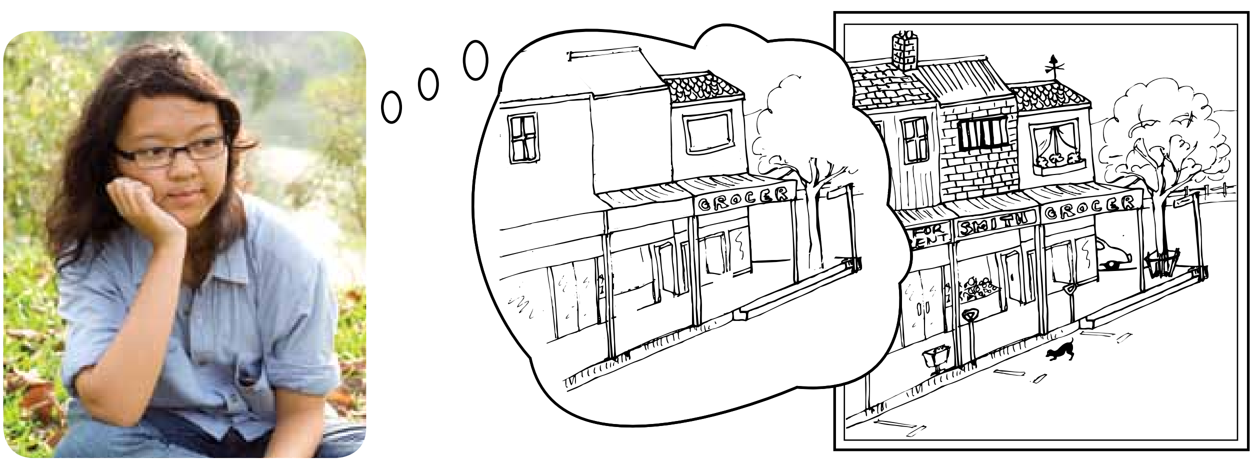


Figure 7.16 According to decay theory, forgetting occurs due to the fading of a memory trace through disuse of the memory over time.

quite unexpectedly in the street. You might not be able to remember their name then and there, or it might be just on the tip of your tongue. At a later time, however, the name might come to you as if it just 'popped out' of memory.

The ability to access memories is assisted by appropriate retrieval cues. If the memory trace simply decayed over time, it would be reasonable to assume that the presentation of retrieval cues would have no effect on the retrieval of information or events that have been held in LTM for a considerable period of time—but it does. Thus, forgetting does not seem to happen in LTM simply because of the fading of memory traces over time, but because other factors such as interference or an inappropriate retrieval cue make memories difficult to retrieve.

Box 7.5

Comparing theories of forgetting

Canadian psychologist Guy Lefrancois (1981) compares some of the theories of forgetting using an analogy of an old filing cabinet. This particular cabinet belongs to a large, long-established firm (an older person's memory). Assuming that all material has been recorded (learned) and filed (stored in memory), the administrative officer (older person)—although a very competent employee—may experience various difficulties in retrieving appropriate files when these are required (*forgetting*). Some of the files have been in the cabinet for so long that they have simply deteriorated with the passage of time, and the writing is hard to read (*decay theory*). In this case, it would be useless to recover the appropriate file since it is now illegible.

As well as these deteriorated and misplaced files, there are a number of entries dealing with sensitive issues. Some years ago, because of the possibility of some scandalous revelations, the administrative officer locked all sensitive files in a small strongbox in one of the dark corners of the bottom drawer. Not only can the administrative officer no longer remember what is contained in these files, but the key to the box has been lost (*motivated forgetting*).

Finally, this filing cabinet contains so much material from so many different years that certain files are still sometimes almost impossible to find. Old and new files are hopelessly confused. As a result, the unhappy administrative officer finds yesterday's files when searching for files several years old (*retroactive interference*), and sometimes finds old files when looking for new ones (*proactive interference*).

Box 7.6

Pseudoforgetting: encoding failure

Another reason for information being unable to be retrieved is because it was never actually encoded properly or stored in LTM in the first place. This is sometimes referred to as *pseudoforgetting*. It is not genuine forgetting, as the information has never actually been stored in LTM—it has been lost from memory prior to entering the LTM store.

Do you know what the front of a five-cent coin looks like? Would you recognise a drawing of one? Undoubtedly, you have probably handled many five-cent coins in your life. Yet many people cannot accurately draw one from memory, identify its features or even recognise a true representation of one. Look at the coins in figure 7.17. Can you recognise the one that displays the features of a five-cent coin? Many people are unable to accurately complete the activity—demonstrating encoding failure. Unless they are a coin collector, most people have not encoded the information that is on the front of a five-cent coin. Sensory memory would certainly have received the information and transferred it to STM or working memory. However, if you did not attend to this information specifically, the exact details of a five-cent coin would not have been encoded to LTM for permanent storage. Hence, your inability to identify the features of the coin is not the result of forgetting; rather, it occurs because you have failed to encode the information.

Figure 7.17 Can you identify a drawing of a real five-cent coin among fakes?

Learning Activity 7.13

Review questions

1 a According to motivated forgetting theory, why are we sometimes motivated to forget? Explain with reference to an example not used in the text.
  b Explain the suggested roles of repression and suppression in forgetting.
  c What is the key difference between repression and suppression?

2 a Briefly describe the decay theory of forgetting.
  b What evidence or experiences suggests that 'information' in LTM
    i may decay through disuse?
    ii does not necessarily fade through disuse?
  c To which other memory system(s) is decay theory more relevant?

3 Suppose you were designing an experiment to test decay theory. The conditions for one of your experimental groups would have to be such that nothing affected the memory trace except the passage of time. Is it possible to set up the conditions for this group, controlling the influence of extraneous variables that could affect the results, such as retrieval failure, interference and motivated forgetting? Explain your answer.

Learning Activity 7.14

Practical activity on childhood amnesia

Multhaup, Johnson and Tetirick (2005) conducted a study on childhood amnesia using a questionnaire with items such as those shown below. These researchers investigated whether the events people say that they remember from early childhood really are *personal recollections*, which involve conscious re-experiencing of some aspect of the event, or whether people *just know* about these events (perhaps from family discussions and conversations), even though they don't truly possess personal recollections. They found that 'personal recollections' tend to emerge later than memory based on 'just knowing', with the transition from mostly 'know' memories to mostly 'recollect' memories occurring at 4.7 years of age.

Use the questionnaire below to test these research findings in an in-class practical activity. Alternatively, your teacher may require you to use the questionnaire for a study using participants of different ages and genders.

Instructions

Please label each of the events listed as a personal 'recollection' or as an event that you 'know' happened but that is not a personal memory. If you neither 'recollect' nor 'know' the event (perhaps because you never experienced it), please label it as 'don't know'. For each event you 'recollect' or 'know', indicate your age at the time the event occurred, as best you can determine, with the year followed by month (e.g. 4.0 is 4 years old exactly, 4.6 is 4½ years old, 4.9 is 4¾, and so on).

Event	Recollect	Know	Age	Don't know
You read your first book with chapters.	❑	❑	❑	❑
You went to your first sleepover.	❑	❑	❑	❑
You saw your first movie in a movie theatre.	❑	❑	❑	❑
You took your first swimming lesson.	❑	❑	❑	❑
You joined your first organised sports team.	❑	❑	❑	❑
You learned to write in cursive.	❑	❑	❑	❑
You stopped taking naps.	❑	❑	❑	❑
You learned to spell your name.	❑	❑	❑	❑
You went to an amusement park for the first time.	❑	❑	❑	❑
You were toilet trained.	❑	❑	❑	❑
You first permanent tooth came in.	❑	❑	❑	❑
You learned to ride a bicycle (two wheels; no training wheels).	❑	❑	❑	❑
You slept in a bed instead of a cot.	❑	❑	❑	❑

Source: The wane of childhood amnesia for autobiographical and public event memories, K.S. Multhaup, M.D. Johnson, & J.C. Tetirick, *Memory*, 13, 172, 2005, Taylor & Francis. Reprinted by permission of the publisher (Taylor & Francis Group, http://www.informaworld.com).

Chapter 7 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Amnesia involves forgetting.

2 ______ Proactive interference is created by prior learning.

3 ______ Suppression is unconscious unintentional forgetting.

4 ______ Retrieval failure theory explains forgetting in terms of failure of the memory trace.

5 ______ Retroactive interference is created by later learning.

6 ______ A photograph can be retrieval cue.

7 ______ The forgetting curve shows that forgetting tends to be slow and gradual for the first hour after the original learning.

8 ______ Retrieval is an all-or-nothing process.

9 ______ A memory trace is the psychological record of a memory.

10 ______ Motivated forgetting may involve intentional or unintentional forgetting.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 7 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Anything that assists recovery of information stored in LTM is called a _____ cue.

A retrieval
B recovery
C trace
D trace-dependent

Q2 Which measure of retention is the most sensitive?

A cued recall
B free recall
C recognition
D relearning

Q3 In an experiment on forgetting, adolescent participants were required to memorise a long list of dates (for example, 1/10/22, 25/2/31, etc.) They were then regularly tested on retention over a period of several weeks.

In general, the forgetting curve for this experiment is likely to show that participants forgot

A about half of the dates within the first 10 minutes of learning.
B about half of the dates within the first hour of learning.
C slowly at first, with a gradual increase as time passed.
D at a slow, steady rate.

Q4 When old learning interferes with the ability to learn something new it is called

A retrieval failure.
B lack of rehearsal.
C retroactive interference.
D proactive interference.

Q5 Repression is said to involve _____, whereas suppression is said to involve _____.

A psychology factors; decay factors
B material lost from memory; material that can be retrieved from memory
C unconsciously blocking a memory from entering conscious awareness; consciously blocking a memory from entering conscious awareness
D consciously blocking a memory from entering conscious awareness; unconsciously blocking a memory from entering conscious awareness

Q6 Forgetting as a result of retrieval failure occurs when

A we are in the same psychological state as the one we were in when we learned the information.
B we fail to use the correct cue to locate and recover information.
C old information interferes with our ability to recall new information.
D the memory trace is ineffective.

Q7 Decay theory suggests that memory loss occurs because

A a memory has not been formed.
B a memory trace fades over time through disuse.
C brain damage has occurred
D inappropriate retrieval cues are used.

Q8 The more meaningful the information that has been learned,

A the slower the rate of forgetting over time.
B the more likely a forgetting curve will be evident.
C the faster the rate of forgetting over time.
D the more likely forgetting will barely be noticeable.

Q9 Which of the following formulas would be used to calculate the amount of information saved from learning at some time in the past?

A $$\frac{\text{(no. of trials for original learning)} - \text{(time for relearning)}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

B $$\frac{\text{(no. of trials for original learning)} - \text{(time for relearning)}}{\text{(no. of trials for original learning)}} \times \frac{1}{100}$$

C $$\frac{\text{(no. of trials for original learning)} - \text{(no. of trials for relearning)}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

D $$\frac{\text{(time for original learning)} - \text{(no. of trials for relearning)}}{\text{(no. of trials for original learning)}} \times \frac{100}{1}$$

Q10 You have just bought a combination lock for your locker and find that you can't remember the first three of the six numbers because you confuse them with the numbers on the combination lock you use on your bike.

This memory failure is most likely due to

A proactive interference.
B partial retrieval failure.
C retroactive interference.
D partial decay of the memory trace.

The answers to the Chapter 7 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

The forgetting curve shows the ________________ and ________________ of forgetting over time.

1 mark

Question 2

Explain the meaning of the phrase 'sensitivity of a measure of retention'.

____

____

____

1 mark

Question 3

Explain three aspects of the retrieval process suggested by studies of the tip-of-the-tongue phenomenon.

____

____

____

____

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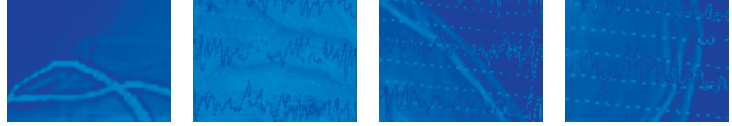
____

____

3 marks

The answers to the Chapter 7 short-answer questions are available at www.OneStopScience.com.au.



8 Manipulation and improvement of memory

Suppose someone asks you to describe your thirteenth birthday party. You may have accurate recollections of what took place based on your direct experience of what you saw, heard, felt and experienced at the time, but you have also stored information from conversations afterwards with friends who attended your party, from family stories, from previous times you've described the party, or from reflections on photographs and videos that you may have viewed afterwards. You will take these bits and pieces and build one integrated version of your thirteenth birthday from them. This account is likely to include accurate information. However, it is also likely to include inaccurate bits and pieces of information that fill gaps but were not part of the original experience. Research findings indicate that much of what we recall from long-term memory is not an accurate representation of what actually happened previously. Instead, it is a logical or plausible account of what *might* have happened, filtered and shaped by our thoughts, attitudes and beliefs, and by who we are as individuals and social beings.

Although we usually remember relevant fragments of what we experience, human memory is prone to errors and distortions. Unlike a camera or audio recorder that captures a perfect copy of visual or auditory information, the details of human memory can change over time. Without our conscious awareness, details can be added, subtracted, exaggerated or downplayed. Research findings indicate that each of us has the potential to confidently and vividly remember the details of some event, yet be completely wrong. Confidence in memory is no guarantee that the memory is accurate. In fact, level of confidence has been found to be generally unrelated to the accuracy with which we recall information from memory. Some researchers believe that strong confidence in the memory of minor details may actually be a cue that the memory is inaccurate or even false (Reisberg, 2007; Hockenbury & Hockenbury, 2006).

How do errors and distortions creep into memories? A new memory is not simply recorded—it is *actively constructed*. To form a new memory, you actively organise and encode different types of information: visual, auditory, tactile, and so on. When you later attempt to retrieve these details, you actively *reconstruct*, or re-create, the details of the memory. In the process of actively constructing or reconstructing a memory, various factors can contribute to errors and distortions in what you remember, or more precisely, what you *think* you remember (Hockenbury & Hockenbury, 2009).

In this chapter, we examine some of the ways that human memory can be manipulated, with reference to factors that influence memory reconstruction. Findings of research studies on the reliability of eyewitness testimony used in courts have been a rich source of information on variables that can produce inaccuracies in what it is that eyewitnesses recall. We then consider ways that memory can be manipulated to enhance how information is stored and retrieved, thereby improving our memory.

Figure 8.1 When we recall an event, our personal characteristics and subsequent experiences influence the way the memory is reconstructed.

Manipulation of memory

A well-known experiment reported by British psychologist Frederick Bartlett in 1932 first drew attention to the reconstructive nature of human memory. Bartlett believed that Ebbinghaus studied human memory in an artificial way. For example, Bartlett suggested that by using nonsense material in order to control the influence of past knowledge, Ebbinghaus also excluded important variables that impact on everyday human memory in real life, such as the influence of our prior experiences, attitudes and expectations. Therefore, instead of using nonsense syllables, Bartlett had participants read prose (a story or essay) or look at a picture. He then asked them on several later occasions to recall and describe the prose passage or draw the picture. Each time, the participants 'remembered' the original stimulus material a little differently. If the original story had contained unusual or unexpected events, the participants tended to describe it in a more logical or 'sensible' way, as if they had revised their memories to make the information more closely match their personal beliefs of what was likely to be true. Bartlett concluded that we tend to remember only a few key details of an experience, and that during recall we *reconstruct* the memory, drawing on our personal values, beliefs and expectations to make up and add missing bits in ways that complete the memory in a logical or plausible way. This is usually done without conscious awareness of it happening. Many subsequent studies have confirmed Bartlett's conclusions and extended his findings about the reconstructive nature of human memory.

The most widely reported of these studies have been conducted by American psychologist Elizabeth Loftus and various colleagues on eyewitness testimony. Loftus has found that eyewitnesses similarly reconstruct their memories, and their testimony is therefore not always accurate. Many of her studies typically involve showing participants a short film, video or slides of an event such as a car accident. Participants are then asked specific questions about the scene they 'witnessed'. Sometimes, information that was not present in the actual scene or which contradicts the scene is introduced. At other times, leading questions are asked.

Loftus's research makes it clear that leading questions can be used to manipulate memory, specifically the reconstruction of memory. A **leading question** is a question that has content or is phrased in such a way as to suggest what answer is desired or to lead to the desired answer. For example, suppose that you witnessed an automobile accident and are asked, 'How fast was the car going when it ran the stop sign?' According to Loftus (1975), this is a leading question because it contains a *presupposition*; that is, information that should or must be true in order for the question to make sense. The question presupposes, or 'assumes', that there was a stop sign. But what if there was no stop sign? You might answer the question anyway because it was a question about how fast the car was going and not a question

Figure 8.2 American psychologist Elizabeth Loftus has conducted more than 200 experiments involving more than 20 000 participants with various colleagues over the past 40 years. She has found that eyewitnesses reconstruct memories of events when questioned and that their reconstructed memories can be manipulated by leading questions that include *presuppositions*—'misinformation' that may be assumed by the witness to be true and may be integrated into a reconstructed memory, along with information about the original event that was witnessed.

about the presence of a stop sign or whether the car ran a stop sign. Loftus proposed, however, that because of the way the question was worded, you might add the new false information about the stop sign to your memory of the event. Then you will be more likely to recall it as a part of your reconstructed memory when answering a question about it, such as 'Did you see the stop sign?', at a later time.

Studies by Elizabeth Loftus

One of the most influential of Loftus's research studies on memory reconstruction was conducted with American colleague John Palmer (1974). The study consisted of two laboratory experiments that investigated the influence of question wording on memory and how information supplied after an event can distort a witness's memory for that event.

In the first experiment, 45 volunteer students from the university where the researchers worked were each shown seven film clips of car accidents. The clips were short excerpts from films made for driver road-safety education purposes and ranged from five to 30 seconds in length. After viewing each clip, the participants ('eyewitnesses') were asked to write a description of the accident they had just seen. They were also asked to answer some specific questions about the accident, including a critical question requiring an estimation of the speed of the cars involved in each collision. There were five conditions in the experiment, with nine participants randomly assigned to each condition. In each condition, a different word (verb) was used to complete the critical question; that is, different groups of participants were given different versions of the question. This question asked, 'About how fast were the cars going when they _____ each other?' and was completed with each of the following words: *smashed*, *collided*, *bumped*, *hit* and *contacted*. For example, in condition 1, the critical question was 'About how fast were the cars going when they smashed into each other?'; in condition 2, the critical question was 'About how fast were the cars going when they collided with each other?', and so on. In order to control the potential influence of the order in which the clips were viewed, the clips were presented in a different order to each group of participants. As shown in table 8.1, the wording of the question influenced the speed estimates given by the participants, with the most 'intense' verb (*smashed*) bringing about the highest speed estimates (a mean of 40.8 miles per hour) and the least 'intense' verb (*contacted*) bringing about the lowest speed estimates (a mean of 31.8 miles per hour). The differences in speed estimates were found to be statistically significant (at $p \leq 0.005$). Loftus and Palmer suggested that the results could be due to participants' memories being distorted by the verbal label that had been used to characterise the intensity of the car crash they witnessed. However, they also suggested that the results could have been influenced by response bias; for example, being uncertain about the exact speed of the cars, participants may have adjusted their estimates to fit in with the expectations of the researcher.

Table 8.1 Estimates for each verb used in the estimation of speed question

Verb	Mean estimate of speed (mph)
Smashed	40.5
Collided	39.3
Bumped	38.1
Hit	34.0
Contacted	31.8

Source: Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 586.

In the second experiment, a procedure similar to that for the first experiment was used. This time, 150 different university students who volunteered for the experiment were randomly assigned to either of three groups (conditions) and viewed a one-minute film that included a four-second scene of a multiple car crash. The participants were then questioned about the accident. Group 1 was asked 'About how fast were the cars going when they *smashed into* each other?'; Group 2 was asked 'About how fast were the cars going when they *hit* each other?'; and Group 3 was not asked a question about the speed of the cars. The results obtained showed that the mean speed estimate for the question with *smashed into* was 10.46 mph and the mean speed estimate for the question with *hit* was 8.00 mph. The difference in the mean scores was found to be statistically significant.

One week later, the participants returned for the second part of the experiment. Without viewing the film again, they were required to answer a series of 11 questions about the car crash. This time, the critical question was '*Did you see any broken glass?*' This question was 'hidden' among the other questions that served as 'distracter' questions. It was also placed in a random position on each participant's question paper. There was, in fact, no broken glass at the accident scene. As shown in table 8.2, the wording of the original question they were asked in the first part of the experiment influenced whether or not participants reported seeing broken glass. Although most participants accurately reported not seeing any broken glass, more participants who had been given the question with the word *smashed* (16) reported seeing broken glass than did those who had been given the question with the word *hit* (7). These results were also found to be statistically significant.

Table 8.2 Responses to the question 'Did you see any broken glass?'

Response	Verb condition		
	smashed	hit	control
Yes	16	7	6
No	34	43	44

Source: Loftus, E.F., & Palmer, J.C. (1974). Reconstruction of automobile destruction: An example of the interaction between language and memory. *Journal of Verbal Learning and Verbal Behavior*, *13*, 587.

In explaining the results, Loftus and Palmer suggested that in the first part of the experiment, participants formed a memory of the car crash they witnessed on viewing the film. Integrated with this memory was the additional piece of 'new' false information supplied *after* the event about the cars having either 'smashed into' or 'hit' each other. This information was included as a presupposition in the critical question on the speed of the cars. When asked one week later whether they saw any broken glass at the accident scene, participants remembered broken glass that wasn't really there. Over time, information from the two different sources (events witnessed when viewing the film and the presupposition in the leading 'critical' question asked afterward) had been integrated in the reconstruction of a new distorted memory. Participants were unable to tell that key information in their memory had come from different sources. This has been described as source confusion. *Source confusion* arises when the true source of the memory is forgotten or when a memory is attributed to the wrong source. In Loftus's studies, 'misinformation' provided in leading questions *after* the event become confused with the details of the original memory.

Numerous other studies by Loftus as well as other researchers have since found that the memories of eyewitnesses are reconstructions, instead of exact replicas, of the events witnessed. They have also confirmed Loftus's findings that eyewitness memories can be altered by post-event exposure to inaccurate information introduced during questioning. For example, people have recalled stop signs as give-way signs, green stop lights as shining red, non-existent barns along empty country roads, non-existent mothers with prams, a blue car used in a crime scene as white and even Minnie Mouse when they really saw Mickey Mouse (Loftus, 1993).

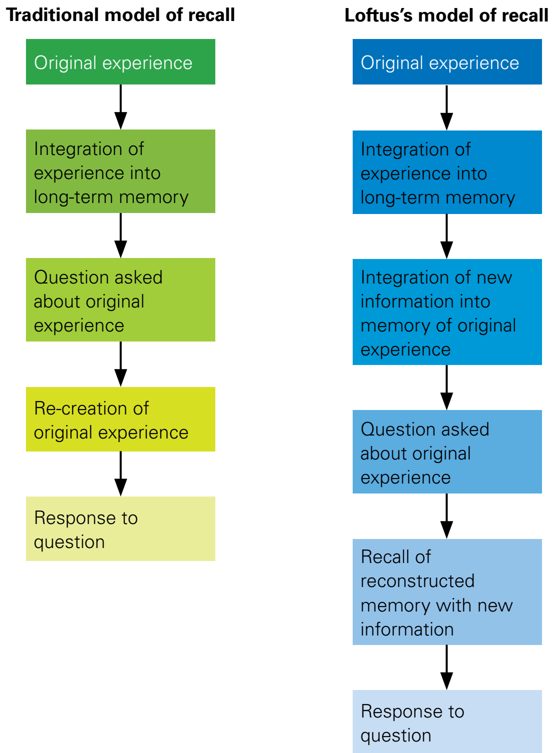


Figure 8.3 A comparison of Loftus's model of recall from LTM with the traditional model. Loftus's model includes an extra step of integrating new information acquired after the original experience, which may be used in a reconstructed memory that does not accurately reflect the original experience.

Although eyewitnesses may think, feel and behave differently when observing a crime in the laboratory as compared with real-world settings, eyewitness testimony cannot be regarded as infallible, even when the witness is trying to be truthful. Among many other variables, it can be distorted by leading questions that contain 'misleading' information. This is the main reason why leading questions by prosecutors and barristers are disallowed in courtroom proceedings.

Loftus has proposed that any model of memory should include the process of reconstruction that occurs when new information is integrated into the original memory of an event. Figure 8.3 shows a traditional model of recall from LTM compared with Loftus's model, which includes an extra step of integrating new information. New information acquired after the original experience is integrated with information in the original memory, resulting in recall of a reconstructed or altered version of the original memory. Later, if asked a question about the original experience, your recall will not be of the actual original experience, but of your reconstruction of the experience.

Box 8.1

Planting false memories

Elizabeth Loftus has also extensively researched and written about *false memories*, or memories of events that are distorted or made up and believed to have been experienced but that never actually took place. Following is an extract from one of her articles on false memories.

> It is one thing to change a stop sign into a yield sign, to turn Mickey into Minnie, or to add a detail to a memory report for something that actually did happen. But could one create an entire memory for an event that never happened? My first attempt to do this used a procedure whereby participants were given short narrative descriptions of childhood events and encouraged to try to remember those events. While participants believed that all of the descriptions were true and had been provided by family members, one was actually a pseudoevent that had not occurred. In this study, approximately 25% of participants were led to believe, wholly or partially, that at age 5 or 6 they had been lost in a shopping mall for an extended time, were highly upset, and were ultimately rescued by an elderly person and reunited with their family. Many added embellishing details to their accounts.
>
> The method of using family members to help plant false memories can simply be called the *lost-in-the-mall* technique. Many investigators have used the lost-in-the-mall technique to

plant false memories of events that would have been far more unusual, bizarre, painful or even traumatic had they actually occurred. Participants have been led to believe that they had been hospitalised overnight or that they had an accident at a family wedding. They have been convinced that they had nearly drowned and had to be rescued by a lifeguard. They have been persuaded by the suggestion that they were once the victims of a vicious animal attack.

Most studies find that a significant minority of participants will develop partial or complete false memories. In one set of studies reviewed by a team of psychologists, the average false memory rate was 31% (but in individual studies, the figures can vary). Sometimes people have been resistant to suggestions, as they were when investigators tried to plant false memories of having received a rectal enema. Conversely, sometimes false memories have been planted in the minds of more than 50% of exposed individuals, as they were when investigators tried to plant false memories of having gone up in a hot-air balloon ride. Particularly striking are the complete false memories, or what might be termed *rich false memories*, which are experiences about which a person can feel confident, provide details, and even express emotion about made-up events that never happened.

Source: Loftus, E.F. (2003). Make-believe memories. *American Psychologist, 58*(11), 867–873.

Figure 8.4 When researchers pasted childhood photos (left) into a photo of a hot-air balloon ride (right), about half the participants could remember the event, even though none had ever been in a hot-air balloon.

Learning Activity 8.1

Review questions

1. Define the meaning of memory construction.
2. Explain *how* and *why* memory construction is believed to occur.
3. **a** Explain what a leading question is with reference to the use of a presupposition.
   b Give an example of a leading question with a presupposition, other than an example given in the text.
4. Explain, with reference to research evidence, how a leading question can be used to manipulate memory reconstruction by eyewitnesses.
5. Suggest three other variables that can influence memory reconstruction, ensuring you give a reason for your choice of each variable.
6. Explain whether Loftus's research findings on the reconstructive nature of memory are relevant to long-term memories other than episodic memories.

Learning Activity 8.2

Data analysis

1. **a** Graph the results in table 8.1.
   b Describe and explain the results in the graph with reference to the experimental procedures used by Loftus and Palmer (1974).
2. Briefly explain the meaning of the phrase 'the differences in speed estimates were found to be statistically significant (at $p < 0.005$)'.
3. Explain whether or not conclusions drawn from table 8.1 are influenced by the lack of a control group in the experiment.
4. Graph the results in table 8.2.
5. Explain why 16 participants in the 'smashed' verb condition reported seeing broken glass.
6. Suggest an explanation for six control group participants reporting that they saw broken glass.
7. What do the data in table 8.2 indicate about participant attrition?

Learning Activity 8.3

Evaluation of research by Loftus and Palmer (1974)

Evaluate the research study conducted by Loftus and Palmer (1974). You may present your evaluation of the two experiments as an annotated diagram; for example, as a flow chart. You are required to:

- construct an operational hypothesis that could have been tested by the procedures used in each experiment
- identify the sample in each experiment and the population from which these were drawn
- identify the participant selection and allocation procedures
- identify the IV and DVs in each experiment
- identify the conditions in each experiment
- identify the type of experimental design used
- briefly state the results obtained
- briefly state a conclusion based on the results obtained
- briefly state what the conclusion suggests about the accuracy of eyewitness testimony
- briefly state the researchers' explanation of the results
- identify a potential extraneous or confounding variable that could impact on the results obtained if uncontrolled and explain how it was controlled
- comment on the external validity of the experiment and the extent to which the results can be generalised.

Improvement of memory

Some day we might be able to effortlessly acquire, retain and retrieve information by taking some kind of 'memory pill', or by hooking up through a direct electrical link from our brains to a personal computer that we wear like a wristwatch. In the meantime, however, those of us who want to improve our memories must rely on specific mental strategies.

Of course, some things are very easy to remember. If you arrived at school one day and saw the principal sitting on top of the flagpole you would not have to rehearse this information to remember it. Observing such an unusual event would be enough to ensure that the scene remained with you always. Similarly, you would probably easily learn and remember the name of the next prime minister of Australia when they were elected. But often we must learn and remember information that is much more difficult. This requires conscious effort. Mere exposure, even very frequent exposure, to information is often insufficient to produce efficient remembering.

To make sure that information goes beyond sensory memory, attention must be given to it. It must also be organised and integrated into the information already stored in LTM. However, while this may sound like a tedious process, improving or enhancing your memory is not very difficult.

Context- and state-dependent cues

An effective way of enhancing retrieval from LTM is to re-create the conditions under which the required information was originally learned. This approach is based on the *encoding specificity principle* (Tulving, 1983).

The principle involves a general 'rule' that the more closely the retrieval cues match the original learning conditions, the more likely it is that the information will be recalled. For example, re-creating the external environment (*context*) in which the original learning occurred, or the learner's internal environment (*state*), has been found to provide valuable cues that aid the retrieval process.

Context-dependent cues

Why is it that police investigating a crime may take an eyewitness back to the crime scene, particularly if the witness is having trouble recalling some details of what they saw that are crucial to the investigation? The answer to this question is based on research findings that cues in the environment may be important in helping to locate and retrieve related memories.

Context-dependent cues are environmental cues in the specific situation ('context') where a memory was formed, which act as retrieval cues to help access the memories formed in that context. These cues may include the sights, sounds and smells within that specific situation.

The context dependency of certain memories was demonstrated in an experiment undertaken to compare the efficiency of land training and underwater training of deep-sea divers. British psychologists Duncan Godden and Alan Baddeley (1975) presented divers with a list of 40 unrelated words in either of two settings: on the beach or under about five metres of water. After the words had been heard, the divers were then tested for recall of the words, either in the same environment or in the alternate one. The results showed that the divers recalled up to 20% more words when the words were learned *and* retrieved in the same context (see figure 8.5).

The context dependency of certain memories helps explain why an eyewitness may recall apparently forgotten information about a crime when they return to the scene of the crime. When they return to the crime scene (the context where the memory was originally formed), the environmental cues act as additional retrieval cues that assist recall of the information.

A number of research studies have tested whether students perform better if their final exams are taken in the same room where they learned or studied the test material. Typically, the results suggest that any differences are sufficiently small so as to not be of concern for students (Saufley, Otaka & Baveresco, 1985). However, these results have been consistently obtained only when the learning environment and the testing environment are similar; for example, if the learning and recalling occurred in different rooms in the same school.

But if the testing environment is substantially different from the learning environment, the differences in performance are likely to be more noticeable (Baddeley, 1999).

Learning Activity 8.4

Evaluation of research by Godden and Baddeley (1975)

Evaluate the experiment conducted by Godden and Baddeley (1975). You may present the evaluation as an annotated diagram; for example, as a flow chart. You are required to:

- identify the aim of the experiment
- construct an operational hypothesis that could have been tested by the procedures used in the experiment
- identify the IV and DVs
- identify the different conditions of the experiment
- identify the type of experimental design used
- identify an appropriate participant allocation procedure
- briefly state the results obtained
- briefly state a conclusion based on the results obtained.

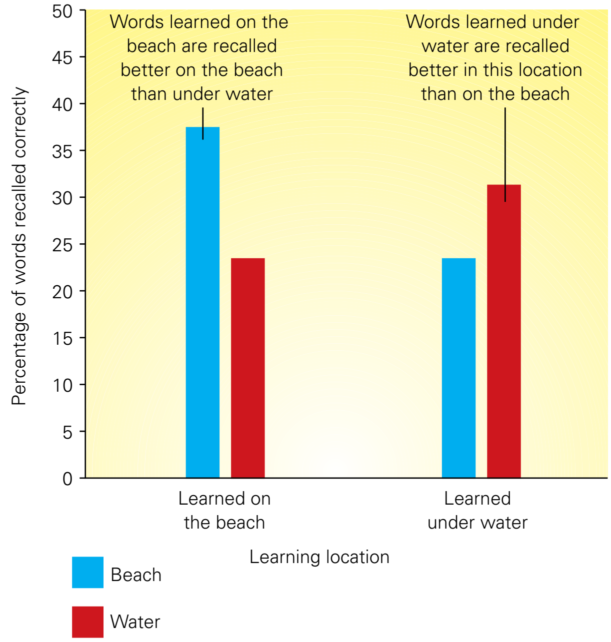


Figure 8.5 The influence of context was evident in a study in which participants learned lists of words either while on the beach or while submerged under five metres of water. In this graph, it is apparent that when the conditions of learning and retrieval matched, participants were able to remember more words (Godden & Baddeley, 1975).

Figure 8.6 When the learning environment and the testing environment are similar, performance on tests is likely to be improved compared with testing in a totally different environment. Context cues assist retrieval when the learning and testing environments are similar.

Box 8.2

Context-dependent retrieval cues in Aboriginal storytelling

When Margaret Mead, an eminent American anthropologist, lived with Aborigines in South Australia, she learned that some important aspects of the culture are transmitted through storytelling. Stories of significant events are memorised so that the next generation can learn about the cultural past. These stories are sometimes long and contain many important details.

Mead observed that in order to be able to tell a long story accurately, the storytellers had to walk through the places involved in the story. Thus, features of the environment were context-dependent cues that triggered the storytellers' memories. If the storytellers were tested in a laboratory setting without the retrieval cues of their physical environment, their memories probably would not be so remarkable.

Figure 8.7 Aboriginal storytellers often use specific cues in the environment to help them recall details of their stories.

State-dependent cues

Internal cues that are related to a specific experience may also trigger the retrieval of associated memories. These are called state-dependent cues. **State-dependent cues** are associated with an individual's internal physiological and/or psychological state at the time the memory was formed, which act as retrieval cues to help access those memories. For example, if information is learned when you are happy, sad, intoxicated, sober, calm or aroused, that information is more likely to be retrieved when you are in the same 'state' (Eich, McCaulay & Ryan, 1994; Bower, 1981).

Research studies have found that when participants learn information while under the influence of drugs such as alcohol, caffeine, nicotine or marijuana, they recall the information better when they are again under the influence of the same drug than when they are not under its influence (Roediger, 1992; Baddeley, 1990). In one research study, Goodwin and his colleagues (1969) conducted an experiment on the effects of alcohol on recall. They found that heavy drinkers who hide alcohol or money when intoxicated are often unable to remember where it is hidden once they are sober. On becoming intoxicated again they tend to remember where the items are hidden. Goodwin studied this effect using a variety of tests and found that, in general, what is learned when intoxicated is best recalled when in the same state.

It seems that taking a drug can produce an internal state with unique psychological and physiological characteristics, aspects of which may become encoded with new memories. At a later point, the same internal state can provide additional retrieval cues that assist recovery of information from memory. Thus *state-dependent retrieval* involves better recall of information when the physiological and/or psychological states of learning and retrieval match. Does this mean that drugs such as alcohol and marijuana *improve* memory? Absolutely not—they actually impair memory, as they interfere with encoding.

Your mood also provides state-dependent retrieval cues. We seem to associate good or bad events with their accompanying emotional state. Thus, the emotional states become retrieval cues when we feel good or bad again, and they trigger memories that are consistent with the mood. However, there is a complicating factor. When we are happy, the happy events are recalled, but when we feel 'down', our minds can become flooded with sad or negative events of the past, which in turn darken our interpretations of current events (Eich, 1995).

Mnemonic devices

Techniques for enhancing or improving memory are known as **mnemonic devices** (from the Greek word *Mnemosyne*, the goddess of memory). They can be as basic as a rhyme or can be complicated strategies that themselves take considerable time to learn. Many of these devices were developed in ancient times by scholars, politicians, orators, actors and priests, when written records were scarce or non-existent. It is only in relatively recent times that psychologists have examined these devices and have recognised their value in improving memory. Further, the devices and their respective uses provide many insights into the organisation and operation of memory.

Mnemonic devices make use of information that is already stored in LTM. The devices do not simplify information; they actually make it more *elaborate*. More information is stored, not less. However, the additional information makes the material easier to locate and retrieve because it has enhanced organisation in LTM. Mnemonic devices tend to organise new information into a cohesive whole, so that retrieval of part of the information generally assists retrieval of the rest of it. These facts suggest that the ease or difficulty with which we learn new information depends not on *how much* we must learn, but on *how well it fits with what we already know*. The better it fits, the easier it is to retrieve (Carlson, 1987).

Each mnemonic device is based on a particular kind of elaboration, encoding or rehearsal strategy to enhance memory. Some mnemonic devices emphasise the logical organisation of information to be remembered, and use a particular structure to facilitate this; for example, narrative chaining. Other mnemonic devices also rely on the use of visual imagery to elaborate the information to be remembered; for example, the method of loci. We first consider some simple mnemonic devices with which you are probably familiar.

Learning Activity 8.5

Review questions

1. What is a context-dependent cue? Explain with reference to a specific example not used in the text.
2. What is a state-dependent cue? Explain with reference to a specific example not used in the text.
3. Give an example of an everyday life situation involving both context- *and* state-dependent cues.
4. Explain how context- and state-dependent cues can improve or enhance retrieval from LTM. For each type of cue, give two relevant examples linked to memory improvement.

Learning Activity 8.6

Experimental design

Outline an experiment that could be conducted to test the state-dependency of memory.

Present your experimental design as a flow chart that shows the key features of the experiment and its design; for example, aim, operational hypothesis, IV(s) and DV(s), sampling procedure, experimental groups or conditions and participant allocation procedure.

Explain your choice of experimental design and identify three relevant extraneous variables whose unwanted influence on the results should be minimised.

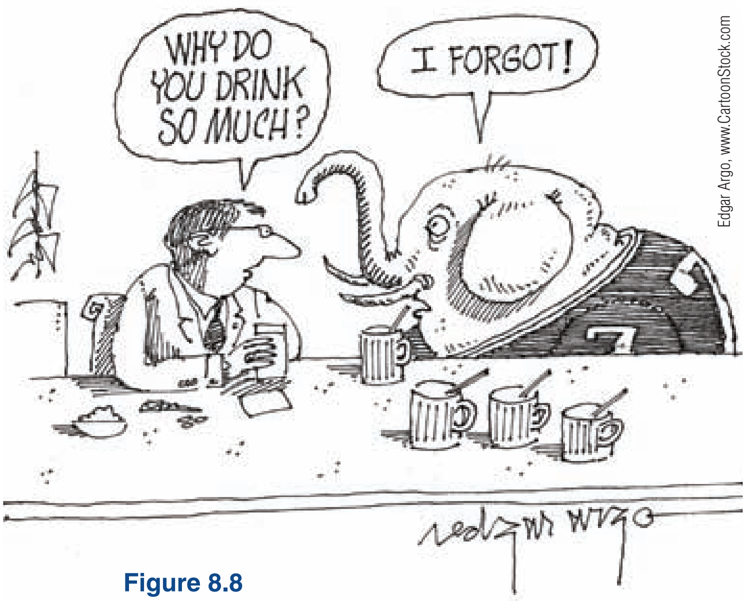


Figure 8.8

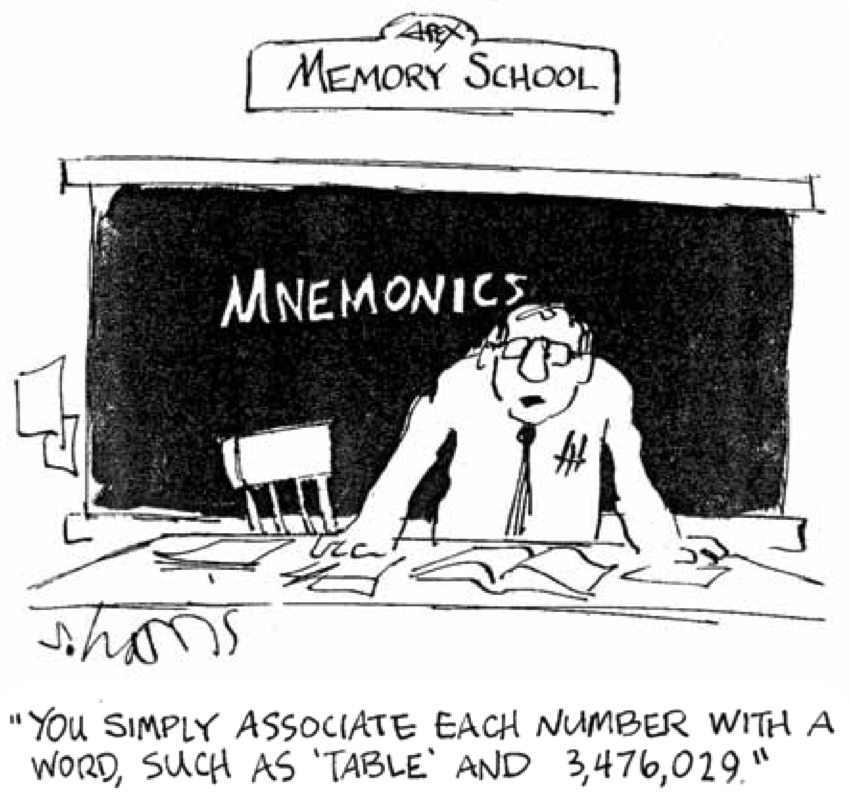


Figure 8.9

Acronyms and rhymes

When using acronyms and rhymes, organisation of information is important. **Acronyms** are pronounceable words formed from the first letters of a sequence of words. The acronym doesn't have to be a real word; for example, an acronym is often a pronounceable abbreviation. The letters of the abbreviation act as a retrieval aid in the recall of more complex material. Acronyms are formed using a type of chunking procedure. ANZAC, for example, is an abbreviation of 'Australian and New Zealand Army Corps', and EFTPOS is an abbreviation of 'electronic funds transfer (at the) point of sale'. For both of the examples, the abbreviation is a pronounceable word. Similarly, a large number of organisations are known by their acronyms rather than by their names: UNESCO, WHO, NATO and so on. Acronyms can also be used for remembering other types of information. For example, the colours in the rainbow or visual colour spectrum can be remembered by relating them to the pronounceable name 'Roy G Biv' (red, orange, yellow, green, blue, indigo, violet).

As with acronyms, you are also likely to have used rhymes as a way of improving memory. A **rhyme** is a phrase or string of words (such as a jingle), often with an emphasis on similar sounding key words. For example, the rhyme '*i before e, except after c*' assists memory for the correct spelling of words containing *ie* and *ei*, and the rhyme '*Big fat Italy kicked poor Sicily into the Mediterranean Sea*' assists memory for a specific geographic location. These types of rhymes organise information by associating the information with a particular rhythm (sound) and with rhyming words. If we make an error in using a rhyme mnemonic, the rhythm is broken, or the rhyme is ruined, or both. Consequently, we immediately know an error in retrieval has occurred.

Another rhyme, used to remember the number of days in each month, is: *Thirty days hath September, April, June and November; all the rest have thirty-one, except February alone, which has twenty-eight days clear, and twenty-nine in each leap year*. Some people, however, find this rhyme difficult to remember. There are many different ways to remember the same information; you need to find a mnemonic that works for you. Another favourite for remembering the days of the month is shown in figure 8.10. Hold your fists in front of you, side by side, and count from the left. The longer months will fall on the knuckles and the shorter months in the hollows.

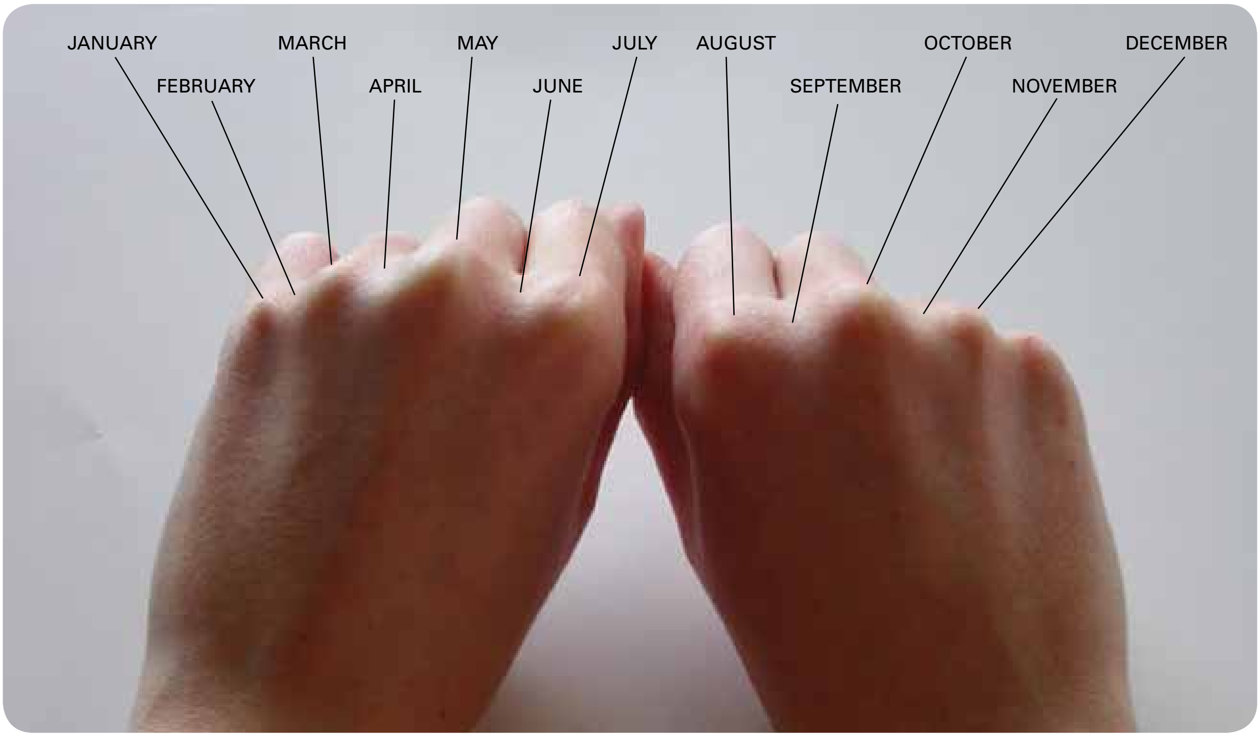


Figure 8.10 This mnemonic helps remember which months have 31 days.

Acrostics

Acrostics, or the *first-letter technique*, involve making verbal associations for items to be remembered by constructing phrases or sentences using the first letters of the information to be remembered. You may have used this method if you recall the names of the original planets (in order from the sun), by linking them to a phrase such as 'my very energetic mother just sits up near pop' (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto). Similarly, in music classes you may have learned the phrase 'every good boy deserves fruit'. The first letters of these words are the same as the names of the musical notes on the lines of a staff (E, G, B, D, F).

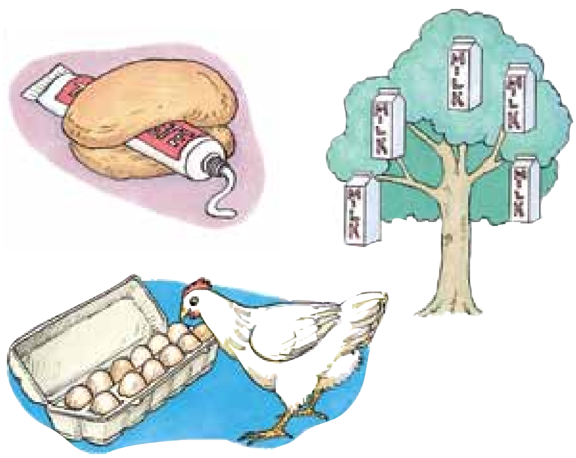
Acrostics can also be useful when you have to remember information in sequential order, such as sets of points for an essay or lists of information. For example, if you wanted to remember several reasons for the colonisation of Australia you could choose key words (for example, *convicts*, *staple*, *imperialism*) and organise them into a sentence. You could then recall the sentence and each word in the sentence would act as a retrieval cue for the recall of specific related information.

Peg-word method

The peg word method is effective when you have a list of information to be remembered in a particular sequence, such as shopping items, errands, sets of facts, historical events and so on. The **peg-word method** consists of memorising a rhyme or jingle that has mental 'pegs' or 'markers' on which you 'hang' the items to be remembered. To do this, you use an easily recalled series such as the numbers 1 to 10. These numbers act as the retrieval cues for words that rhyme with each number. For example, the numbers 1 to 10 can be used to recall the list of rhyming words (for example, 1 – bun, 2 – shoe) shown in the left-hand column of figure 8.11. The rhyming words, in turn, will be retrieval cues (the 'peg' words) for information you wish to remember. Importantly, you must associate the information to be remembered with the rhyme by using visualisation.

The peg-word method is particularly effective when the image of the peg-word object and the image of the object to be recalled interact, rather than merely being paired side by side. For example, suppose you wanted to remember the grocery list presented in figure 8.11. You might imagine eating a bun with toothpaste oozing from the middle, a tree that grows milk cartons, and a hen pecking a carton of eggs. To recall the items, you recite the rhyme. The peg-word that is associated with a particular number then acts as a cue for retrieving the item that interacted with the peg-word. For example, if you imagined a bun you would automatically retrieve an image of toothpaste oozing from the bun.

While it may seem as if learning and memorising information using the peg-word method is a lot of extra work, experimental evidence indicates that it is worth the effort as it can significantly improve recall of information from semantic LTM.



Step 1: Memorise peg-words in order	Step 2: Pair items with peg-words
one is a bun	bun—toothpaste
two is a shoe	shoe—soap
three is a tree	tree—milk
four is a door	door—margarine
five is a hive	hive—yoghurt
six is sticks	sticks—lettuce
seven is heaven	heaven—muesli
eight is a plate	plate—bread
nine is a vine	vine—garlic
ten is a hen	hen—eggs

Figure 8.11 The peg-word method can be used to recall a grocery list. Each grocery item on the list is paired with a peg-word and the retrieval of the peg-word will cue the retrieval of the associated grocery item.

Narrative chaining

Narrative chaining involves linking otherwise unrelated items to one another ('chaining') to form a meaningful sequence or story ('narrative'). It is a mnemonic device. Table 8.3 is an example of narrative chaining.

Table 8.3

Word to be remembered	Stories
Bird Costume Letterbox Head River Nurse Theatre Wax Eyelid Fireplace	A man dressed in a *bird costume* and wearing a *letterbox* on his *head* was seen leaping into the *river*. A *nurse* ran out of a nearby *theatre* and applied *wax* to his *eyelid*, but her efforts were in vain. He died and was tossed into the *fireplace*.
Burglar Penthouse Mountain Koala Hotel Fuzz Gland Antler Pencil Vitamin	A *burglar* lived in a *penthouse* on top of a *mountain*. He stole *koalas*. He would take his captive animals to a *hotel* where he would remove *fuzz* from their *glands*. Unfortunately, all this exposure to koala fuzz caused him to grow *antlers*, so he gave up his profession and went to work in *a pencil* factory. As a precaution he also took a lot of *vitamin* E.

Source: adapted from Bower, G.H., & Clark, M.C. (1969). Narrative stories as mediators for serial learning. *Psychonomic Science, 14*, 181–182.

In a study showing the effectiveness of narrative chaining, one group of participants (control group) was asked to learn 12 lists of ten simple nouns. The participants were given no instructions other than to remember each list of words in order. A second group of participants (experimental group) was given the same 12 lists to learn but was instructed to use narrative chaining. This group was asked to make up short stories that used each of the words on the list in turn. Immediately after each list was learned, both groups were asked to recall the list of words in order. There was virtually no difference in the immediate recall scores of both groups. But when participants were later asked to recall all the lists of words, those who used narrative chaining recalled an average of 93% of the words, while the other group recalled an average of only 13% of them (Bower & Clark, 1969).

In another experiment, participants who used narrative chaining remembered six times more information than participants who learned by simply repeating the words to themselves (Loftus, 1980). These results provide strong evidence that using a technique that adds *organisation* and *meaningfulness* to otherwise meaningless material is a form of elaborative rehearsal that will improve retrieval. Narrative chaining is a particularly useful mnemonic device when you want to remember information in a particular order.

Research studies have found that narrative chaining is not only effective for people with normally functioning memory, but also for people who have memory impairment (Wilson, 1995).

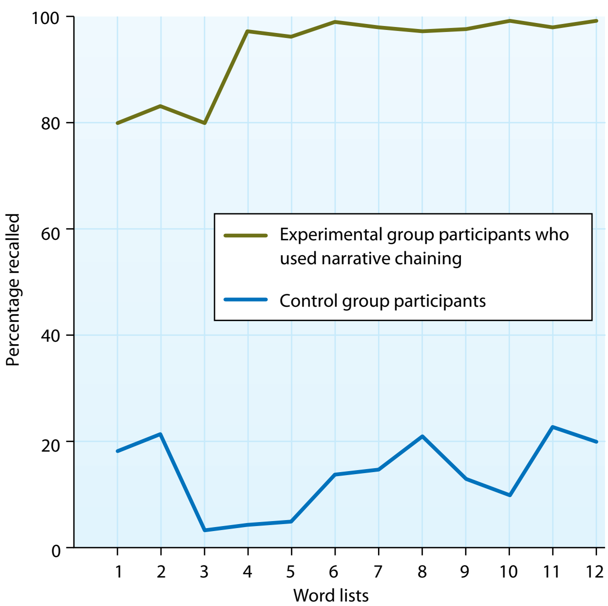


Figure 8.12 The graph shows the results of the Bower and Clark (1969) experiment. The experimental group participants who used narrative chaining recalled many more of the words from the lists when compared with the control group participants who chose their own strategy to learn the words.

However, a narrative will not be helpful if it hangs together so loosely that you cannot remember the story (Matlin, 2002).

Method of loci

One of the oldest mnemonic devices was used by Ancient Greek and Roman public speakers who, without the benefit of paper, had to learn and recall their long speeches or poems. The technique, called the **method of loci** (*loci* means 'place' in Latin), uses a well-learned sequence of locations as a series of retrieval cues for the information to be recalled.

When the orators used this method, they would associate the parts of their speeches with landmarks in a familiar place or a part of a building. For example, if an opening point of a speech was about 'love', they might visualise a couple embracing at the entry of a temple to remind them of this point. As they mentally 'walked' around the temple, just as you could make a mental tour of your house to count the windows, they would come across each of the points to be made in their speech in the appropriate order. Like narrative chaining, the method of loci is particularly useful when you want to remember a list of items in a particular order (Heath, 1998); for example, if you had to remember the sequence of a number of historical events in chronological order.

The first step involved in the method of loci is to learn, in their naturally occurring sequential order, some locations that are easily distinguishable and well known to you. For example, the layout of your home or backyard, the route you take between home and school, or parts of your body from head to toe. The number of locations in the sequence should correspond with the number of items of information to be remembered. It should also be possible to mentally 'move' through the locations sequentially without difficulty.

The second step is to associate a visual image of each item to be remembered with a location in the sequence. This involves creating a mental image of the items to be remembered and visually linking them with a particular location. For example, if the location is your backyard and the first item to be remembered is the planet Pluto you might imagine the Disney character, Pluto the dog, lying at the back door. If the second item is a space vehicle, you might imagine this hovering over the first pot plant you come to after you walk out your back door. If any item is an abstract or unusual concept that is hard to visualise, it must be changed into an object that can be visualised instead; for example, a courtroom might be a good substitute for the concept of 'justice'. When you need to remember the material, you mentally revisit each place in the sequence in its predetermined order, retrieving from each place the image associated with it.

The method of loci elaborates the information to be learned by linking it with memory cues that are very familiar. This almost guarantees that these cues will be available when the information is being recalled (Matlin, 2002). Although this method may seem an unusual strategy to enhance memory, experimental findings indicate that it can improve memory by a factor of two to three times over serial recall without the use of a mnemonic device.

In one experiment, participants in the experimental group used the method of loci to associate a list of 25 words with 25 locations in a familiar route. Participants in the control

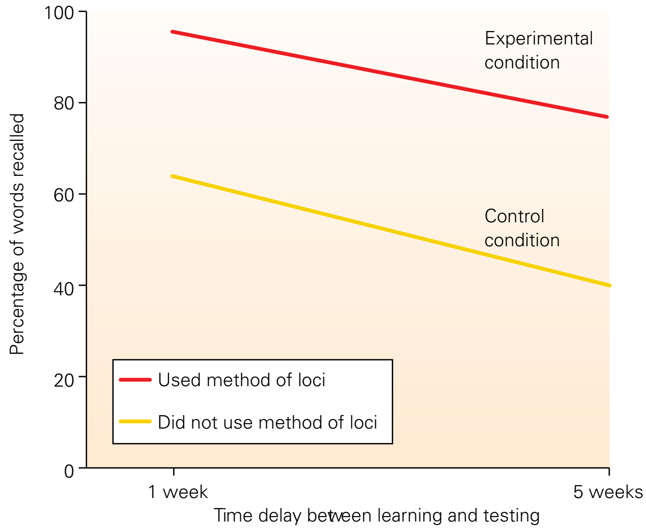
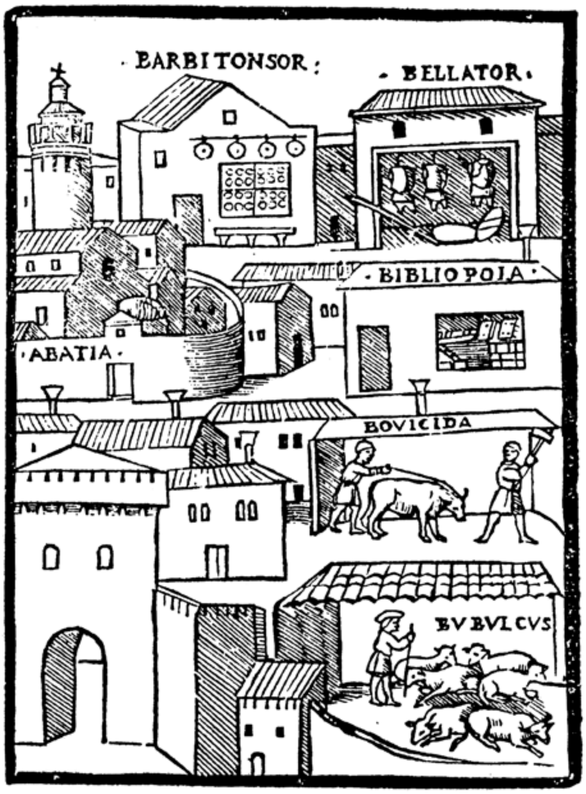
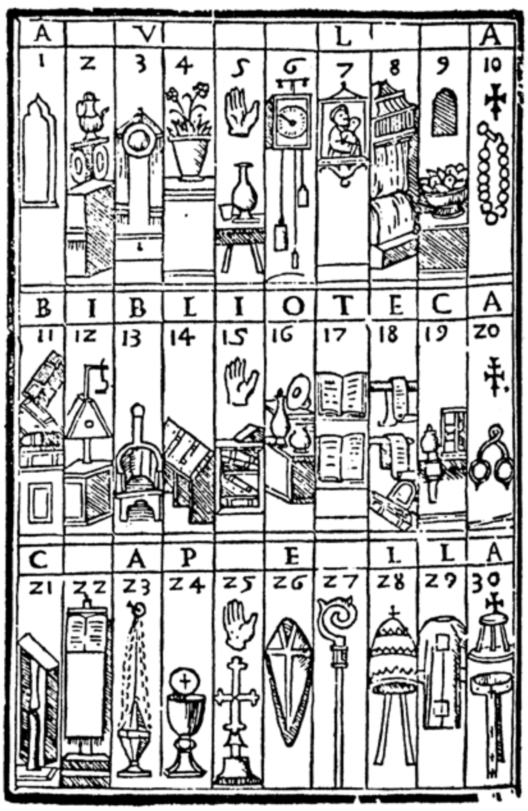


Figure 8.13 The results of Groninger's (1971) research show that participants who used the method of loci to learn a list of 25 words had greater recall of the information both one week and five weeks after learning compared with participants who did not use the method of loci.

Figure 8.14 This illustration by a Dominican monk in the 16th century shows how the method of loci is applied. On the left is the abbey and the surrounding buildings through which the speaker will mentally walk, placing the ideas (illustrated on the right) to be recalled.





group learned the same 25 words using whatever method they preferred (apart from the method of loci). All participants were instructed not to rehearse the material further. The participants were tested on their recall of the words one week and five weeks after the initial learning. As shown in figure 8.13, the results showed a much greater retention of the information by the experimental group as compared with the control group (Groninger, 1971).

Learning Activity 8.7

Experiencing narrative chaining and the method of loci

To experience first hand narrative chaining and the method of loci, visit the website www.exploratorium.edu/memory/dont_forget/playing_games.html. Follow the prompts to 'Games' to learn how to use these two mnemonic devices.

Box 8.3

Simonides and the method of loci

The Ancient Greek poet Simonides has been referred to in some sources as the creator of the *method of loci*. As the story goes, in the 5th century BC, Simonides stepped outside the banquet hall where he had recited a poem in honour of a Roman nobleman. While Simonides was outside, the hall collapsed, killing all the guests and mangling their bodies beyond recognition.

By using the method of loci, Simonides was able to identify all of them by generating vivid images of each guest and mentally picturing where they had sat at the banquet table.

Box 8.4

Key-word method

The *key-word method* was developed by two American psychologists as a mnemonic device for learning languages other than English (LOTE). Like the method of loci and the peg-word method, it involves visual imagery as a way of encoding information to improve retrieval. The psychologists suggested that to improve memory of non-English-language vocabulary, it is useful to imagine some connection visually linking the non-English word to the English equivalent. For example, the Spanish word for 'horse' is *caballo*, pronounced *cab-eye-yo*. To remember this association, *eye* could be chosen as the key word and a horse actually kicking someone in the eye could be visualised. Alternatively, a horse with a very large eye or a very large eye with a horse protruding from it could be pictured (Atkinson & Raugh, 1975).

Some non-English words may not be good direct cues for their English equivalents. However, they can often be used as an indirect recall cue by using rhyme. For example, *maison* is the French word for house. *Maison* approximately rhymes with the English word *mason*, and it would be easy to visualise a stonemason building a house. In this case, *maison* would be a cue for mason, which could be a cue for house.

The same basic technique can be used whenever you want to remember any paired information. For example, American psychologist Gordon Bower (1972) asked participants to learn lists of pairs of English words. One group (experimental group) was asked to form a mental image that showed some interaction between the two words. The other group (control group) was given no instructions other than to learn the lists of paired words. Recall for word pairs was, on the average, much better for those participants who formed mental images than it was for those who did not.

Figure 8.15 The key-word method can help you to remember pairs of words even if there is no obvious relationship between the two words.

Box 8.5

Is cramming effective when studying?

Many students believe that if they cram—that is, do the majority of their revision the night before a test or exam—the information will be available to them when they need it the next day.

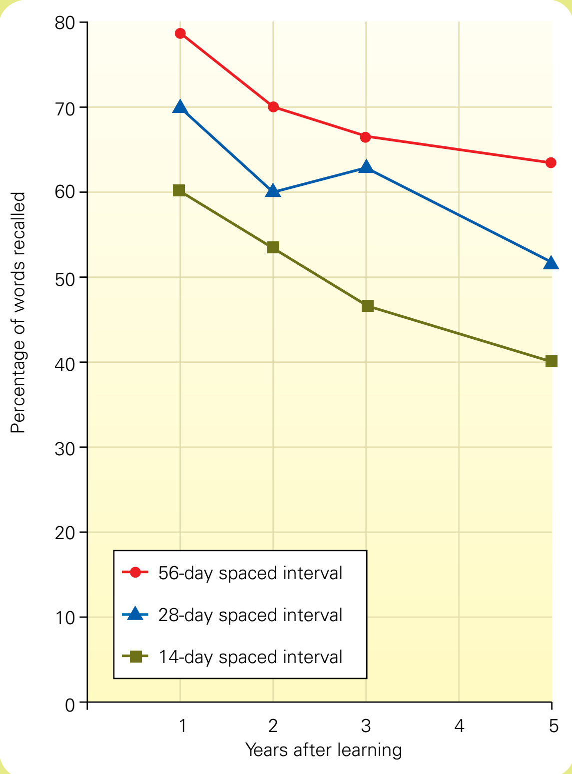
There is also a belief that one or two extended study sessions over a very short period of time (that is, *massed rehearsal*) is more effective than spacing out the study sessions over an extended period of time (that is, *spaced* or *distributed rehearsal*).

However, research findings suggest that if long-term retention of information is required, spaced rehearsal is a more effective strategy.

In one study, researchers tested the long-term effects of spaced rehearsal on the retention of 300 foreign-language words. They compared the retention of information in three different conditions, when study sessions were spaced at intervals of 14 days, 28 days and 56 days. Participants were tested on retention of information subsequently each year for five years.

The results indicated that longer intervals between rehearsal sessions resulted in greater retention of the learned information one, two, three and five years after the last training session (Bahrick & others, 1993). These findings have been replicated by other studies that used different material and memory tasks (Toppino & Schneider, 1999).

The results have important implications for students, especially those who want or need to retain information learned for a longer period of time.



Source: adapted from Bahrick, H.P., Bahrick, L.E., Bahrick, A.S., & Bahrick, P.E. (1993). Maintenance of foreign language vocabulary and the spacing effect. *Psychological Science, 4*(5), 316–321.

Figure 8.16 Bahrick & others (1993) research findings on the impact of spaced learning on retention over five years. Longer intervals between rehearsal sessions resulted in greater retention of the learned information one, two, three and five years after the last training session.

Figure 8.17 Many students believe that if they cram, the information will be available to them when they need it the next day; however, research findings suggest this is *not* the most effective strategy.

Box 8.6

Effective studying: memory and SQ3R

There are many different study strategies and the more effective ones apply principles that improve memory (and learning). One strategy for studying reading materials, such as information in this psychology textbook, is called the SQ3R method. SQ3R is an abbreviation for the five steps in the method: *survey*, *question*, *read*, *recite* and *review*.

Survey

Look over the material you will study to get a general impression of what it's about and to help you create a framework to use in organising the information. Focus on the headings and subheadings for different sections. Do not concern yourself with reading the information at this stage unless it's a brief summary of the entire information to be studied.

Question

Convert the headings and subheadings into questions and write these down. Include additional questions that occur to you as you scan the information. These questions will become goals and provide the foundations for the next step.

Read

Read the material carefully in order to answer the questions. Answering aloud as well as writing down notes is helpful.

Recite

Recite (aloud or sub-vocally) the answers to the questions you wrote. Do not proceed to the next question until you can satisfactorily answer the preceding one. Questions for which your answers are uncertain indicate gaps in your understanding and sections of the material that need to be read again.

Review

Go over the entire material periodically until you feel you have learned all of it. You should also recite answers to the questions again, particularly those for the material you are uncertain about or have difficulty recalling.

You will find that less time and effort is required on each successive occasion you review the material to reach the same level of mastery, as you will have retained information from previous learning.

Eventually, you may find that you need to reread only particular sections of the material, but you should keep in mind that 'overlearning' the material will make you less likely to forget it and more confident that you know it.

Learning Activity 8.8

Review questions

1 **a** What is a mnemonic device?
  b How do mnemonic devices improve memory?

2 Construct a table that summarises the mnemonic devices described in this chapter. Headings should include 'Name of device', 'Type of information it suits', 'How it is used', 'Example', 'Why it is effective'.

3 Briefly describe three characteristics that the various mnemonic devices have in common.

Learning Activity 8.9

Evaluating a mnemonic device

Cover list B and read the words in list A for 20 seconds. Then, without looking at list A, write as many of the words in list A as you can, in the same sequence as they are presented in the list. Next, cover list A and read the words in list B for 20 seconds. Then without looking at list B, write as many of the words in list B as you can, in the same sequence as they are in the list.

Which list of words was remembered better? Explain why.

List A	List B
most	school
a	is
for	a
hard	lot
students	of
is	hard
of	work
work	for
lot	most
school	students

Learning Activity 8.10

Designing an experiment

Outline an experiment that could be conducted to test the effectiveness of using one (or more) of the mnemonic devices.

- Present your experimental design as a flow chart that shows the key features of the experiment and its design (for example, aim, operational hypothesis, IV(s) and DV(s), sampling procedure, experimental groups or conditions and participant allocation procedure).
- Explain your choice of experimental design.
- Identify key ethical issues to be considered and how these could be addressed.
- Describe how the results could be summarised, with reference to appropriate descriptive statistics.
- Identify three relevant extraneous variables whose unwanted influence on the results should be minimised.

Learning Activity 8.11

Practical activity on visual imagery versus maintenance rehearsal

The aim of this experiment is to compare visual imagery with maintenance rehearsal as methods of enhancing memory.

Before conducting the research construct an operational hypothesis that can be tested in the experiment. Your hypothesis should be consistent with theory on the effects of maintenance rehearsal and elaborative rehearsal on subsequent recall of information. Use two volunteers as participants. Participants can be tested individually or together. All relevant ethical guidelines should be followed.

Read aloud to the participant(s) a list of 12 paired associates (word pairs) comprising randomly selected common nouns such as *curtain–scissors*, *cake–finger, book–tape*. The participant's task is to learn the pairs so that later, when the first word of a pair is presented, they will be able to recall the word that goes with it (the second word of the pair).

Participants are required to use either visual imagery or rehearsal for learning each paired associate. For *visual imagery*, the participant should be instructed to take about 10 seconds to form a mental image or picture in which the words are interacting in some way. For example, for the word pair *galah–train* they might picture a galah driving a train.

For *maintenance rehearsal* the participant should be instructed to repeat the two words aloud five times. The participant should also be instructed that just before each word pair is presented, they will be told which method of learning the words to use: 'image' or 'rehearse'. Half of the pairs should be learned using each method. (Each paired associate should be randomly labelled in this way when the list is developed.)

After all the 12 paired associates have been presented, instruct the participant to count backwards by threes from 1113 for about 30 seconds, after which a verbal test of recall is given. Participants are given one word of each pair. They are required to recall the second word of the pair. Participants' responses should be recorded on a sheet of paper. The number of correct responses for imagery and rehearsal can then be compared. Data can be collated with that of other class members.

The data should be analysed and the experiment evaluated with reference to the following tasks.

- Identify the IV(s) and DV in the experiment.
- At what level would you set the *p* value for a test of significance? Explain why you would use this value rather than a higher or lower value.
- Construct a graph or table and use other relevant descriptive statistics to summarise the results.
- Do the results support your hypothesis? What conclusions can be drawn from the results obtained?
- Compare your research findings with theoretical expectations, or results obtained from other studies.
- If there is a difference in the mean scores between the two conditions of the experiment, and $p \le 0.05$, what does this indicate about the results? Would the results be more meaningful if $p \le 0.01$? Explain your answer.
- What generalisation(s) can be made from the results? Explain your answer.
- Evaluate the experimental design. Identify any relevant extraneous or confounding variables and suggest improvements to the experimental design.

Learning Activity 8.12

Essay on techniques for improving and manipulating memory

Write an essay of about 500–600 words in which you explain and evaluate techniques for improving and manipulating memory. References may be used to obtain information for your essay.

In your essay, ensure that you:

- outline the structure and function of human memory with reference to models and frameworks
- describe the reconstructive nature of recall from memory
- explain how memory reconstruction can be manipulated with the aim of distorting the accuracy of what is recalled, and referring to research on eyewitness testimony
- explain how memory can be manipulated with the view of improving what is recalled, and referring to the use of mnemonic devices
- compare and contrast the relative effectiveness of mnemonic devices in relation to their use with different types of information
- accurately define and explain key concepts
- use appropriate examples to demonstrate your understanding of key concepts
- structure the information in a logical way
- express your information in a clear and concise way
- accurately cite and reference all material using appropriate conventions.

Learning Activity 8.13

Visual presentation on techniques for improving and manipulating memory

Prepare a visual presentation in which you explain and evaluate techniques for improving and manipulating memory. You may use one or more media and/or formats to present your response, such as PowerPoint, A2 poster paper, animations, photographs and diagrams.

In your presentation ensure that you:

- outline the structure and function of human memory with reference to models and frameworks
- describe the reconstructive nature of recall from memory
- explain how memory reconstruction can be manipulated with the aim of distorting the accuracy of what is recalled, and referring to research on eyewitness testimony
- explain how memory can be manipulated with the view of improving what is recalled, and referring to the use of mnemonic devices
- compare and contrast the relative effectiveness of mnemonic devices in relation to their use with different types of information
- accurately define and explain key concepts
- use appropriate examples to demonstrate your understanding of key concepts
- organise your information in a logical way
- express your information in a clear and concise way
- accurately cite and reference all material using appropriate conventions.

Point form may be used in explaining and evaluating techniques for improving and manipulating memory. References may be used to obtain information for your presentation.

Chapter 8 true/false quiz

Indicate whether each item is true or false by writing ‘T’ or ‘F’ in the blank space next to each statement.

1 ______ Research has clearly shown that eyewitness testimony is always reliable and accurate.

2 ______ A leading question may contain a presupposition.

3 ______ Returning an eyewitness to a crime scene may trigger context-dependent retrieval cues.

4 ______ BHP is an acronym.

5 ______ Mnemonic devices make use of information already stored in LTM.

6 ______ Ebbinghaus devised a theory of memory reconstruction.

7 ______ Happiness may act as a state-dependent retrieval cue.

8 ______ Mnemonic devices typically require conscious effort.

9 ______ Maintenance rehearsal is more effective than narrative chaining.

10 ______ The peg-word method involves the use of a rhyme or jingle.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 8 test

Section A— Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Enhancing memory by weaving otherwise unrelated information into a meaningful story is called

A context-dependent memory.
B narrative chaining.
C the method of loci.
D the encoding specificity principle.

Q2 Trying to memorise a set of key terms, in their correct order, by constructing a phrase made up of the first letters of the key terms is an example of a mnemonic device called

A an acrostic.
B the peg-word method.
C an acronym.
D the method of loci.

Q3 When you remember a list of objects by mentally placing them at different landmarks you pass as you go to school each day, you are using

A maintenance rehearsal.
B narrative chaining.
C state-dependent retrieval.
D the method of loci.

Q4 A professional cyclist falls off her bike on day one of the Great Victorian Bike Ride. She breaks various bones in her body and is very upset about not being able to continue in the race. However, she does not sustain any head injuries, as she was wearing protective headgear. Afterwards, she remembers very little about the events leading up to, during and following the accident. She eventually recovers and enters the Around-Tasmania Bike Race. Again she has an accident on day one, breaks various bones in her body, gets upset, but doesn't suffer any head injuries. However, soon after falling, the events surrounding the fall in the Great Victorian Bike Ride come flooding back.

The cyclist's recovery of memory of the first fall is an example of

A consolidation theory.
B the context-dependency of certain memories.
C the state-dependency of certain memories.
D decay theory.

Q5 People are more likely to recall something when they are in the same situation where the original learning of that information occurred. This event illustrates the role of _____ in retrieval.

A recognition
B rehearsal
C state-dependent cues
D context-dependent cues

Q6 A researcher tested which of two memory strategies produced better recall when English-speaking participants were required to learn words in a new language such as Indonesian. Group 1 was told to repeat the words aloud over and over. Group 2 was told to think of an English word with which they could associate the Indonesian word.

Which memory strategy did each group use?

A Group 1: elaboration; group 2: maintenance rehearsal
B Group 1: maintenance rehearsal; group 2: elaboration
C Group 1: elaboration; group 2: narrative chaining
D Group 1: maintenance rehearsal; group 2: narrative chaining

Q7 Tina is required to learn a list of ten Spanish words as homework. She decides to organise the words into a story. Tina is using a technique that involves

A visual imagery.
B narrative chaining.
C method of loci.
D state-dependent cues.

Q8 Trinh learns to play poker at his friend's house. When he gets home, he decides to teach his younger sister, but can't recall whether 'three of a kind' is a better hand than a 'full house'. When he returns to his friend's house a few days later and plays poker again, he recalls with ease that a 'full house' beats a 'three of a kind'.

A probable explanation for his inability to recall the information at home is

A state-dependent memory.
B context-dependent memory.
C anterograde amnesia.
D retrograde amnesia.

Q9 Memory reconstruction involves

A re-creating a memory using all available information in LTM.
B building up a new memory using information planted in leading questions.
C re-creating a distorted memory that has been manipulated by a researcher
D building up an accurate account of what was actually experienced at some time in the past.

Q10 Using numbers as retrieval cues for words that rhyme with each number, then using those rhyming words as retrieval cues for the information to be remembered is an example of a mnemonic device called

A the peg-word method.
B rhyming.
C the method of loci.
D acronyms.

The answers to the Chapter 8 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Distinguish between the recall of an episodic memory using context-dependent and state-dependent retrieval cues.

2 marks

Question 2

Name a mnemonic device that involves a deep level of processing and explain why use of this device can improve memory.

2 marks

Question 3

Give an example of how Elizabeth Loftus manipulates the memory of an eyewitness.

1 mark

Question 4

State two key components of a reconstructed memory following manipulation of memory, as proposed by Elizabeth Loftus.

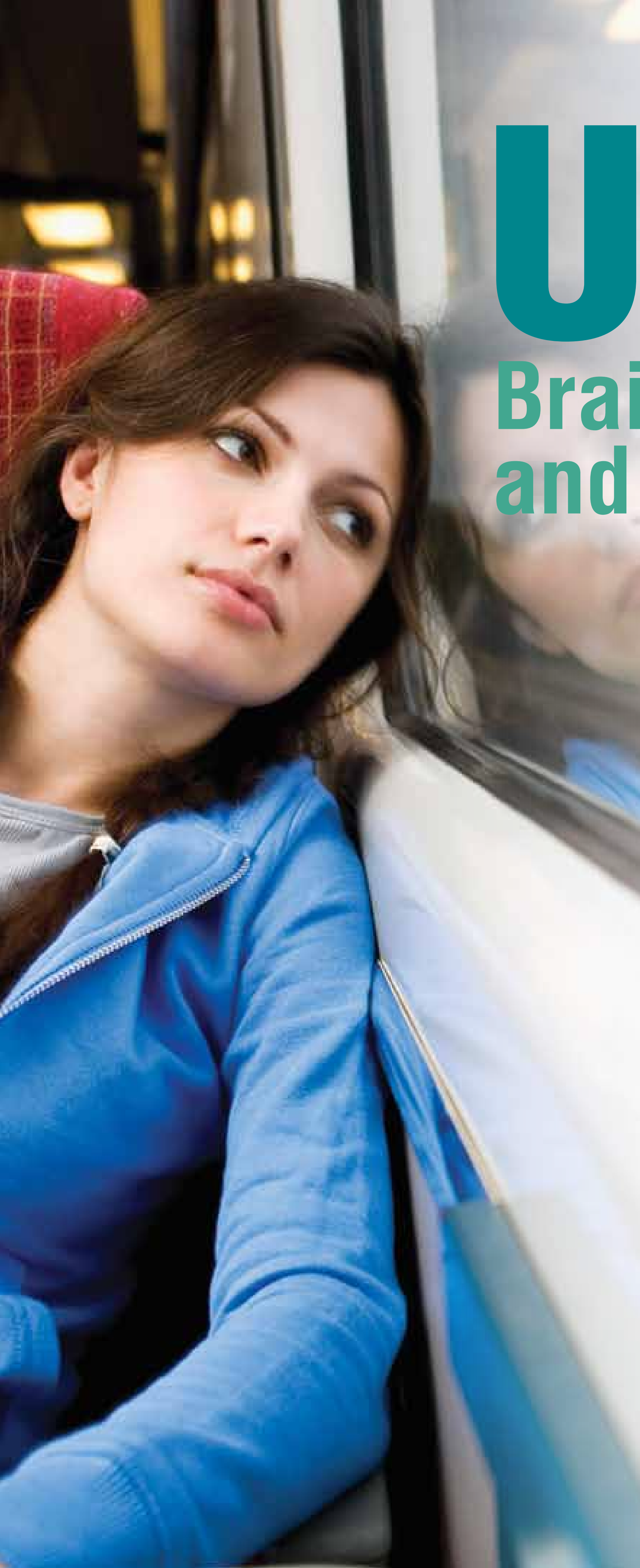
2 marks

Question 5

Explain why Elizabeth Loftus believes eyewitness testimony is unreliable, with reference to an example of a research method.

3 marks

The answers to the Chapter 8 short-answer questions are available at www.OneStopScience.com.au.



Unit 4

Brain, behaviour and experience

On completion of this unit the student should be able to:

Outcome 1

Explain the neural basis of learning, and compare and contrast different theories of learning and their applications.

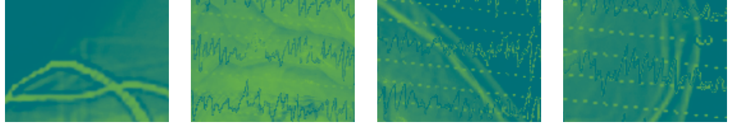
Outcome 2

Differentiate between mental health and mental illness, and use a biopsychosocial framework to explain the causes and management of stress, simple phobia and a selected mental disorder.

Unit 4: Key knowledge

Chapter 9 Mechanisms of learning	• behaviours not dependent on learning including reflex action, fixed action patterns and behaviours due to physical growth and development (maturation) • mechanisms of learning: – areas of the brain and neural pathways involved in learning, synapse formation, role of neurotransmitters – developmental plasticity and adaptive plasticity of the brain: changes to the brain in response to learning and experience; timing of experiences – use of imaging technologies in identification of localised changes in the brain due to learning specific tasks
Chapter 10 Learning theories	• applications of, and comparisons of, learning theories: – classical conditioning as informed by Ivan Pavlov: roles of neutral, unconditioned, conditioned stimuli; unconditioned and conditioned responses – applications of classical conditioning: graduated exposure, aversion therapy, flooding – three-phase model of operant conditioning as informed by B.F. Skinner: positive and negative reinforcement, response cost, punishment and schedules of reinforcement – applications of operant conditioning: shaping, token economies – comparisons of classical and operant conditioning in terms of the processes of acquisition, extinction, stimulus generalisation, stimulus discrimination, spontaneous recovery, role of learner, timing of stimulus and response, and nature of response (reflexive/voluntary) – one-trial learning with reference to taste aversion as informed by John Garcia and Robert A. Koelling (1966) – trial-and-error learning as informed by Edward Lee Thorndike's puzzle-box experiment – observational learning (modelling) processes in terms of the role of attention, retention, reproduction, motivation, reinforcement as informed by Albert Bandura's (1961, 1963a, 1963b) experiments with children – insight learning as informed by Wolfgang Köhler – latent learning as informed by Edward Tolman • the extent to which ethical principles were applied to classic research investigations into learning including John Watson's 'Little Albert' experiment • research methods and ethical principles associated with the study of learning, as outlined in the introduction to the unit
Chapter 11 Normality, mental health and mental illness	• concepts of normality and differentiation of mental health from mental illness • systems of classification of mental conditions and disorders: underlying principles of classification; strengths and limitations of discrete categorical (DSM-IV and ICD-10) and dimensional (graded and transitional) approaches to classification of mental disorders • use of a biopsychosocial framework (the interaction and integration of biological, psychological and social factors) as an approach to considering physical and mental health
Chapter 12 Stress and health	• application of a biopsychosocial framework to understanding the relationship between stress and physical and mental wellbeing: – physiological and psychological characteristics of responses to stress including fight–flight response, eustress and distress; strengths and limitations of Selyes' General Adaptation Syndrome – psychological determinants of the stress response; strengths and limitations of Richard Lazarus and Susan Folkman's Transactional Model of Stress and Coping – social, cultural and environmental factors that exacerbate and alleviate the stress response – allostasis (stability through change brought about by the brain's regulation of the body's response to stress) as a model that integrates biological, psychological and social factors that explain an individual's response to stress • strategies for coping with stress including biofeedback, meditation/relaxation, physical exercise, social support

Chapter 13 Anxiety disorder: simple phobia	• application of a biopsychosocial framework to understanding and managing simple phobia as an example of an anxiety disorder: – biological contributing factors: role of the stress response; role of the neurotransmitter gamma-amino butyric acid (GABA) in the management of phobic anxiety – psychological contributing factors: psychodynamic, behavioural and cognitive models; the use of psychotherapies in treatment including cognitive behavioural therapy (CBT), systematic desensitisation and flooding – socio-cultural contributing factors: specific environmental triggers such as being bitten by a dog; parental modelling and transmission of threat information • the interaction between biological, psychological and socio-cultural factors which contribute to an understanding of the disorder and its management
Chapter 14 Mood disorder: major depression	• application of a biopsychosocial framework to understanding mood disorder: major depression – biological contributing factors: role of genes in contributing to the risk of developing major depression; roles of the neurotransmitters serotonin and noradrenaline in major depression; the function of antidepressant medication in management – psychological contributing factors: learned helplessness; stress; the use of psychotherapies in management including cognitive behaviour therapy and psychodynamic psychotherapy – socio-cultural contributing factors: abuse, poverty, social isolation and social stressors as risk factors; support factors including family and social networks and recovery groups – the interaction between biological, psychological and socio-cultural factors which contribute to an understanding of the disorder and its management
Chapter 15 Addictive disorder: gambling	• application of a biopsychosocial framework to understanding addictive disorder: gambling – biological contributing factors: role of the dopamine reward system and as a target for treatment – psychological contributing factors: social learning theory and schedules of reinforcement; the use of psychotherapies in treatment including cognitive behavioural and psychodynamic therapies – socio-cultural contributing factors: social permission of gambling opportunities; management including social network and recovery groups • the interaction between biological, psychological and socio-cultural factors which contribute to an understanding of the disorder and its management
Chapter 16 Psychotic disorder: schizophrenia	• application of a biopsychosocial framework to understanding psychotic disorder: schizophrenia – biological contributing factors: genetic predisposition; drug-induced onset; changes in brain activity; the use of medication that blocks dopamine to treat psychosis – psychological contributing factors: impaired mechanisms for reasoning and memory; the use of psychotherapies in management including cognitive behavioural and remediation therapies, stress management – socio-cultural contributing factors: social disadvantage, trauma and psycho-social stress as risk factors; psychoeducation, supportive social (including family) environments, removal of social stigma – the interaction between biological, psychological and socio-cultural factors which contribute to an understanding of the disorder and its management • research methods and ethical principles associated with the study of mental health, as outlined in the introduction to the unit.



9 Mechanisms of learning

Defining learning

Can you think of a behaviour that you did *not* learn? It's a difficult task because learning is involved in nearly all our behaviours. Except for a range of physiological responses that are involuntary and normally occur automatically, such as breathing, digesting food, sleeping, secreting hormones and blinking, most of what you do each day depends to a large degree on learning. For example, behaviours such as brushing your teeth, tuning in to your favourite television program, buying a DVD and undertaking the VCE all depend on learning in a significant way. Your attitudes, values, beliefs, opinions, interests and decisions all involve learning. Many of our emotions are also learned. Learning is such an integral part of daily living that without the ability to learn, people would be unable to live independently and would need constant care in order to survive. And, as you are now aware, if we could not learn, there would be nothing to remember.

Learning can be defined as a relatively permanent change in behaviour that occurs as a result of experience. It is an ongoing process that continues throughout the lifespan, enabling us to adapt and cope in an ever-changing world. Learning can occur *intentionally*, such as when someone takes piano lessons, or *unintentionally*, such as while watching or hearing someone else playing the piano. Similarly, learning can be *active*, such as reciting multiplication tables, or *passive*, such as when hearing about Australia's performance in the Olympic Games.

The notion of *change* is an important part of the definition of learning, because something must be different about an organism after learning has taken place. The change in behaviour may be immediate (for example, changing a tennis serve immediately after a coach suggests a way to improve it), or the change may be delayed and actually occur some time after learning has taken place (for example, changing a tennis serve the next time you play tennis after watching an instructional video). Furthermore, the change may be possible but not evident because of a lack of opportunity (for example, by watching Roger Federer in a tournament you know how to improve your tennis serve but you never again play tennis). Consequently, learning refers to the potential to behave in a particular way, as well as behaviour that is observed to take place.

Learned behaviour is also defined as *relatively permanent* because it cannot be something that is present one moment and gone the next, or 'here today and gone tomorrow'. It must have a continuing or lasting effect for a period of time, but it does not necessarily have to produce a permanent (lifelong) change. Thus, information you recalled when correctly answering a question in the mid-year VCE Psychology exam is said to have been learned even if you can't recall that information now. Learning is regarded as *relatively* permanent because most, if not all, learned behaviours can be modified. For example, someone who has learned to fear spiders can subsequently learn not to fear them.

Temporary changes in behaviour that are caused by illness, prescription and illegal drugs, injury, fatigue and alcohol are *not* classified as learning. Such changes in behaviour tend to be brief compared with those that result from learning. For example, the effects on behaviour of a sleepless night will typically wear off after a night or two of rest. Similarly, the effects of medication will usually disappear after a certain period of time.

Behaviour not dependent on learning

Although learning accounts for most of the behaviour observed in people and animals, not all behaviour has to be learned. Reflexes, fixed-action patterns and maturation also account for certain behaviours.

Reflex actions

Some behaviours, such as blinking your eyes when the wind blows in your face, or withdrawing your hand from a very hot object, occur automatically in response to particular stimulation. Similarly, when an infant feels a light touch on the cheek, it will automatically turn its head towards the touch, as its mouth searches for a milk-giving nipple. Such automatic involuntary behaviour that does not require prior experience and occurs in the same way each time is called a **reflex**. We are born with a large number of reflexes, but most of these disappear or are incorporated as parts of other behaviours within several months after birth. Generally, reflexes allow people (and animals) to deal with specific stimuli that are important for their protection or survival through rigid automatic responses. For example, the sucking reflex that appears soon after birth is an involuntary response that enables the infant to feed and is therefore important for its survival.

Figure 9.1 All infants are born with a sucking reflex. This sucking reflex is an involuntary response that is important for survival as it enables the infant to feed.

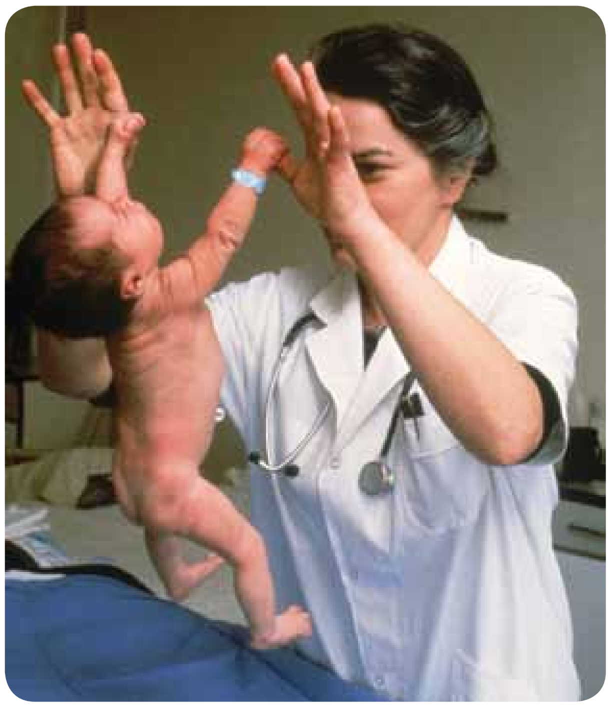


Figure 9.2 This newborn infant demonstrates the grasping reflex. Although it is strong enough to allow infants to support their own weight, the grasping reflex disappears within the first few months of life, like many other reflexive behaviours with which we are born.

Fixed-action patterns

Honey bees perform a sequence of ritualistic behaviours to communicate the location of a food source (for example, nectar) to other honey bees. When a worker bee finds a food source, it returns to the hive and performs a dance. This dance is symbolic in meaning and indicates to the other bees the distance and direction of the food source as well as the amount of nectar. It appears that this communication system is specific to the species of bee that performs it. Other species of bees become confused if they attempt to locate a food source from the dance of a different species of bee. This is an example of a behaviour, or 'action pattern', that takes place in a set or 'fixed' way.

A **fixed-action pattern** of behaviour occurs when all members of a species produce an identical response to the same specific environmental stimuli. This type of behaviour is also referred to as *species-specific behaviour*. The mechanisms that control the behaviours are fixed, in that they are genetically programmed into the animal's nervous system and appear to be unable to be changed as a result of learning. Furthermore, the term 'fixed-action pattern' is used to describe behaviour that is *inherited* by every individual member of a species or, if the behaviour is sex-specific, by all members of one sex of the species. Sex-specific behaviours are often linked to courtship, sexual behaviour and 'nesting' behaviour shown by male and/or female members of the species. For example, during the breeding season, the male three-spined stickleback's belly turns from grey to red, he builds a nest and he will aggressively attack any other red-bellied three-spined stickleback that comes into his territory. This behaviour is specific to the male of the species and is a behaviour displayed by all male three-spined stickleback fish.

Fixed-action patterns differ from reflexes in that a reflex, although inborn, usually consists of a single or simple response, whereas a fixed-action pattern is more complex, usually consisting of a sequence of responses.

Fixed-action patterns are observed in many animals. For example, a mother finch will build a nest, lay eggs, search for food and return to the nest to feed her young. Salmon migrate thousands of kilometres through ocean waters to spawn in the rivers in which they were born. The male greater frigate bird displays his red throat as part of his courtship behaviour with a female greater frigate.

Figure 9.3 (a) A worker bee performs a dance to indicate to the other bees the distance, direction and amount of a nectar source; (b) during the breeding season, the male three-spined stickleback fish's belly turns from grey to red.

All these behaviours are considered to be fixed-action patterns for the following reasons:

- all members of the species (or, if the behaviour is sex-specific, all members of the same sex of the species) demonstrate the behaviour
- the behaviour is similar whenever it is executed
- when the organism reaches the right level of maturation, it will produce the behaviour the first time it is required, without having learned it
- the behaviour is difficult to change
- the behaviour is complex; it follows a fixed-action pattern (or preset sequence) and appears without the organism having had the opportunity to learn it.

Generally, the higher the order of animal, the fewer the inborn or instinctive behaviours, and the more learning influences behaviour. Although people have inbuilt, unlearned behaviour patterns in the form of reflexes, these are not complex enough to be called fixed-action patterns. Nor can complex human patterns of behaviour be considered fixed-action patterns, because they can be expressed in many different ways among people. For example, some mothers breastfeed, some bottle-feed, and in some cultures, mothers depend on other women to feed their babies.

Figure 9.4 Salmon display fixed-action-pattern behaviour when they migrate thousands of kilometres through ocean waters to spawn in the rivers in which they were born.

Behaviour dependent on maturation

Other unlearned behaviour is the result of maturation involving physical growth and development. **Maturation** is a developmental process leading towards maturity, based on the orderly sequence of changes that occurs in the nervous system and other bodily structures controlled by genetic inheritance. Responses that depend on maturation generally appear at predictable times in development (unless there is undue interference from an environmental factor). At about eight to ten months of age, for example, most infants throughout the world begin crawling. This behaviour will occur automatically, and the time at which it emerges and the way it emerges appear to be programmed in the individual's genes. No amount of practice will hasten the onset or significantly influence its course of development. Similarly, during puberty a boy's voice changes and becomes deeper. This is a maturational change in behaviour due to physical growth and development that is not attributable to learning.

Figure 9.5 Some unlearned behaviour is a the result of maturation and depends on the development of the body and nervous system structures. At about 8–10 months, for example, most infants begin crawling.

Box 9.1

Measuring learning by observing performance

Like consciousness, memory and many other psychological characteristics and processes, learning is a *psychological construct*; that is, a concept used to describe or explain something that is believed to exist or occur but cannot be directly observed or measured. Because it is not possible to observe or measure learning actually taking place, psychologists observe behaviour, or *performance*, to gain an understanding of the learning process. From observations of performance, it can be inferred that learning has (or has not) taken place. For example, it is not possible to see learning take place as you read this textbook. In this case, the change referred to as part of the definition of learning may not be immediately evident. But a test of your recall of the material (such as your performance on a test) will provide information about whether learning has occurred and how much learning has taken place.

The measurement of performance on a learning task can be plotted on a graph to produce what is referred to as a **learning curve**. A learning curve shows the increase in performance that occurs over the period of time the task is practised. Typically, learning progresses slowly at first, then it speeds up, and finally slows down (or levels off) again. When learning something for the first time, we may experience a *plateau*; that is, a period of limited progress in the learning process. This is represented on a learning curve by a 'flat spot' or a horizontal section of the graph. Of course, a plateau may also indicate that learning is complete.

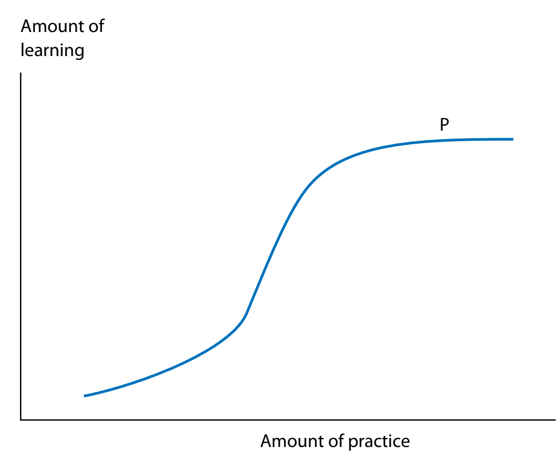


Figure 9.6 This graph represents an ideal S-shaped learning curve. It shows the *amount of learning* plotted against the *amount of practice*. The point marked P indicates a plateau, or period of little progress, in learning.

Learning Activity 9.1

Learned versus non-learned behaviour

Explain whether each of the following human behaviours is best described as a learned behaviour (L), reflexive behaviour (R), fixed-action pattern (FAP), behaviour due to maturation (M); or more than one of these (for example, L&M).

- emotional attachment by an infant to a caregiver
- speaking in high-pitched 'baby talk' to an infant
- being scared of snakes
- scratching an itch
- nodding in agreement
- smoking cigarettes
- perceiving an illusion
- whistling
- walking
- playing
- curiosity
- sleeping
- loving
- roller-skating.

Learning Activity 9.2

Review questions

1. a. Define the meaning of the term learning.
   b. Briefly describe three key characteristics of behaviour that is learned.
2. Differentiate between a learned response, a reflex action, a fixed-action pattern and behaviour dependent on maturation. Give an example of each, but use examples not referred to in the text.
3. Smiling, laughing and crying are all observed in deaf–blind children who cannot have learned these responses by seeing or hearing them in others. Normally, each of these behaviours is seen within several months after birth. Some psychologists view this as evidence of fixed-action patterns in humans and suggest that these behaviours are programmed by our genetic inheritance.
   a. Do you agree or disagree with this view? Why?
   b. Can someone learn to control a reflex response? If so, give an example. Explain your answer.

Learning Activity 9.3

Practical activity on effect of practice on performance

Because learning cannot be observed directly, psychologists observe and measure performance and make inferences about how much learning has occurred. Performance can be represented graphically as a learning curve.

This experiment enables you to measure the effect of practice on learning and to collect data that can be used to graph a learning curve. Performance on a novel (new) task is used as the measure of learning. Before conducting the experiment you should construct an operational hypothesis on the effect of practice on performance.

Participants can be a class of volunteer students in any year level at your school and they may be tested individually or as a group. All relevant ethical guidelines should be followed.

Participants are required to write the letters of the alphabet in reverse order, beginning with 'z'. There will be 20 trials and a time limit of 15 seconds for each trial. On any trial, if a participant completes the alphabet, they should start again from 'z'.

Participants should use a separate sheet of paper (labelled with the trial number) for each trial. When a trial has been completed, they should fold the sheet and set it aside. There should be a 15-second delay between each trial. This delay period is used by the participants to fold the sheet completed previously and to prepare a sheet for the next trial.

In order to prevent participants rehearsing during the delay period, each participant is required to count backwards by threes from 997. They should count sub-vocally (by counting the numbers in their head). This ensures they are prevented from rehearsing without distracting others.

After the twentieth trial, each participant's score for the number of letters correctly sequenced in reverse alphabetical order on each trial is calculated. These scores are used to calculate a mean score for the sample for each trial. The mean score for each trial is then plotted on a graph so that a learning curve can be generated for the class.

The learning curve obtained from the experiment should be compared with the learning curve shown in figure 9.6 (see box 9.1) and analysed in terms of theoretical expectations and with due regard to limitations of the research procedures. Points of comparison should include the general trend of performance and any apparent plateaus.

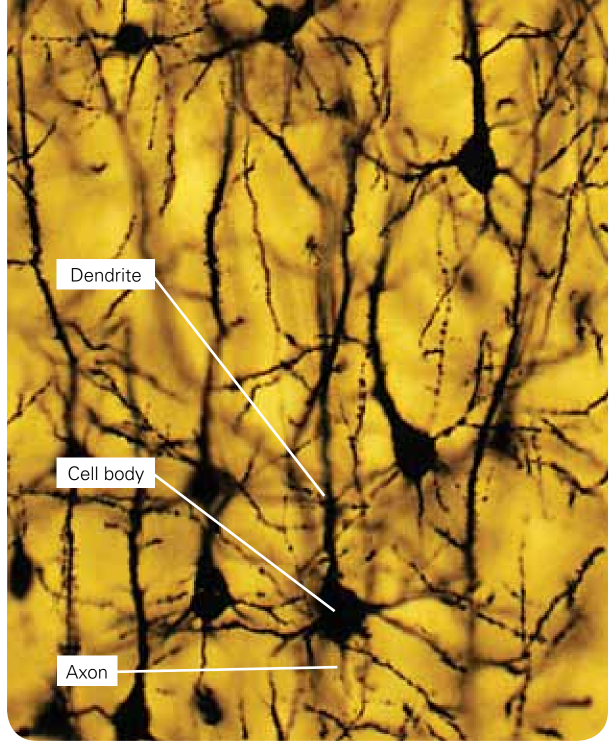
Neural basis of learning

The human brain follows a predictable pattern of growth and development, with different structures and abilities progressing at different rates and maturating at different points in the lifespan. Although the basic structure and organisation of our brain in terms of a cerebral cortex with hemispheres, lobes, lower brain structures and so on are irreversibly established well before birth, our brain continues to develop after birth. It is not a solid fixed organ. Nor are the neural pathways extending within and between different areas of our brain 'hardwired' like a computer or other human-made electronic device.

Neurons are soft, flexible living cells. They can change their sizes, shapes, functions, connections with other neurons and patterns of connections. These types of changes can occur at any time in the human lifespan, including old age. They are influenced by the interaction of biological processes that are genetically determined and by experiences in everyday life.

When neurons communicate with one another, they do so by sending a **neurotransmitter** comprising electrochemical messages across the tiny space between the *axon ending* of one neuron (which sends the neurotransmitter) and the *dendrite* of another (which receives the neurotransmitter). This tiny space is called the **synaptic gap**. The synaptic gap is one component of the synapse. The other two components of the synapse are the axon ending of the 'sending', or **presynaptic neuron**, and the dendrite of the 'receiving', or **postsynaptic neuron**.

The **synapse** is the site of communication between adjacent neurons. The act of sending a neurotransmitter across the synaptic gap actually *changes* the synapse. Some dendrites that receive the neurotransmitter messages from other neurons can grow longer and 'sprout' new branches or tips when used, whereas others are 'pruned' away if not used. Every day we form, or 'grow', millions of new synapses and millions of others disappear through disuse. At least some of these changes seem to depend on our unique experiences of that day.



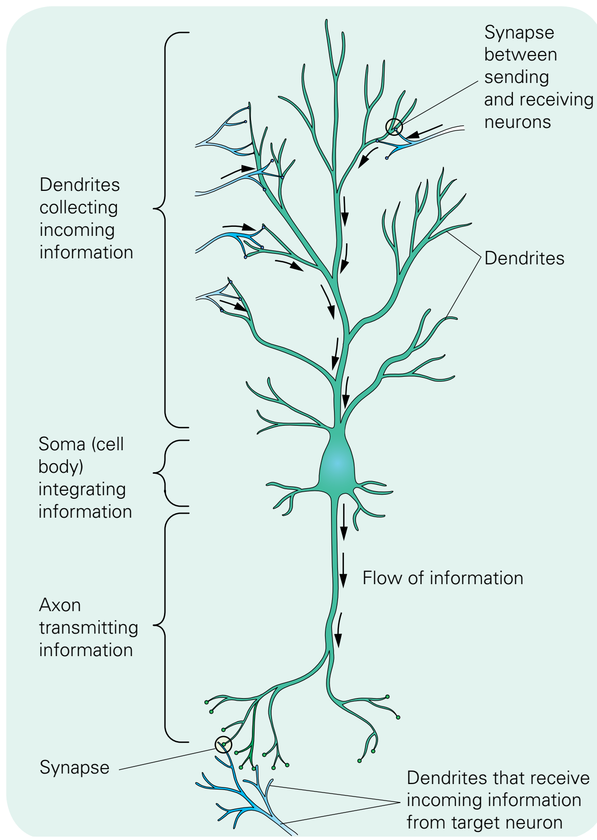


Figure 9.7 Neurons are the cells specialised to process information. Most neurons have three main components: dendrites for collecting information, a soma (cell body) that integrates this information, and one or more axons that transmit information to other neurons. Information flows mainly in one direction, from dendrites to axon(s).

As we learn through the constant stream of new experiences in everyday life, our brain modifies its neural pathways (or circuits) and neural connections within and between pathways, thereby literally changing its structure and function by 'rewiring' itself. Existing connections between neurons can reorganise, and new pathways can form and strengthen during the learning process, thus making communication across a connection and along a pathway easier the next time.

This ability of the brain to change is commonly called *plasticity*, a property that makes learning and memory possible, provides the brain with a way of being continually responsive to environmental input, and thereby assists us in adapting to life's ever-changing circumstances. In the next section, we examine areas of the brain involved in learning, the plasticity of the brain, and the effects of experience on the brain.

Areas of the brain and neural pathways involved in learning

As you are aware, different types of incoming information are processed by different areas of the brain; for example, visual information is processed by the visual cortex in the occipital lobe and auditory information is processed by the auditory cortex in the temporal lobe. Similarly, areas of the parietal lobe are involved in processing somatosensory and spatial information, and areas of the frontal lobe are responsible for directing and maintaining attention, developing and acting on plans, and so on. Consequently, many areas of the brain are involved in responding to input during learning and different brain areas interact by exchanging information in the learning process. Like memory, most human learning is not located in any single area of the brain, although some brain areas process different types of information and some areas seem to be more actively involved in specific types of learning.

Box 9.2

Between-neuron transmission: neurotransmitters

The activation of a single neural impulse is not sufficient to produce any noticeable response, even something as small as the twitch of a muscle, let alone complex mental activity such as thinking of a creative solution to a problem. It is only when one neuron stimulates others around them that any noticeable activity begins to occur. It usually takes billions of neurons to be activated together for complex behaviour or mental processes to occur.

Neurons do not link together like a chain. Each neuron is separated from the next neuron by a tiny gap called a *synaptic gap* (or *synaptic cleft*, as it also called). The synaptic gap is about 500 times thinner than the thinnest strand of your hair. Neural information passes across the gap from the axon terminal and connects with any number of dendrites from adjacent neurons (see figure 9.8). The point, or site, of chemical communication between neurons is called a *synapse*. The synapse includes the synaptic gap and a small area of the membrane of each of the connecting neurons.

The transmission of neural impulses within the neuron basically involves electrical activity. However, when the neural impulse reaches the end of the axon, the transmission of the information from one neuron to the next primarily involves a chemical process.

When the neural impulse reaches the end of each axon, neurotransmitter is released from tiny vesicles within the synaptic buttons. A *neurotransmitter* is a chemical substance that is made by the neuron and enables communication between neurons. Each neurotransmitter contains ions that travel across the synapse from the neuron releasing it (the presynaptic neuron) to the receptors on the dendrites of the receiving neuron (the postsynaptic neuron). The neurotransmitter works by attaching ('binding') itself to the receptor site on the receiving neuron. Generally, the neurotransmitter will have either of two

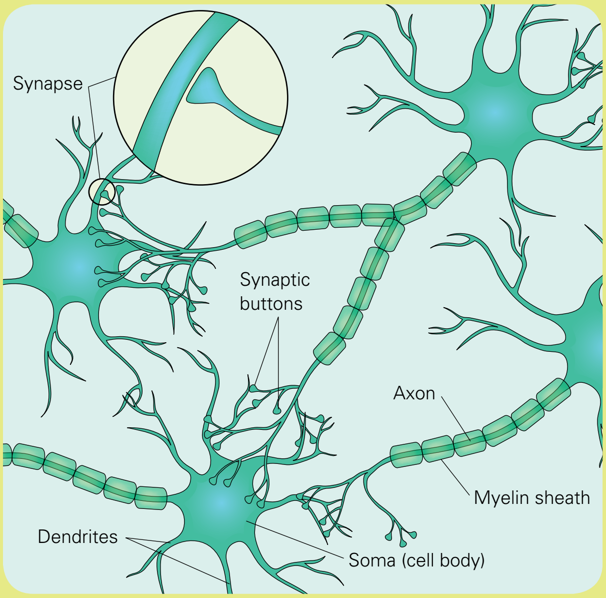


Figure 9.8 Neurons do not link together like a chain. The branches of an axon almost touch the dendrites of the next neuron, leaving a tiny space called a synaptic gap.

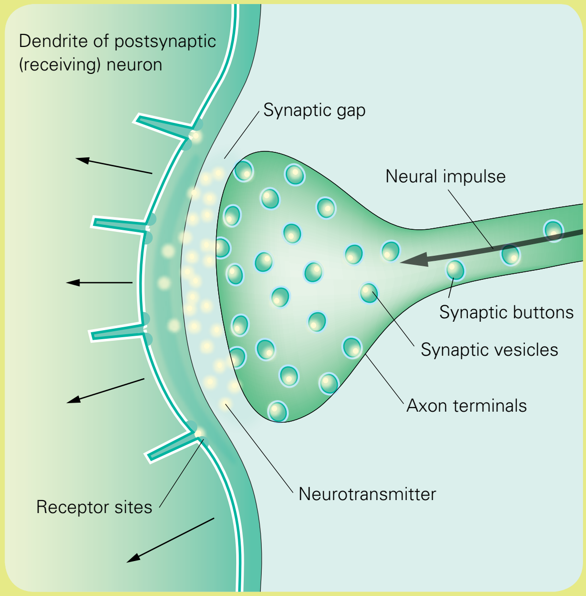


Figure 9.9 When a neural impulse reaches the axon terminal, neurotransmitters are released from the synaptic buttons, travelling across the synapse to the receiving neuron.

effects. Sometimes, the neurotransmitter will have an *excitatory* effect, and consequently stimulates or activates a neural impulse in another neuron. At other times, the neurotransmitter will have an *inhibitory* effect, and blocks or prevents the receiving neuron from firing (see figure 9.9).

Each type of neurotransmitter has a chemically distinct shape. When released by the presynaptic neuron, the neurotransmitter searches for the correctly shaped receptor sites on the dendrites of the postsynaptic neurons. Like a key in a lock or a piece of a jigsaw puzzle, a neurotransmitter's shape must precisely match the shape of the receptor site on the postsynaptic neuron's dendrites for the neurotransmitter to have an effect on that neuron. However, a postsynaptic neuron can have many different-shaped receptor sites on its dendrites and may therefore be able to receive several different neurotransmitters (Hockenbury & Hockenbury, 2006) (see figure 9.10).

The number of neurotransmitters that a neuron can manufacture varies. Some neurons manufacture only one type of neurotransmitter, whereas other neurons manufacture two or more. Although estimates vary, researchers have identified more than 100 different neurotransmitters. For example, two of the major neurotransmitters believed to be involved

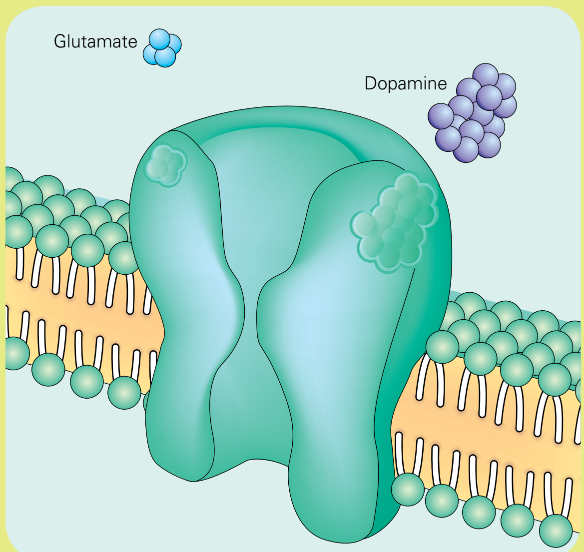


Figure 9.10 Each neurotransmitter has a chemically distinct shape. Like a piece of a jigsaw puzzle, or a key in a lock, a neurotransmitter must perfectly fit the receptor site on the receiving neuron in order to communicate its message.

in learning and memory are *glutamate* and *dopamine*.

While communication between one neuron and another is usually a chemical process involving neurotransmitters, communication between neurons also occurs in other ways. In some instances, communication between neurons is electrical; for example, when axons transmit messages directly to other axons or directly to the cell body of other neurons and when dendrites of one neuron communicate directly with the dendrites of other neurons.

What happens within the brain when something new is learned? As in the process of memory formation, when learning occurs, physical changes take place in the brain at the neuronal, or 'cellular', level. The most prominent of these changes is in the area of the synapses where transmission between neurons occurs and neurons interconnect with others in forming new synapses and neural pathways. In some cases, learning changes the strength of connections between neurons at the synapses within neural pathways that also become our memory of an experience. In other cases, learning can cause new synapses to form (Breedlove, Rosenzweig & Watson, 2007). This has led some psychologists who adopt the biological perspective to describe learning as a process that involves synapse formation and the building of neural pathways in the brain. Although this description is simplistic as it overlooks many other influences on learning, it is not an inaccurate description of the relationship between learning and the resulting physical changes in the brain. Most psychologists believe that the ability of the brain to 'rewire' itself by modifying existing neural connections and pathways, or by forming new neural connections and pathways, provides the biological basis, or 'foundation', of learning.

Canadian psychologist Donald Hebb is credited with the idea that learning involves the establishment and strengthening of neural connections at the synapse. For example, learning the piano will establish new neural connections and regular piano practice will strengthen the connections. Hebb (1949) proposed that learning results in the creation of *cell assemblies*, or inter-connected groups of neurons that form networks or pathways. Neurons in a network send messages to other neurons within the network but messages from one network may also be sent to other networks, and small networks may also organise into bigger networks. Consequently, the same neurons may be involved in different learning or in producing different patterns of behaviour, depending on which combination of neurons is active.

According to Hebb (1949), when a neurotransmitter is repeatedly sent across the synaptic gap, the presynaptic ('sending') neuron and the postsynaptic ('receiving') neuron are repeatedly activated at the *same* time. This has the effect of actually changing the chemistry of the synapse, leading to a strengthening of the connections between the neurons at the synapse. When the synaptic connection between neurons is strengthened, this makes them more likely to fire together again and to transmit their signals more forcibly in the future. Conversely, not firing together—for example, through disuse—weakens the connections between neurons and also makes them less likely to fire together at the same time in the future. Known as 'Hebbian learning', this biological theory of learning is summarised by Hebb's rhyme *neurons that fire together, wire together*. Hebb's theory has since been supported by a considerable amount of research evidence and many biological models of learning have been, and continue to be, based on his theory. For example, Kandel's research on memory formation was influenced by and provided evidence for Hebb's theory.

When Kandel studied the neuronal basis of memory in the sea snail *Aplysia*, he had to induce learning. In doing so, he was able to observe what was happening at the synapse as *Aplysia* learn and remember. A neuron was observed to release more neurotransmitter across the synaptic gap and dendrites on postsynaptic neuron receiving the neurotransmitter became bushier. According to Kandel, these changes at the synapse strengthened the connections between adjacent neurons. As a result, a neural pathway for the learning and memory of the relevant information was created along which there was greater efficiency in the transmission of information.

The synaptic changes that take place within a neural pathway during learning are believed to have long-term potentiation. **Long-term potentiation (LTP)** refers to the longlasting strengthening of the synaptic connections of neurons, resulting in the enhanced or more effective functioning of the neurons whenever they are activated. Basically, the effect of LTP is to improve the ability of two neurons—a presynaptic neuron and a postsynaptic neuron—to communicate with one another at the synapse. It is now widely believed that LTP is a crucial neural mechanism that makes learning possible in humans, as well as in all animals with nervous systems (Breedlove, Rosenzweig & Watson, 2007; Gazzaniga & Heatherton, 2006).

The earliest evidence that LTP is likely to be involved in learning comes from studies with animals. In one study, British psychologist Richard Morris and his colleagues (1982) investigated the role of both LTP and the hippocampus in spatial learning using rats and a water maze. The researchers set up a circular tank filled with milky water that obscured a platform submerged just below the surface. The researchers used this apparatus to compare the performance of three groups of rats in swimming through the water maze to the platform. Group 1 comprised rats with a cerebral cortex that had been surgically damaged in the upper area of the frontal lobe, group 2 comprised rats with a surgically damaged hippocampus and group 3 comprised rats with no surgically damaged brain area or structure. When a group 3 'normal' rat was placed in the tank, it would swim around until it found the platform and then pull itself up. Each time it was placed in the tank, it located the platform more quickly, eventually working out the most direct route and thereby demonstrating learning. When a group 1 rat (with cortical damage) was placed in the tank, it performed about as well as a group 3 rat. After several trials, it would learn a direct route through the maze to the platform. However, whenever a group 2 rat (with hippocampal damage) was placed in the tank, it showed little evidence of learning. As shown in figure 9.11, these rats failed to learn a direct path to the platform, performing in each trial as if it was the first trial. The results of this study indicate that the hippocampus is important in spatial learning. It also suggests that LTP is important in learning because the hippocampus has been found in many previous and subsequent studies on learning and memory to influence neuronal changes that result in LTP.

Further evidence of the possible role of LTP in learning comes from studies indicating that drugs which enhance transmission of information across the synapse also tend to enhance learning. NMDA (N-methyl-D-aspartate) is a neurotransmitter receptor found on the dendrites of neurons, particularly neurons in the hippocampal region. NMDA is specialised to receive the neurotransmitter called *glutamate* and, together with glutamate, is believed to have an important role in LTP. Without NMDA at the site of a dendrite where glutamate is received, any message carried in glutamate from a neuron cannot be 'accepted' by a postsynaptic neuron. Research findings that NMDA glutamate receptors are involved in LTP led researchers to examine whether they could influence learning by manipulating the capability of NMDA receptors in postsynaptic neurons during learning tasks. In one study, American psychologist

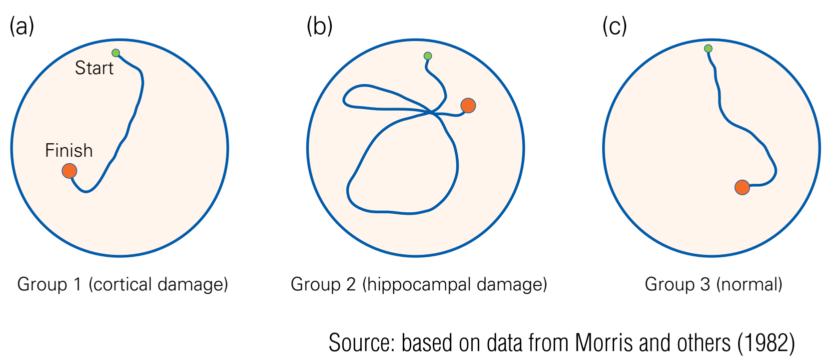


Figure 9.11 Typical swimming paths shown by rats within a water maze. Normal rats (c) rapidly acquire a direct path, as do rats with cortical damage (a), whereas hippocampal damage results in a failure to learn (b).

Joseph Tsien (2000) used genetic engineering to produce a strain of mice that had more-efficient NMDA receptors. When tested on various learning and memory tasks, these mice performed better on all tasks than did normal unaltered mice in the control group. For example, they outperformed the normal mice in maze-learning and object recognition tasks. They also showed significantly better memory when tested a day or more later. These findings raise the possibility of developing drugs that might enhance the learning process (and memory) by activating or mimicking NMDA. However, much research on the role of LTP and NMDA in learning remains to be done. Although LTP has been recorded in the brains of higher order animals and human research participants during learning (and memory), the role of LTP in complex forms of learning in humans has yet to be extensively investigated. Generally, it is now widely accepted that LTP is necessary for learning and that NMDA receptors are necessary for the changes at the synapse assumed to underlie learning. However, this does not mean that other biological processes, as well as psychological processes, are of lesser importance in learning (Breedlove, Rosenzweig & Watson, 2007; Gazzaniga & Heatherton, 2006).

Learning Activity 9.4

Review questions

1. Name the three components of the synapse and their roles in communication between neurons.
2. What role does neurotransmitter play at the synapse?
3. Explain the meaning of synapse formation and the role of this process in learning.
4. Explain the meaning of Hebb's rhyme 'cells that fire together, wire together' in relation to learning.
5. **a** What is long-term potentiation (LTP)?
   b Why is LTP believed to be a crucial biological process for learning to occur?
   c Why is the study by Morris and others (1982) considered to provide evidence for LTP having a role in learning?
6. Explain why some psychologists who adopt the biological perspective have described learning as a process of modifying existing neural pathways or building new neural pathways.

Figure 9.12 In Tsien's (2002) experiment, the 'smart' (genetically altered) mice were exposed to two objects: one that they had explored previously and one that was new. Like other mammals, mice prefer to explore new objects more than familiar ones. The 'smart' mice explored the new object (red top) more than the original object (orange top), even when several days had passed since the first session. The unaltered mice explored the new object more than the familiar one only when a shorter period of time had elapsed. To Tsien and his colleagues, this was evidence that the 'smart' mice remembered the original object for longer than did the unaltered mice.

Learning Activity 9.5

Visual presentation

Using poster paper or PowerPoint, prepare a visual presentation in which you

- show changes at the synapse when learning occurs (e.g. synapse formation)
- show the modification of a neural pathway for learning
- show the creation of a new neural pathway for learning
- demonstrate the role of long-term potentiation
- label all relevant anatomical structures and features and briefly describe the roles of key structures and features
- briefly explain the roles of synapse formation, long-term potentiation and neural pathways in learning.

In preparing your presentation, ensure you use relevant graphics and base the presentation on learning of a specific motor or cognitive skill.

Learning Activity 9.6

Visual presentation

Working in a group of five or six, prepare a role play demonstrating synapse formation in learning and the strengthening of neural connections during the learning process. Ensure each anatomical feature and biological process can be clearly distinguished and understood by other members of the class.

Plasticity and effects of experience on the brain

The brain is capable of learning because of its flexibility in being able to adjust to changes in environmental input. Experience associated with learning causes changes at the synapse, including the establishment and strengthening of connections between neurons that form neural pathways within the brain. New pathways can form and link up with existing pathways and existing pathways may interconnect with other pathways. These types of changes involve neurons as well as other types of brain cells. Their activities result in changes to the brain's physical structure and function. For example, the brain can reorganise and reassign its neural connections and pathways based on which parts of it are overused or underused. Its structure is constantly remodelled by experience. This fundamental but very important ability to change is referred to as *neuroplasticity*, *neural plasticity*, or simply *plasticity*.

Plasticity is the ability of the brain's neural structure or function to be changed by experience throughout the lifespan. The term 'plasticity' is used because plastic originally meant flexible, pliable or malleable. The brain's plasticity is a feature that persists from embryonic development through to and including old age. Lifelong plasticity accounts for many of the learning experiences we have throughout life, such as learning our native ('first') language as a child, learning to play a musical instrument as an adolescent, learning to text message as an adult, learning to use a computer in old age, and so on. Our genes govern the overall architecture of our brain, but experience guides, sustains and maintains the details. If a monkey is trained to push a lever with a finger several thousand times a day, the brain tissue that controls the finger changes to reflect the experience. Human brains function in a similar way. Whether learning to use a keyboard or a skateboard, we perform with increasing skill as our brain incorporates the learning within its structure. The neural activity underlying this process occurs in a systematic way and not haphazardly (Breedlove, Rosenzweig & Watson, 2007; Myers, 2007).

Although some areas of the brain such as the sensory and motor cortices have a higher level of plasticity than others, it is unclear as to whether all brain areas have plasticity. However, the brain of a developing individual is even more plastic than that of an adult, particularly at specific times in development when it seems that the brain is more responsive to certain types of experiences. This is one reason why infants learn a new language more quickly than do adults. Similarly, infants recover more quickly from brain damage than do adults due to the greater plasticity of their brain. There also seems to be a relationship between the type of experience we have and the extent of the structural change that takes place in the brain. Generally, the more complex the experience in terms of the variety of sensory input, the more distinctive the structural change in neural tissue involved in the experience. This seems to be the case for both children and adults.

A series of experimental research studies conducted with rats in the 1960s by American psychologist Mark Rosenzweig and his colleagues provided the first substantial evidence that the brain can be altered by learning and experience. In their initial experiments, laboratory-born rat pups of the same sex and from the same litter were randomly assigned to different environments shortly after weaning (at 25 days after birth). Within each environment, the rats had different experiences and opportunities for informal learning. The three most common environments were (1) a 'standard' environmental condition in which three rats were kept in a standard issue laboratory cage and provided with food and water but no opportunity for complex stimulation and informal learning (which is a typical environment for laboratory rats); (2) an 'impoverished' (deprived) environmental condition in which a single rat was housed in a standard laboratory cage; and (3) an 'enriched' environmental condition in which a group of ten to 12 rats was kept in a large cage containing a wide variety of stimulus objects, which were changed daily and provided opportunities for complex stimulation and informal learning. All rats were kept in these conditions for 80 days. When their brains were dissected, those rats reared in the enriched environment were found to have developed a thicker and heavier cerebral cortex than had their littermates raised in the other two conditions. The differences in cortical tissue were also found to be unevenly distributed throughout the cerebral cortex. They were largest in the occipital lobe and

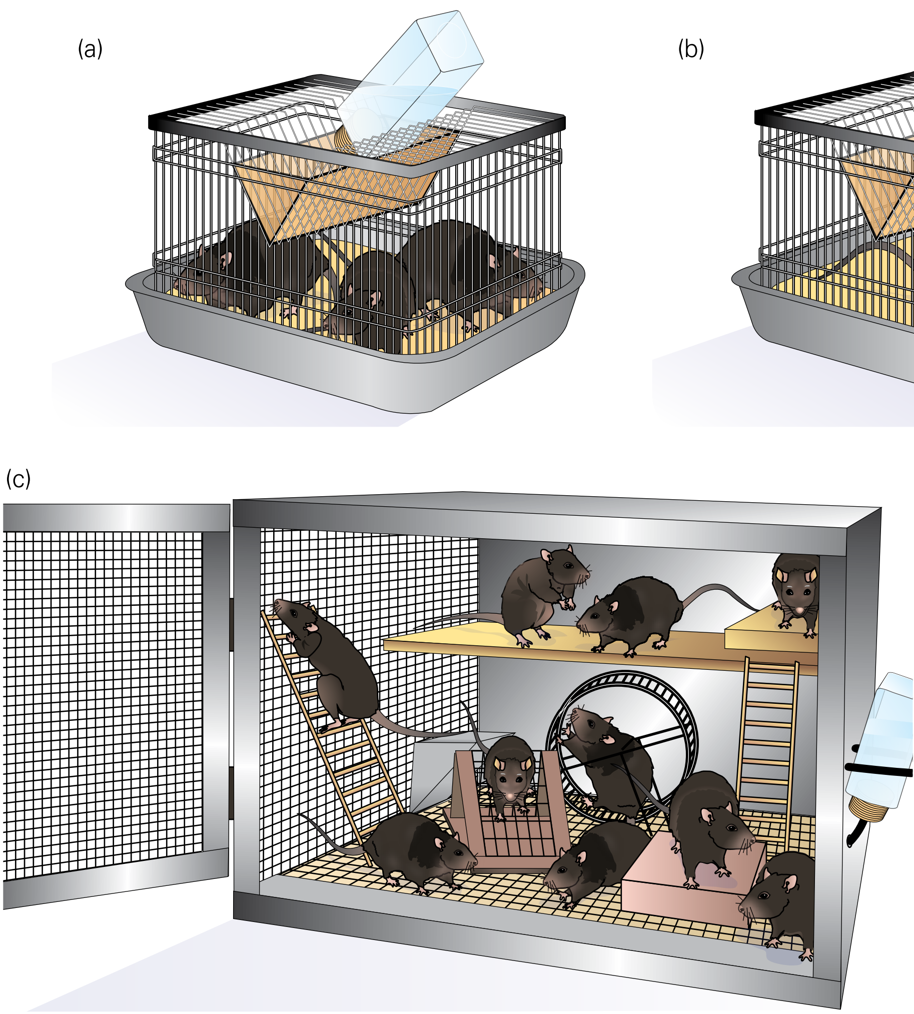


Figure 9.13 Rosenzweig's 1960s experiments with rats: (a) standard condition, (b) impoverished condition and (c) enriched condition

smallest in the somatosensory cortex. Significant changes were also found to occur at the neuronal level, particularly at the synapse. The brains of rats reared in the enriched environment had larger cortical neurons and longer and bushier dendrites, and existing synapses were bigger and new synapses had formed. There was also more acetylcholine, a neurotransmitter that is prominent in the cerebral cortex of mammals (Rosenzweig, Breedlove & Leiman, 2002).

In later experiments, the researchers found that spending shorter periods in the enriched condition could produce similar changes in the cerebral cortex, and that the brains of both young and adult rats changed, although changes in the young were more pronounced than those of the adults. Furthermore, these changes occurred even when rats were not placed in the differing environments until well into adulthood (Rosenzweig, Breedlove & Leiman, 2002). Other researchers who replicated or substantially varied Rosenzweig's experiments have obtained similar results. American psychologists Bryan Kolb and Ian Whishaw (1998) analysed the results of these types of studies and reported that the weight of rats' brains following exposure to an enriched environment, and therefore opportunities for new experiences, can increase by up to 10% and the number of synapses can increase by as much as 20%. These neural changes may provide a greater number and variety of connections in the brain, thereby increasing the brain's ability to effectively deal with a more cognitively demanding and complicated environment. For instance, there is research evidence that rats raised in complex environments are much better than control group animals in solving various maze-learning tasks. Similarly, dendrites lacking normal anatomical features may disrupt or prevent certain mental processes. For example, in humans, the cognitive decline associated with neurodegenerative diseases such as Alzheimer's disease is also associated with a thinning of the branches on dendrites (Banich, 2004).

Enrichment and impoverishment studies have been carried out with many other species, including monkeys, cats, birds, honey bees, and even fruit flies. In all cases, enriched environments are associated with measurable changes in the brain (Kolb & Whishaw, 1998). But can the conclusions drawn from studies on rats, monkeys and other animals be applied to human brains? Obviously, for ethical reasons, researchers cannot conduct experiments on the effects of enriched or impoverished environments on human brain tissue as they can with animals. However, there is a growing body of evidence from studies that have used other research methods indicating that the human brain also seems to benefit from enriched, stimulating environments. For example, autopsies have been conducted to study differences in the brains of university graduates with those of high-school dropouts. The brains of university graduates had up to 40% more synaptic connections than those of high-school dropouts (Hockenbury & Hockenbury, 2006).

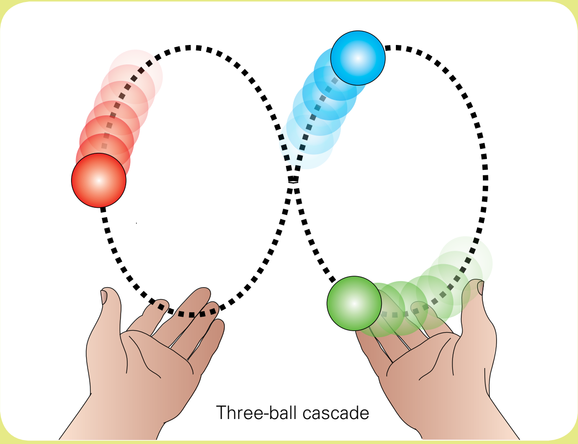
Researchers have also conducted studies that have compared the life experiences of elderly people. The results of these studies suggest that a stimulating environment may delay the onset of some of the adverse effects of ageing. For example, in a long-term study of more than 5000 adults it was found that being involved in activities that are intellectually stimulating and challenging, both at work and at home, reduces the risk of cognitive decline in old age. These activities include having a job involving a high level of complexity and a low level of routine, participating in continuing education such as a short course at a TAFE, having a habit of extensive reading, being active in social groups and engaging in travel. Such an effect is also found when biological factors are kept constant, or 'controlled'. For example, in a research study using sets of identical twins, one with dementia and one without, it was found that the twin with a low level of education (i.e. didn't complete high school) and who tended not be mentally active was more likely to get Alzheimer's disease (Banich, 2004).

Developmental plasticity and adaptive plasticity

Some psychologists distinguish between various types of brain plasticity. One such distinction is in terms of *developmental plasticity*, which occurs as brain development proceeds according to its maturational blueprint or plan, and *adaptive plasticity*, which is most apparent in recovery

Box 9.3

Juggling and brain plasticity



Research conducted by German psychologist Bogdan Draganski and his colleagues (2004) provides strong evidence that structural changes can occur in the human brain when a new skill is learnt. In their experiment, 24 adult participants (21 females and three males), all with no prior juggling skills, were randomly assigned to either a 'jugglers' group (experimental condition) or 'non-jugglers' group (control condition). Participants were then given MRI scans to collect baseline data on brain structure. The scans revealed no significant differences between the two groups in the volumes of grey matter and white matter in their brains.

Participants in the jugglers group were taught a relatively uncomplicated juggling routine using three tennis balls. For the next three months, the jugglers were required to practise the routine until they could juggle three tennis balls for at least 60 seconds without error.

All participants were then given a second series of MRI scans. The scans of the jugglers' brains showed a 3–4% increase in the volume of grey matter when compared with their baseline scans. As shown in yellow in figure 9.14 on page 438, these changes occurred in brain areas around the mid-temporal lobe that process and store information about how we perceive and anticipate moving objects. In comparison, the scans of the non-jugglers over the same three-month period showed no change in the temporal lobe or other brain areas.

The jugglers were then asked to stop practising their newly acquired skill. Three months later, the jugglers and non-jugglers were given a third series of MRI scans. The scans showed that three months after stopping juggling, the 3–4% increase in grey matter of the jugglers, compared to levels at the start of the experiment, had fallen to a 2% increase. In comparison, the same areas in the non-jugglers remained unchanged.

Draganski and his colleagues proposed that while the jugglers were learning their new skill, neurons in the affected areas were extending ('growing') and making more connections with other neurons, thereby increasing the volume of grey matter. The subsequent decrease in grey matter after juggling had ceased could not be explained. Nor did the researchers account for any possible differences between women's and men's brains.

The importance of these research findings is that there was a change in the anatomical structure of the brain that can be directly attributed to learning a new skill. Moreover, the results indicate that the brain can change as an adult. Australian researcher, and director of Melbourne's Brain Research Institute, Graeme Jackson (2004) believes that these results should not be surprising: 'If you use something a lot it changes to cope with that use and there is no reason why neurons in the brain should be different from our muscles.'

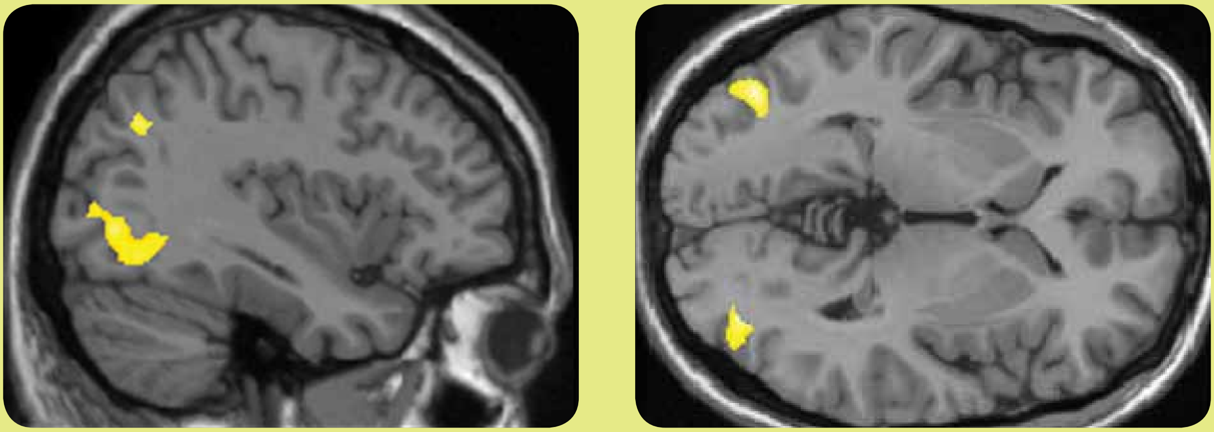


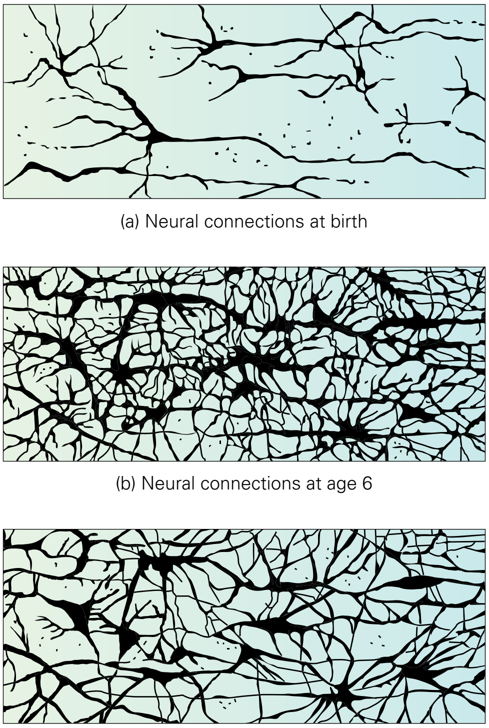
Figure 9.14 The yellow areas in these MRIs show the regions of the brain that temporarily increased in size in participants learning to juggle. These regions are involved in the abilities to perceive, remember and anticipate complex visual motions.

Source: Hockenbury, D.H., & Hockenbury, S.E. (2006). *Psychology* (4th ed.). New York: Worth, p. 83.

from trauma due to brain injury. However, a clear line cannot be drawn between these two types of plasticity. Both are influenced by experience. In addition, the maturing brain of a child has the capacity to adapt to and therefore recover from trauma more effectively than the mature brain of an adult.

Developmental plasticity refers to changes in the brain's neural structure in response to experience during its growth and development. This type of plasticity is predetermined and therefore influenced by the genes we inherit, but it is also subject to influence by experience. One of the significant developmental changes after birth is that the infant brain forms far more synaptic connections than it will ever use. This process of forming new synapses is called **synaptogenesis**. Synaptogenesis occurs so rapidly within the first year of life that the total number of synapses increases tenfold. Synaptogenesis during early development is believed to allow the brain to initially have the capability to respond to the constant stream of new environmental input; for example, to deal with all the sensory information that bombards the sense organs. However, following the proliferation in the formation of new synaptic connections, the brain undertakes a process of eliminating synaptic connections. This process of eliminating synaptic connections is called **synaptic pruning**. Synaptic pruning occurs in different areas of the brain at different times. For example, in humans, it is complete in the visual cortex by about age ten but continues in the cortex of the frontal lobe until about age 14. What is constant across different areas of the brain, however, is that the number of synapses in an adult is about 40% less than the number in a three-year-old. Experience determines which connections will be retained and strengthened and which will be pruned. The connections that are frequently used are retained and those that are not decay and disappear. The entire process occurs as if the rule 'use it or lose it' is being followed. It is also a process that closely ties experience to brain development (Gazzaniga & Heatherton, 2006; Banich, 2004).

Although plasticity is a core feature of the brain throughout life, the timing of some experiences early in the lifespan is important. Certain periods in an individual's development are particularly well suited to learning certain skills and gaining knowledge. These periods are called *sensitive* or *critical periods*. A **sensitive period** is a specific period of time in development when an organism is more responsive (or 'sensitive') to certain environmental stimuli or experiences. Sensitive periods usually have specific onset ('start') and offset ('end') times. For example, if for a certain time after birth, one eye of a cat, monkey or human is kept closed or does not function



(a) Neural connections at birth

(b) Neural connections at age 6

(c) Neural connections at age 14

Figure 9.15 The infant brain forms far more neural connections than it will ever use to allow the brain to respond to the constant stream of new environmental input. The brain then 'prunes' any synaptic connections that aren't used in a process of 'use it or lose it'.

properly because of some abnormality such as a cataract, that eye will be forever blind. The changes responsible for this loss of visual function occur in the visual cortex. In cats, monkeys and humans, the visual cortex fails to develop normally if one eye is kept closed after birth. However, the sensitive period after birth when closing one eye can produce permanent impairment of vision varies. In cats and monkeys, the sensitive period extends to several months of age. Over this period, the effect of closing one eye (by stitching it closed) becomes progressively less. Closing it for the first two months after birth produces a much greater visual impairment than closing it for the fifth or sixth months. In humans, the sensitive period seems to last for about the first six years of life. Keeping one eye closed for only a few weeks in the sensitive period is believed to produce a measurable visual impairment (Thompson, 2000).

Sensitive periods are sometimes described as 'windows of opportunity for learning' because they are the optimal, or 'best possible', times for the relevant learning to occur. For example, certain skills and knowledge, such as those of language acquisition, are believed to be more easily acquired during a sensitive period in development. If these skills and knowledge are not acquired during the sensitive period, they may be acquired at a later time but it will usually take more time, be more difficult and the learning may not be as successful. In relation to language learning, psychologists are not in complete agreement about the age limits for the sensitive period. Generally, the sensitive period for our native language is up to the age of about 12 years, with the window gradually closing from about age seven. At birth, however, it seems that we are ready to learn the language of whichever culture into which we happen to be born. For instance, we are able to perceive almost all the differences in sounds that are expressed in the various languages used throughout the world. By age one, this ability to perceive differences in language sounds is refined. We become more sensitive to the differences relevant to our language environment and less sensitive to differences important in other languages. Although a second language can be acquired at any time after childhood, if acquisition occurs before the ages of five to seven years, the individual's competence will be like that of a native speaker. In some cases, learning a second language during early adolescence leads to the development of a second Broca's area in the left hemisphere, adjacent to the original Broca's area (Gazzaniga & Heatherton, 2006; Banich, 2004; Rosenzweig, Breedlove & Leiman, 2002).

Sensitive periods indicate that brain development goes through certain periods during which some synaptic connections are most easily made and some neural pathways are most easily formed, assuming there is exposure to the appropriate environmental stimulus. Furthermore, the proliferation of synapses during synaptogenesis early in development may reflect a genetically directed preparation by the brain to respond to certain types of experiences. This has been described as an *experience-expectant* process; that is, the brain is priming itself, or 'getting ready', for 'experiences' that are 'expected' during sensitive periods.

Adaptive plasticity

Adaptive plasticity refers to changes occurring in the brain's neural structure to enable adjustment to experience, to compensate for lost function and/or to maximise remaining functions in the event of brain damage. It is most evident in neural processes that occur when the brain has experienced damage through either inflicted or acquired injury. However, among other factors, the way the brain may respond to injury, and the effectiveness of its response, depends on the location, degree and extent of the damage, and the age at which the damage is experienced. Although adaptive plasticity can take place at any time in the lifespan, it is typically quicker and more substantial and extensive in the earlier years, particularly in infancy and early childhood.

Generally, adaptive plasticity enables the brain to compensate for damage by reorganising its structure. Reorganisation can occur immediately or continue for years and may involve a number of different processes. Some of these processes occur at the neuronal level, whereas other processes involve larger areas of brain tissue or even the transfer of a function from one hemisphere to another.

At the neuronal level, two processes for recovery are rerouting and sprouting. Both of these processes involve forming new connections between undamaged neurons. In *rerouting*, an undamaged neuron that has lost a connection with an active neuron may seek a new active neuron and connect with it instead. *Sprouting* is the growth of new bushier nerve fibres with more branches to make new connections. Thus, sprouting involves not only nerve growth, but rerouting as well. Sprouting may occur not only near the damaged area, but also in brain areas far away from the damaged area. Either way, sprouting and rerouting enable the growth and formation of entirely new neural connections at the synapse to compensate for loss of function due to brain damage. This essentially means that the brain's adaptive plasticity enables it to take over or shift functions from damaged to undamaged areas. Such plasticity can occur at all levels of the central nervous system, from the cerebral cortex down to the spinal cord. However, in order for neurons to reconnect or form new connections, they need to be stimulated through activity. Relevant types of experience during recovery from brain damage are therefore important influences on the speed of recovery. For example, depending on the location and degree of brain damage, stroke or accident victims often need to 'relearn' tasks they previously performed routinely such as walking, speaking or reading. The younger the individual, the greater the likelihood of successful 'relearning' and subsequent new learning.

Through adaptive plasticity, functions that were assigned to certain areas of the brain can sometimes be reassigned to other undamaged areas of the brain to compensate for changing input from the environment. For example, an extraordinary amount of stimulation of one finger can result in that finger 'taking over' a part of the somatosensory cortex that usually represents other adjacent fingers. If you lost your middle finger in an accident, the area of the somatosensory cortex that represents that finger will initially be unresponsive because there is no longer any sensory input received from the location of the missing finger. You might expect the 'left middle

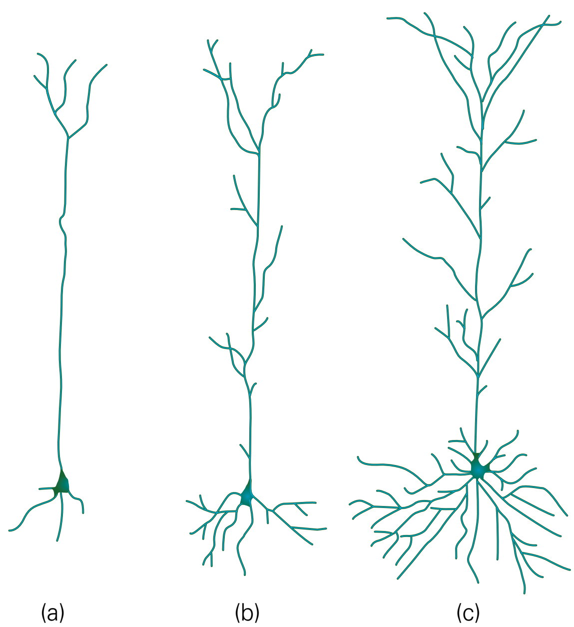


Figure 9.16 Progressive dendritic sprouting is shown in (b) and (c). Figure (a) shows the damaged neuron before sprouting.

finger neurons' of the somatosensory cortex to degenerate and eventually disappear. Instead, over time, that area of the somatosensory cortex will begin to receive input from the adjacent fingers and become responsive to stimulation of these fingers. This has been demonstrated experimentally in studies in which psychologists have surgically destroyed areas of the somatosensory cortex of monkeys. The results of such studies typically show that the somatosensory cortical 'map' representing the destroyed areas gradually shifts to undamaged adjacent areas of the parietal lobes, restoring the ability to experience bodily sensations (Thompson, 2000).

A dramatic example of the brain's reassignment of functions to other areas is evident when a function is taken over by the opposite cerebral hemisphere if injury destroys the part of the hemisphere where the function is primarily located.

Recovery from other types of extensive brain injury by adults through adaptive plasticity can also be quite dramatic. Some patients with a paralysed hand or arm, for example, very often recover its use within a few months. The case of a 25-year-old adult female who was an accomplished pianist highlights this fact. The patient had a stroke that damaged the left hemisphere of her brain. Consequently, she was unable to speak and had lost complete use of her right hand. It was a devastating loss at a young age, and her inability to play the piano only added to the tragedy. She was placed in a rehabilitation program that involved repeated attempts to engage the right side of her body, including speech therapy and piano playing. After several months of rehabilitation, she regained nearly full use of her right hand, and she was again able to speak. Furthermore, she also demonstrated exceptionally rapid finger movements in both hands, displaying speed and coordination beyond

Box 9.4

The effect of childhood loss of one hemisphere

During early development, the brain is particularly vulnerable. This is evident, for example, when the effects of a prolonged, difficult birth involving oxygen loss are considered. An infant born under such circumstances may sustain brain damage in one of the hemispheres. As a result, the infant may have paralysis on one side of their body and experience severe uncontrollable epileptic seizures that occur so often and unpredictably that they are life-threatening.

A radical procedure to reduce the frequency of the seizures involves surgical removal of the malfunctioning hemisphere. Although at first some severe effects of the surgery are evident, over a long period of time recovery of mental functions and behaviour is practically complete. This result is illustrated in the case of a boy who had paralysis on his right side as an infant. By five years of age he was experiencing ten to 12 seizures a day. Although the boy's verbal comprehension was normal, his speech was hard to understand. To treat the problem, neurosurgeons removed all the cerebral cortex of the left hemisphere. At first, the boy's language abilities worsened, but then improved rapidly. Long-term follow-up studies extended to the age of 26, at which time he had almost completed university. Diagnostic tests revealed an above-normal IQ and superior language abilities. Thus, it seems that the early loss of most of the left hemisphere had not impaired or prevented language development. This patient also had highly developed non-verbal functions, including visual spatial abilities and motor skills. Whereas surgical removal of the left hemisphere of an adult's brain usually results in drastic impairment of language, affecting both speech and writing, surgical removal of the left hemisphere during early childhood does not necessarily have permanent consequences for cognitive and behavioural functions.

Source: Breedlove, S., Rosenzweig, M., & Watson, N. (2007). *Biological psychology: An introduction to behavioral, cognitive, and clinical neuroscience* (5th ed.). Sunderland, Massachusetts: Sinauer Associates, p. 601.

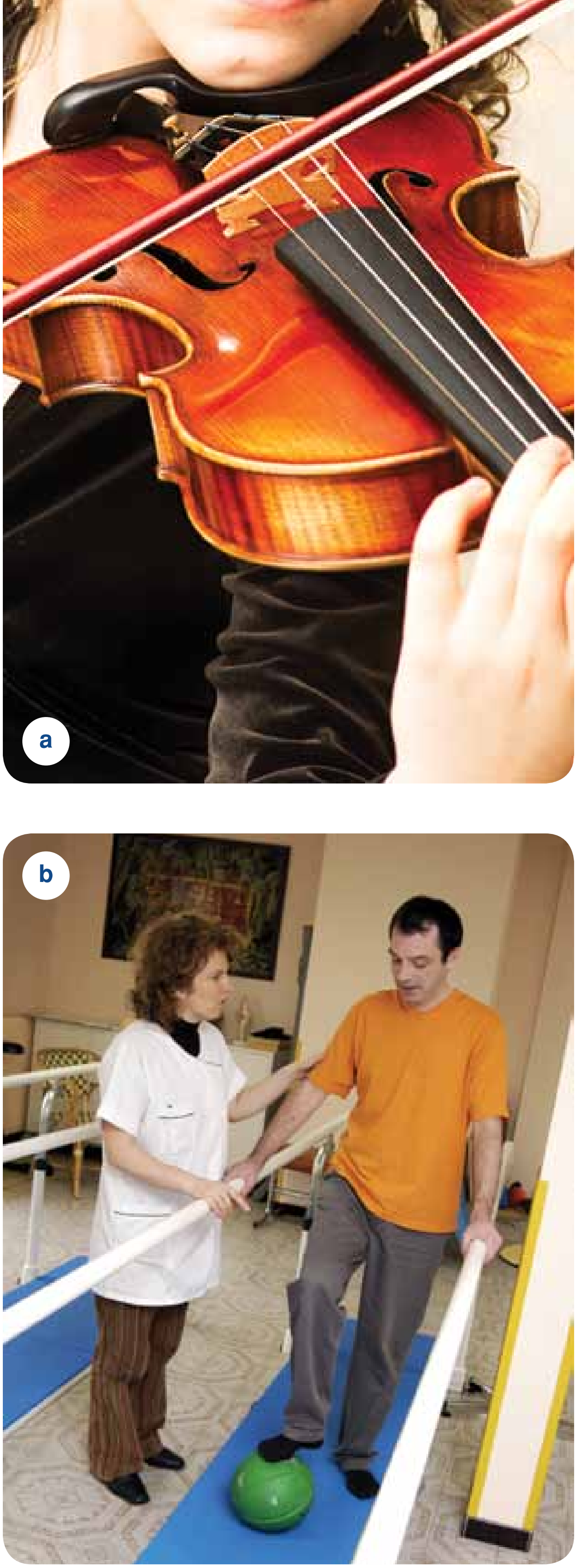


Figure 9.17 Adaptive plasticity occurs in response to experience and to assist recovery and/or compensate for lost function after brain injury. The professional violinist in (a) is likely to have an overdeveloped somatosensory cortex in the finger control area. The man in (b) is learning to walk again after suffering an injury to the brain.

those of the average (non-stroke-affected) person. Today she has resumed her piano playing and has fully recovered her abilities to the virtuoso levels attained before the stroke (Azari & Seitz, 2009).

Adaptive plasticity does not only occur to compensate for damage. It can also occur as a consequence of everyday experience. For example, neuroimaging studies show that in musicians who play string instruments, the area of the somatosensory cortex that represents the fingers of the left hand (the hand requiring greater motor learning for fine finger control) is larger than the area that represents the right hand (which is used to bow), and larger than the left hand area in non-musicians. Similarly, concert pianists have larger than usual cortical areas for finger control and professional quilters have highly developed areas for the thumb and forefinger, which are critical to their craft (Nelson, 1992).

There is also evidence that other brain areas can increase in size through extensive use. For example, to become a taxi driver in London, individuals have to go through a comprehensive training course for about two years and then pass a strict test of their ability to find the shortest route between any two locations. As a result of this type of training and assessment, London taxi drivers have become renowned for their ability to efficiently navigate their way throughout one of the most complex and largest metropolitan areas in the world without using a street directory (or GPS).

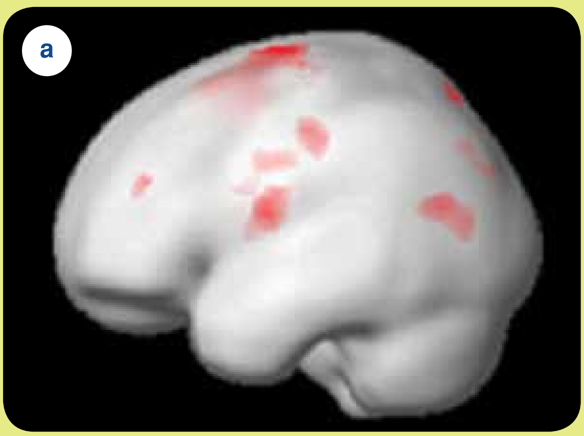
When MRI scans of London taxi drivers (who find new routes daily) are compared with London bus drivers (who follow a limited number of set routes daily), they show that the rear part of the hippocampus of taxi drivers, which is involved in spatial navigation (and memory), is significantly larger. Studies have also found a significant positive correlation between years of taxi-driving experience and growth of the hippocampus; that is, the more years an individual has driven a taxi, the larger the hippocampal area, and vice versa (Schacter, Gilbert & Wegner, 2009; Gazzaniga & Heatherton, 2006).

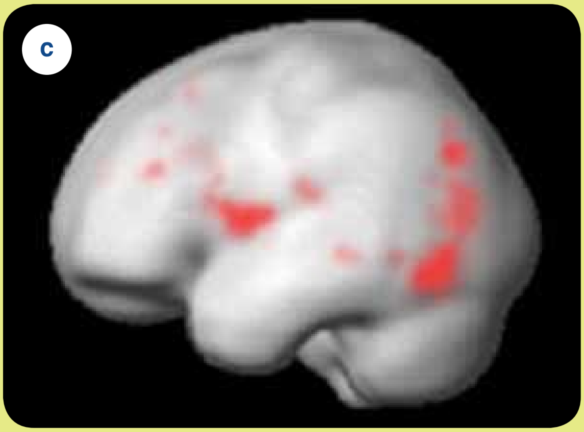
Box 9.5

Brain plasticity in children with dyslexia

Most children who are exposed to language throughout their infancy master the incredible complexities of speech production and comprehension with seemingly little effort, but some children lag behind their peers in the development of these skills. Studies have estimated that 3–10% of all preschoolers have at least some language-learning problems that are not attributable to diagnosable factors, such as hearing impairment, intellectual disability or brain damage. These children are commonly described as having *language-learning impairment (LLI)*. Some of these children develop a cluster of impairments in language and reading that may be diagnosed as dyslexia. *Dyslexia* is a specific difficulty in reading that is severe enough to interfere with academic functioning and cannot be accounted for by lack of educational opportunities, personal motivation or problems perceiving sights or sounds.

American psychologists Elise Temple, Paula Tallal and John Gabrieli (2003) conducted a neuroimaging study that found that the brains of children with dyslexia can be 'rewired' by intensive remediation training to function more like the brains of normal readers. The brains of children with dyslexia were scanned using functional magnetic resonance imaging (*f*MRI) before and after the children participated in the eight-week training program. A control group of children with normal reading abilities also had their brains scanned but did not participate in the training. At the beginning of the study, both the dyslexic children and the control group were asked to perform a simple rhyming task while the initial brain images were captured.





Courtesy Elise Temple from Temple, E., Deutsch, G.K., Poldrack, R.A., Miller, S.L., Tallal, P., Merzenich, M.M., & Gabrieli, J.D. (2003). Neural deficits in children with dyslexia ameliorated by behavioral remediation: evidence from functional MRI. *Proceedings of the National Academy of Sciences USA* (March 4), *100*(5), 443 (all).

Figure 9.18 (a) Children with no reading disability show strong left-brain activity in language-processing regions; (b) children with dyslexia show frontal lobe activity but a lack of activation in the temporal parietal lobe area; (c) children with dyslexia display increased brain activity in both these language-processing areas after training, more closely resembling the normal activity seen in the control group participants in (a).

Participants were shown two uppercase letters and told to push a button if the names of the two letters rhymed with each other. For example, 'B' and 'D' would rhyme, but 'B' and 'K' would not. During the rhyming exercise, children in the control group showed activity in both the left frontal and temporal lobes of the brain, as shown in figure 9.18a. Both of these brain areas are important for processing language. Children with dyslexia, however, struggled with the task and failed to activate the left temporal region, as shown in figure 9.18b.

Next, the children with dyslexia participated in a computer-based training program for five days a week, as part of their regular school day. The program consisted of seven exercises that rewarded them when they answered questions correctly. For example, the computer might show a picture of a boy and a toy, and a voice from the computer would ask the child to point to the boy. A correct response required the child to distinguish the very brief difference in the sound of the first consonant of 'boy' versus 'toy'; that is, the sounds of *b* and *t*. Initially, the questions were asked with those key initial consonants presented in a slower, more exaggerated fashion than in normal speech to help the children recognise the sounds inside the words. As the child progressed, the speed of the voice in the program slowly increased. After the training, the children scored higher in language and reading tests. In addition, the brains of the children with dyslexia showed significant increases in activation of language-processing areas, behaving much more like the brains of good readers, as in figure 9.18c.

This suggests that children's brains are remarkably plastic and adaptive, and that language-intervention programs can alter the brain in helpful ways.

Nintendo brain training 'no better than pen and paper'

Asher Moses

Figure 9.19 Nintendo used Nicole Kidman for its *Brain Training* advertisements in Britain.

People buying Nintendo DS consoles to give their grey matter a workout with brain training games are wasting their money, a new study shows.

Titles such as *Brain Training*, *More Brain Training* and *Big Brain Academy*, which cost $50 on top of the $200 DS handheld, are no better than a pen and paper at stimulating memory and improving brain power, a study of 10-year-old children by the University of Rennes in France has found.

Nintendo claims in its advertising for the games—which in Britain feature Nicole Kidman—that they 'stimulate your brain and give it the workout it needs' to improve blood flow and 'practical intelligence'.

It also claims the games can improve memory and keep your mind young, reinforced by the fact that players are given a 'brain age' when completing the tests, which lowers as performance improves.

In Australia, Nintendo furthered the perception that the games boost memory by announcing it would donate $1 to Alzheimer's Australia for every copy of *Brain Training* sold.

Market watcher GfK said *Brain Training* was the seventh best-selling console game in Australia last year, with more than 140 000 units sold.

But the study of 67 10-year-olds found that homework, reading, playing puzzles such as Sudoku and board games such as Scrabble were just as good as, if not better than, the brain training games.

'As a game it's fine but it is charlatanism to claim that it is a scientific test,' University of Rennes professor of cognitive psychology Alain Lieury told London's *The Times*.

'If it doesn't work on children, it won't work on adults.'

The children were broken up into four groups—two did a seven-week Nintendo DS memory course, the third did puzzles with pencil and paper and the fourth went to school as normal.

Each group was tested before and after the programs on logic, memorising words on a map, doing maths sums and interpreting symbols.

The researchers found there was a 19 per cent increase in maths performance and a 10 per cent improvement in logic tests when using the DS, but the other groups showed similar improvements.

In the memory tests, the pencil and paper group improved by 33 per cent while the Nintendo DS group performed 17 per cent worse.

The results differ markedly from claims by celebrity Sydney GP Dr Penny Adams, who claims brain training games are better than traditional mental exercises such as reading and doing puzzles because they impose a time limit.

However, Adams made those remarks while she was marketing her own brand of brain training software for the PC, 'Dr Penny Adams' Brain Trainer'.

Alzheimer's Australia says all exercises and puzzles that keep the mind active are good but there is no evidence to suggest one exercise is better than another. Puzzles could delay the onset of Alzheimer's if one is predisposed that way but would not stop the disease from occurring, a spokesman said.

A different study of 600 pupils in 32 Scottish schools, carried out by Learning and Teaching Scotland last year, found the brain training games improved maths attainment and concentration.

Students played *Brain Training* for 20 minutes at the start of their class for nine weeks, while a control group did not play at all.

The researchers found that the students who played *Brain Training* showed improvements that were 50 per cent better than the control group.

Nintendo Australia spokeswoman Heather Murphy said *Brain Training* was inspired by the work of prominent Japanese neuroscientist Dr Ryuta Kawashima. Activities in the game were based on the premise that cognitive exercise can improve blood flow to the brain.

'We have seen very positive examples of *Brain Training* being used in primary schools and nursing homes, which have been reported on widely,' she said.

Source: Moses, A. (2009, January 27). Nintendo brain training 'no better than pen and paper'. *The Age*, www. theage.com.au.

Learning Activity 9.7

Review questions

1 Explain the meaning of plasticity in relation to the brain.

2 Explain why the brain is considered to have plasticity with reference to two key points.

3 Many psychologists distinguish between two types of plasticity called structural plasticity and functional plasticity. Devise a suitable definition for each of these terms.

4 Explain the meaning of developmental plasticity with reference to learning.

5 In what way do synaptogenisis and synaptic pruning demonstrate the plasticity of the brain?

6 **a** What is the meaning of a sensitive period in relation to learning?

b Give an example of research evidence for sensitive periods in learning and explain why the evidence supports this concept.

c What biological process(es) occurring during early development suggests that there may be sensitive periods in learning?

7 a What is adaptive plasticity?

b In what way is adaptive plasticity similar to and different from developmental plasticity?

c Describe three neural processes that indicate and enable adaptive plasticity.

8 Give an example of research findings that support the occurrence of adaptive plasticity in response to

a everyday experience

b recovery from brain damage.

9 Explain how adaptive plasticity enables compensation for lost brain function and/or maximises remaining functions in the event of brain damage.

Learning Activity 9.8

Media response

Read the newspaper article on Nintendo's *Brain Training* on pages 444–5 and answer the following questions.

1 What is the article about?

2 What key arguments and/or evidence are proposed in support of and against expensive brain training games and software programs?

3 Based on your reading of chapter 9, which types of brain training games or activities are likely to

a improve learning effectiveness?

b prevent the onset of cognitive decline?

Explain each answer with reference to relevant theory and/or research evidence.

Learning Activity 9.9

Evaluation of research

Evaluate the experiment conducted by Morris and others (1982) *or* the series of experiments by Rosenzweig and others (1960s). You are required to:

- suggest an aim for the experiment(s)
- construct an operational hypothesis that could have been tested by the procedures used in the experiment(s)
- identify the IV and DVs
- identify the different conditions of the experiment (or typical experiment)
- identify the type of experimental design used
- identify an appropriate procedure for allocating the research animals to different conditions
- briefly state the results obtained
- briefly state a conclusion(s) based on the results obtained.

Learning Activity 9.10

Essay on the neural basis of learning

Write an essay on about 600–650 words in which you describe and explain the neural basis of learning. References may be used in obtaining information for your essay. In your essay, ensure that you:

- define learning with reference to examples of behaviour that are learnt and behaviours considered to not be learnt
- refer to areas of the brain involved in learning
- describe changes in the brain associated with learning; in particular, changes at the synapse, LTP and the formation of neural pathways
- discuss the brain's plasticity and what this indicates about the role of the brain in learning

- refer to relevant research evidence
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms and concepts
- structure the information in a logical way
- explain your information in a clear and concise way
- accurately cite and reference all material using appropriate conventions.

Learning Activity 9.11

Visual presentation on neural basis of learning

Prepare a poster or PowerPoint presentation in which you describe and explain the neural basis of learning. References may be used in obtaining information for your presentation.

In your presentation, ensure that you:

- define learning with reference to examples of behaviour that are learnt and behaviours considered to not be learnt
- show the areas of the brain involved in learning
- outline changes in the brain associated with learning; in particular, changes at the synapse, LTP and the formation of neural pathways
- outline the brain's plasticity and what this indicates about the role of the brain in learning
- refer to relevant research evidence
- accurately define and explain all key terms
- use appropriate graphics and/or examples to demonstrate your understanding of key terms and concepts
- organise the information in a logical way
- explain your information in a clear and concise way (dot points may be used)
- accurately cite and reference all material using appropriate conventions.

Chapter 9 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ The brain can change its structure.

2 ______ Learning is influenced by biological processes.

3 ______ Learning can occur without experience.

4 ______ Learning cannot occur unless a conscious effort to learn is made.

5 ______ A neural pathway can be reconstructed by learning.

6 ______ Reflex actions are a form of learning.

7 ______ Some brain areas can 'take over' the functions of other areas.

8 ______ A fixed-action pattern differs from a reflex action as it is inherited and a reflex action is not.

9 ______ A sensitive period is a specific period of time when an organism is unable to learn.

10 ______ The brain is plastic.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 9 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the following statements **best** describes learning?

- **A** Learning is a change in behaviour that can only occur intentionally.
- **B** Learning can only occur when there is active participation on the part of the learner.
- **C** Learning is a lasting change in behaviour that occurs as a result of experience.
- **D** Learning is a change in observable behaviour.

Q2 Which of the following statements is **not** true of learning?

- **A** Learning always involves some sort of experience.
- **B** Learning includes all those responses that are inborn or instinctive.
- **C** All forms of learning involve a relatively permanent change in behaviour.
- **D** Learning always involves some sort of change in the organism.

Q3 Which of the following examples best demonstrates a reflex response?

- **A** A one-week-old infant withdraws her foot when it is stroked in a particular way.
- **B** A female dog digs a hole in the garden in which to give birth to her pups.
- **C** A person withdraws all their money from the bank, fearing an economic collapse.
- **D** A young Hopi Indian child who has been carried in a cradleboard for most of his early life still walks at the same age as other children who have been allowed to sit and then crawl along the ground.

Q4 Which of the following is **not** a distinguishing feature of fixed-action pattern behaviour?

- **A** The behaviour tends to be the same in all members of a species (unless it is sex-specific).
- **B** The behaviour is difficult to change.
- **C** The behaviour will be demonstrated the first time the organism requires it, without the organism having learned it.
- **D** The behaviour is simple and occurs automatically.

Q5 Neurons communicate with one another by sending _____ across the _____ .

- **A** neurotransmitter; synaptic gap
- **B** axon; synapse
- **C** synapse; synaptic gap
- **D** neurotransmitter; synapse

Q6 A neurotransmitter involved in learning is called
- **A** LTP.
- **B** NMDA.
- **C** NMAD.
- **D** glutamate.

Q7 A newly hatched herring gull chick pecks at the red spot on its parent's beak, indicating that it is hungry. This behaviour is an example of
- **A** a fixed-action pattern.
- **B** maturation.
- **C** learning.
- **D** a reflex.

Q8 Which of the following examples best demonstrates behaviour that depends on maturation?
- **A** A child withdraws its hand after touching the point of a needle.
- **B** A male lyrebird performs elaborate courtship behaviour in order to win a mate.
- **C** A young child begins to have bladder control and no longer needs nappies.
- **D** An infant turns her head in the direction of the cheek that was touched.

Q9 Despite a wide range of culturally based practices, infants throughout the world tend to first walk unassisted at about 12–14 months on average. This suggests that walking is a behaviour that is
- **A** reflexive.
- **B** dependent on maturation.
- **C** a fixed-action pattern.
- **D** learned.

Q10 Which of the following statements about learning is **not** true?
- **A** Learning causes changes at the synapse.
- **B** Learning can create cell assemblies.
- **C** Learning causes weakening of synaptic connections.
- **D** Learning can create neural networks.

Q11 Which of the following behaviours is best described as a reflex action?
- **A** putting on a hat to shield against the harsh rays of the sun
- **B** answering the telephone when it rings
- **C** blinking to the sound of a loud noise
- **D** choosing to take an umbrella when rain is forecast

Q12 When a brain area assumes or 'takes over' the function of an adjacent damaged brain area, this is best described as
- **A** sprouting.
- **B** adaptive plasticity.
- **C** rerouting.
- **D** developmental plasticity.

Q13 The neuron that receives the neurotransmitter is called _____ and is found on a _____ .
- **A** presynaptic; dendrite
- **B** postsynaptic; axon
- **C** postsynaptic; dendrite
- **D** presynaptic; axon

Q14 Which of the following behaviours is a learned behaviour?
- **A** the transition from nappies to underpants
- **B** washing your hands after using the toilet
- **C** the transition from crawling to walking
- **D** salivating at the smell of freshly baked bread

Q15 The process of growing new synapses during early brain development is called

A synaptogenesis.
B synaptosprouting.
C synaptopruning.
D synaptic pruning.

The answers to the Chapter 9 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the difference between developmental plasticity and adaptive plasticity.

2 marks

Question 2

Explain the meaning of a sensitive period in relation to learning with reference to an example.

2 marks

Question 3

What is synapse formation and what role does it play in learning?

2 marks

Question 4

Explain the meaning of the phrase ‘learning involves the building of neural pathways in the brain’.

2 marks

Question 5

What is long-term potentiation and what role does it play in learning?

2 marks

The answers to the Chapter 9 short-answer questions are available at www.OneStopScience.com.au.

10 Theories of learning

Psychologists have developed many different theories to describe and explain human learning in terms of psychological processes. Most of these theories are based on studies involving observations of the learning experiences of animals in laboratory experiments. Through such studies, psychologists have identified many principles of learning that apply across a wide range of species, including humans. Collectively, the theories indicate that there are many ways that we learn and that different types of learning may share common elements. In addition, the theories suggest that how we learn can vary from situation to situation and from individual to individual. We may also shift between different types of learning depending on personal factors, what we are learning and the context in which the learning is occurring.

One of the most basic learning processes involves associating, or ‘connecting’, two events that occur close together. **Conditioning** is the process of learning associations between a stimulus in the environment (one event) and a behavioural response (another event). For example, associating a smile with friendly behaviour and associating working at a supermarket with getting paid involve learning through conditioning by connecting events that occur together. The term ‘conditioning’ is often used interchangeably with ‘learning’, but conditioning is more to do with the learning process; that is, *how* the learning occurs. However, as well as being considered as an element of other types of learning, conditioning is viewed by many psychologists as a type of learning in its own right.

The two main types of conditioning on which psychologists have tended to focus are called classical conditioning and operant conditioning. In *classical conditioning* we learn that two events go together after we experience them occurring together on a number of occasions; for example, walking in the rain and getting wet. In *operant conditioning* we learn by forming a three-way association between a stimulus, a response and the consequence of the response. Therefore, in response to an upcoming VCE exam (a stimulus), we are likely to repeat behaviour (studying) associated with a satisfying consequence (passing). Conversely, the upcoming exam (stimulus) will also make us more likely to avoid behaviour (partying) associated with an unsatisfying consequence (failing).

Other types of learning that are similar to and different from classical and operant conditioning in varying degrees have also been described and explained. For instance, we can learn by trying out different possibilities until we achieve the desired outcome. This is called *trial and error learning* and, as with operant conditioning, it also involves a three-way association between a stimulus, a response and its consequence. Sometimes, we can learn by associating two events after only one experience of their occurring together. This is like classical conditioning, but because it involves only one experience, it is called *one-trial learning*. At other times, learning what we need to know occurs suddenly in the form of an insight. Not surprisingly, this type of learning is called *insight learning*. In other situations, learning can occur but what has been learnt does not become apparent until there is some incentive to demonstrate the learning. The learning that has taken place may remain 'hidden', or latent, for a period of time and is consequently called *latent learning*. Finally, learning may also occur by watching someone else doing something. This is called *observational learning* and reflects the widely held belief that learning involves cognitive processes as well as associations between behaviour and consequences.

In this chapter, we examine each of these types of learning, their influences on behaviour and their applications. We start with classical conditioning, which was first reported at the end of the 19th century.

Classical conditioning

What do the following four people have in common: Annie, a former cigarette smoker who always has the urge to light up a cigarette whenever she has coffee; Samir, who will no longer travel anywhere by aeroplane after his previous two interstate flights got caught in a violent thunderstorm; Emma, who got bitten by a dog when she went for a walk around the block and has since given up this type of exercise in her neighbourhood; and Jack, who broke up with his girlfriend a year ago but still feels sad whenever he catches sight of her? The answer is classical conditioning. Annie, Samir, Emma and Jack have all changed their behaviour by learning through classical conditioning, sometimes called *respondent conditioning*.

Classical conditioning was first described by Russian physiologist Ivan Pavlov in 1899 while he was conducting research into the digestive system of dogs. Pavlov was particularly interested in the role of salivary secretions in the digestion of food and was awarded the Nobel Prize in Physiology or Medicine in 1904 for his work in this field. He used apparatus like those shown in figures 10.1 and 10.3 to measure the amount of saliva produced when a dog ate. The flow of saliva occurred naturally whenever food (meat powder) was placed in the dog's mouth, as salivation is an involuntary reflex response.

To minimise the influence of extraneous or potential confounding variables, the dog was restrained in a harness that held it in the desired position. Food (meat powder) was placed directly on the dog's tongue or in its bowl. A tube was surgically attached to the dog's cheek near one of the salivary glands. Pavlov surgically made a fistula (a narrow opening in tissue) so the saliva drained straight out into a measuring device. In Pavlov's initial experiments, the tube drained the saliva into a type of test tube with volume calibrations on it. This enabled precise measurements of the amount of saliva secreted.

Figure 10.1 This sketch shows the simple apparatus used by Pavlov to collect the dog's saliva in his initial experiments.

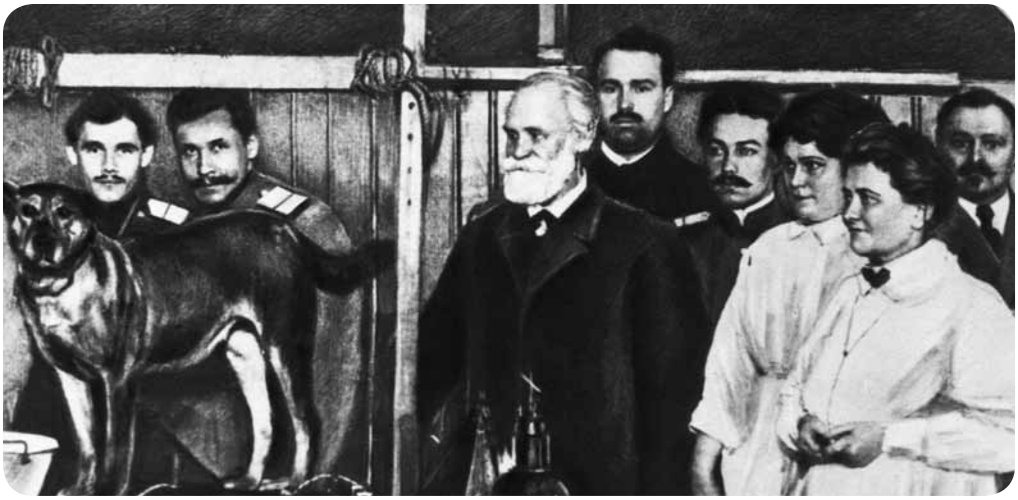


Figure 10.2 Ivan Pavlov (1849–1936) and some of his research colleagues

In later experiments, more sophisticated measuring devices were used, some of which measured the rate (speed) of the saliva flow as well as the quantity produced. The dog was observed by using a series of mirrors, as shown in figure 10.3, so that it could not see or be distracted by the observer. In the course of his research, Pavlov observed that the dogs salivated not only at the sight of the food and when food entered their mouths, but also at the sight or sound of the laboratory technician who had been preparing their food. For example, the dogs salivated when they heard the rattling sound of the spoon against the container as the food was being prepared. These unintentional observations intrigued Pavlov and he decided to conduct further experiments under controlled conditions in order to systematically investigate the phenomenon.

Pavlov's subsequent experiments provided clear evidence of a type of learning that was based on the repeated association of two different stimuli. A **stimulus** is any event that elicits (produces) a response from an organism. A **response** is a reaction by an organism to a stimulus. In Pavlov's experiment, the stimulus of *food* initially produced the response of *salivation*. Eventually though, the sight or sound of the technician became the stimulus that produced the salivation response. The salivation response is controlled by the autonomic division of the peripheral nervous system. It occurs involuntarily; that is, it is a reflex response over which the dog has no control. The salivation had become associated with, and conditioned to, a new stimulus—the sight or sound of the technician. This process, whereby the dog learned to associate the sight or sound of the technician with food, is in essence the process of classical conditioning.

Classical conditioning refers to a type of learning that occurs through the repeated association of two (or more) different stimuli. Learning is only said to have occurred when a particular stimulus consistently produces a response that it did not previously produce. Learning results from linking this stimulus, over a number of trials, with a stimulus that normally produces the response automatically. In classical conditioning, a response that is automatically produced by one stimulus becomes associated, or linked, with another stimulus that would not normally produce this response.

In later experiments, Pavlov varied the stimulus that had been conditioned to test whether it would still produce the same response (salivation). He found that the salivation response could be brought on after repeated associations of the meat powder with a range of different stimuli such as a tug on the hind leg, a bell, the musical tone of a tuning fork, a light or even the sight of a circle.

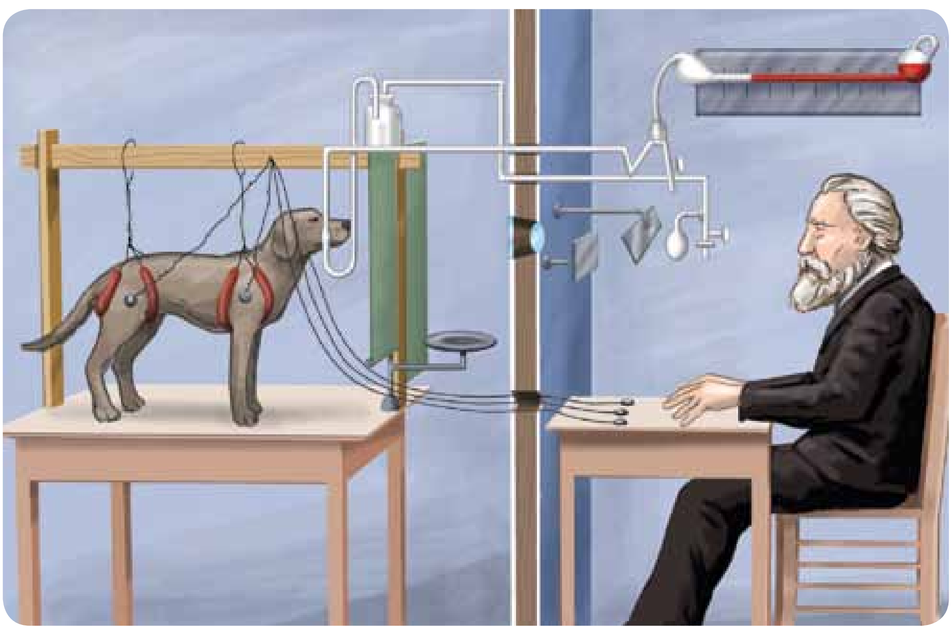


Figure 10.3 This sketch of Pavlov's apparatus is one that appeared in his published lectures and shows a more elaborate saliva-measuring device than that used in his earlier experiments (as shown in figure 10.1).

Box 10.1

Habituation—the simplest type of learning

A sudden, unexpected noise usually startles us and causes an orienting response. When the 'orienting response' occurs, we become alert and turn our head towards the source of the sound. For example, if a person laughs during a test when everyone else is silent, the class members will orient towards the sound by looking in the person's direction. However, if the same noise occurs over and over again, we gradually cease to respond to it until we ignore it altogether. This is an example of **habituation**—learning not to respond to a stimulus or event that occurs repeatedly. Habituation is regarded as the simplest of all forms of learning and reflects the fact that an organism has become familiar with or accustomed to a particular stimulus over time.

Habituation is evident for many everyday events. For example, we become so accustomed to the ticking of a clock in the lounge room that we are unaware of it unless it stops. Similarly, people living near main roads in the city become habituated to the noise of passing traffic but can be woken early in the morning by the sounds of birds when they take a holiday in the country.

Habituation is observed among almost all animal species. As you are aware from your study of Kandel's experiments on memory formation in *Aplysia*, even animals with very primitive nervous systems are capable of habituation. For example, if you tap the shell of a snail with a pencil, it will withdraw its body into its shell (known as *escape or avoidance behaviour*). After a while, it will extend its body out of its shell and continue with whatever it was doing. If you tap again it will again withdraw, but this time it will tend to stay within its shell a shorter time. After several repetitions, it will eventually stop responding to the tap. The organism will have habituated.

Consider how distracting it would be to have your attention diverted every time a common noise occurred. Habituation is believed to be adaptive—it allows us to ignore a stimulus that has no significance and to focus our attention on more important things, relatively free from distraction.

Figure 10.4 People who live in big cities become habituated to the sound of traffic or low-flying planes, and other city noises.

Key elements of classical conditioning

Four key elements are used to describe the process of classical conditioning. These are known as the unconditioned stimulus, unconditioned response, conditioned stimulus and conditioned response.

The **unconditioned stimulus (UCS)** is any stimulus that consistently produces a particular, naturally occurring, automatic response. In Pavlov's experiments, the UCS was the food. Another example of a UCS is the placement of a nipple in a newborn infant's mouth. With no learning whatsoever, and assuming it is 'maturationally ready', the infant will automatically commence sucking. This is a naturally occurring, automatic sucking reflex response.

The **unconditioned response (UCR)** is the response that occurs automatically when the UCS is presented. A UCR is a reflexive involuntary response that is predictably caused by a UCS. In Pavlov's experiments, the UCR was the salivation by the dogs to the presence of food. In the example of the newborn infant, the infant's sucking is the UCR to the mother's nipple being placed in its mouth.

The **conditioned stimulus (CS)** is the stimulus that is *neutral* at the start of the conditioning process and does not normally produce the unconditioned response. However, through repeated association with the UCS, the CS triggers a very similar response to that caused by the UCS.

Association refers to the pairing or linking of one stimulus with another stimulus; that is, a stimulus that would not normally produce a particular automatic response is associated with a stimulus that would produce the automatic response. In Pavlov's experiments, the bell and subsequently other stimuli such as a light or a musical tone were initially *neutral* (with respect to salivation), but each became *associated* with the meat powder (UCS). Once conditioning has occurred and the originally neutral stimulus produces the response of salivating, then it is called the CS.

The newborn infant can also learn to associate the appearance of the mother's breast, the smell of the mother's breast milk or the sight of a feeding bottle (CS), with the placement of the nipple in the infant's mouth (UCS). The infant learns to associate this visual and olfactory (smell) experience with the pleasurable sensation of feeding and begins sucking (CR) in advance, in anticipation of the unlearned UCS.

The **conditioned response (CR)** is the learned response that is produced by the CS. The CR occurs after the CS has been associated with the UCS. The behaviour involved in a CR is very similar to that of the UCR, but it is triggered by the CS alone. Pavlov's dogs displayed a CR (salivation) only when they began to salivate to a CS. When the dog responded to a CS such as the sound of a bell, classical conditioning had taken place because salivation would not be a usual response to the sound of a bell. Similarly, we would not expect the newborn infant to begin sucking merely at the sight or smell of the mother's breast unless an association between these stimuli and the feeding process had been made.

The acquisition of the conditioned response is evident in the anticipatory behaviour in the learner. That is, Pavlov's dogs could anticipate the arrival of the meat powder (UCS) by the sound of the bell (CS). Similarly, the newborn infant soon learns to anticipate the arrival of the milk well before the nipple enters its mouth. In bottle-fed babies, this may be even more evident, as they anticipate food at the sight of the bottle, even before it has been filled with milk.

Figure 10.6 illustrates the process of classical conditioning. In classical conditioning, an individual (person or animal) is initially presented with a CS such as the sound of a bell. This stimulus is neutral to the UCR as it does not normally elicit any predictable response. For example, dogs do not normally salivate in response to the ringing of a bell. Pavlov's dogs had to be conditioned to do so through repeated pairing of the CS (the bell ring) with the UCS (the meat powder), a stimulus that does produce the particular response.

Figure 10.5 Many pets, like the dog shown here, form an association between the sight or sound of the food container (CS) and the presentation of food (UCS). Such examples demonstrate the development of anticipatory behaviour through repeated pairings of two stimuli.

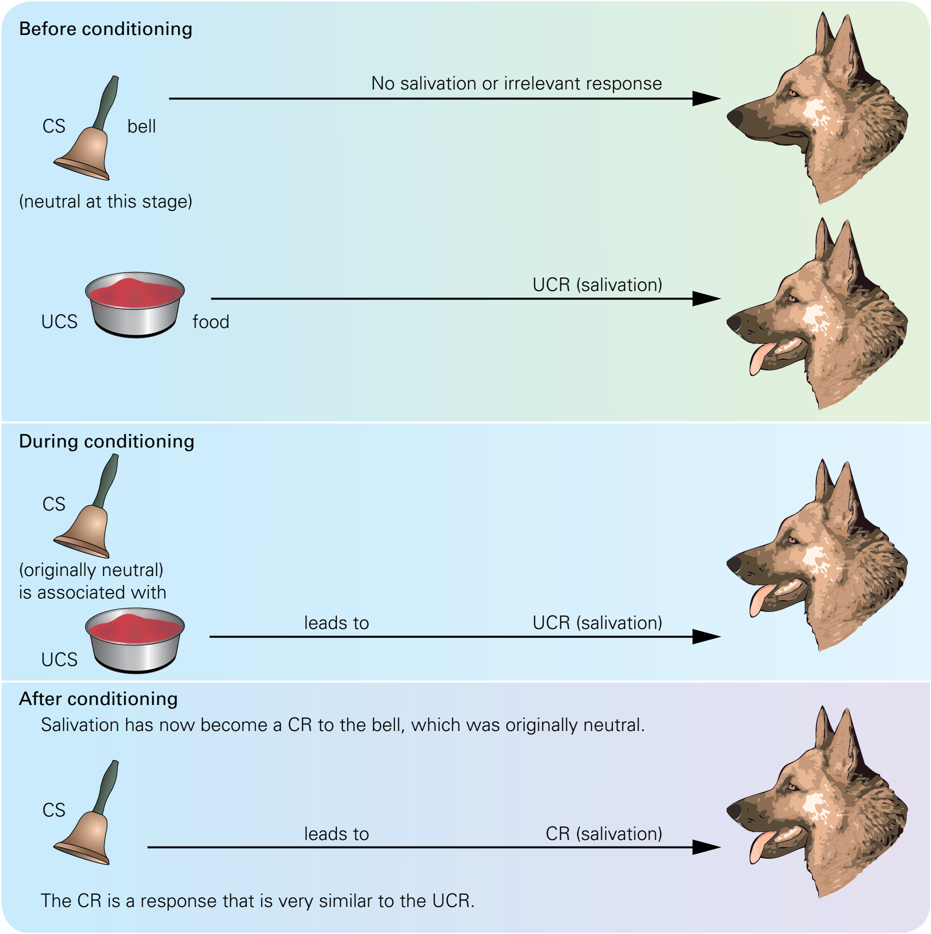


Figure 10.6 The process of classical conditioning in Pavlov's experiments

Learning Activity 10.1

Practical activity on classical conditioning of an eye-blink

Classical conditioning of the eye-blink reflexive response is perhaps the most thoroughly studied form of classical conditioning of mammals over the past 100 years or so. For example, as shown in figure 10.7, it has been used in rabbits. Note the use of electronic devices to produce an eye blink (by delivering a puff of air) and to accurately record the reflexive response (by using an electromyograph to detect electrical activity of muscles). What is most important about eye-blink conditioning is that in most cases it appears similar across species, and thus results found in one species can reasonably be expected to apply to others (Gluck, Mercado & Myers, 2008)

This practical activity enables you to apply classical conditioning procedures in conditioning an eye-blink response using a simpler apparatus than that shown in figure 10.7. The two stimuli that will be paired to create a conditioned eye-blink response are:

- a puff of air (blown through a drinking straw and directed at the bridge of a participant's nose)
- a tapping sound (made by your knuckle or a pencil on a table).

Figure 10.7 A tube (upper right) delivers a puff of air (UCS) to a rabbit and a photo beam measures the eye-blink CR and UCR.

You are to work in groups of three. One person will be the experimenter, one person will be the participant, and the third person will observe and record the participant's responses. The three group members will take it in turns to apply the conditioning procedure as it is outlined below. The experimenter and the participant should sit on opposite sides of a table within reach of each other. The observer should sit next to the experimenter with a clear view of the participant. The activity is best undertaken in a place free from distractions such as external noise and other people. The procedure has three stages.

Stage 1

Pre-conditioning. The experimenter should tap the pencil several times at irregular intervals without presenting the puff of air. This is done to get the participant habituated to the tapping alone so that they no longer respond by blinking. When the participant shows no sign of blinking to the tapping alone, the experimenter can begin conditioning.

Stage 2

Conditioning. There will be a total of 25 trials. In trials 1 to 15, first present the tapping sound, then immediately blow a puff of air through the straw, aiming at the bridge of the participant's nose. The tap and air-puff pairings should be presented at irregular intervals within a time period of about 90 seconds. This allows an average time of just 3 seconds for each trial. In trials 16 to 25, present only the tapping sound (i.e. no air-puff) for the five trials asterisked in table 10.1. If the participant blinks in all of these five trials then the response can be said to be conditioned. Record the participant's responses in a table such as table 10.1.

Stage 3

Post-conditioning. Tap without the air puff several times at irregular intervals until the eye-blink response no longer occurs (is extinguished).

Table 10.1 Individual data recording sheet

Trial no.	Eye-blink response (Y/N)		
	Participant 1	Participant 2	Participant 3
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16*			
17			
18*			
19			
20			
21*			
22*			
23			
24*			
25			

*Tapping sound alone presented on these trials.

Analysis and interpretation

1. Construct an operational hypothesis that could be tested by this practical activity.
2. Compare your data with those of your two partners. Combine the class data and evaluate it in terms of theoretical expectations.
3. In what sense can a control and an experimental condition be seen in trials 16 to 25?
4. Represent the combined class data in summary form based on table 10.1, except with total responses for the class in the right column instead of individual data.
5. Describe the results evident in the combined data.
6. What is the purpose of presenting the tapping sound alone for five of the 25 trials? Why are these five trials scheduled towards the end of the 25 trials?
7. Identify the UCS, CS, UCR and CR in the procedure used for this activity.
8. What conclusion(s) can be drawn from the results obtained from this experiment?
9. Identify and explain any extraneous variables that might have influenced the results.
10. Explain how the experimental design could be modified to minimise or control the extraneous variable(s) referred to in question 9.

Learning Activity 10.2

Review questions

1. What observation led Pavlov to study classical conditioning?
2. Define classical conditioning and briefly describe how it occurs, without referring to any 'technical' terms.
3. In what way(s) did the restraint of the dogs in Pavlov's experiments help to control the potential influence of extraneous variables?
4. a. Define and explain the role of each of the different kinds of stimuli and responses in classical conditioning: UCS, CS, CR, UCR.
   b. Which of the stimuli is originally a neutral stimulus?
   c. Why is it called a neutral stimulus?
   d. Explain the relationship between the neutral stimulus and the conditioned stimulus in classical conditioning.
5. At what point in the process of classical conditioning can it be said that a response has been learned?
6. Draw and label a diagram like figure 10.6, showing the elements in classical conditioning as they occur for the conditioned response to the sight or sound of the food container demonstrated by the dog in figure 10.5.

Learning Activity 10.3

Identifying elements of classical conditioning

Identify the CS, UCS, CR and UCR in each of these three scenarios.

Scenario A

During Christmas Eve in 1974, Cyclone Tracey—one of the most destructive cyclones in Australia's history—struck Darwin. People sought shelter in the smallest room of their house because it was structurally the strongest. Many families therefore huddled together in bathrooms as the cyclone destroyed the area. After the cyclone, some children feared going to the bathroom—a fear that persisted for a several years. These children had learned to associate going to the bathroom with the noise and destruction of a cyclone.

Scenario B

On 11 September 2001, terrorists crashed two passenger planes into the twin towers of the World Trade Center in New York. The noise, destruction and loss of life witnessed on that day has led many New Yorkers to become anxious whenever they see or hear low-flying aircraft.

Scenario C

A participant is seated in an experimental chamber. A buzzer is sounded and the participant is given a mild electric shock to the left hand through a metal plate on the armrest of the chair. After several trials, the buzzer is sounded without the electric shock being given, but the participant still moves their hand.

Key processes in classical conditioning

Pavlov and other researchers who subsequently tested his findings have distinguished several key processes involved in classical conditioning. The key processes have come to be known as acquisition, extinction, stimulus generalisation, stimulus discrimination and spontaneous recovery.

Acquisition

In classical conditioning, each paired presentation of the CS with the UCS is referred to as a *trial*. **Acquisition** is the overall process during which an organism learns to associate two events (the CS and the UCS). During acquisition, the presentations of the CS and the UCS occur close together in time and always in the same sequence. The duration of the acquisition stage is usually measured by the number of trials it takes for the CR to be acquired (learned). This may vary considerably. The rate of learning is often very fast in the early stages of the acquisition phase (see figure 10.9).

One of the important considerations in classical conditioning is the *timing* of the CS and UCS pairing. Pavlov examined how much time should elapse between the presentation of the CS (for example, the bell) and the UCS (the meat powder) in order to maximise the speed with which the conditioned response could be acquired. He found that a very short time between presentations of the two stimuli was most effective. Other studies have determined that a delay of about half a second is ideal with many different species. Acquisition is often more rapid when the CS occurs and remains present until the UCS is presented. The end of the acquisition stage is said to occur when the CS alone produces the CR. At this point, conditioning is said to have taken place.

Extinction

A conditioned stimulus–response association is not necessarily permanent. The strength of the association may fade over time or disappear altogether. **Extinction** is the gradual decrease in the strength or rate of a CR that occurs when the UCS is no longer presented. Extinction is said to have occurred when a CR no longer occurs following presentation of the CS. For example, Pavlov's dogs eventually ceased salivating (CR) in response to the bell (CS) presented alone after a number of trials in which the food (UCS) did not follow the sound of the bell (see figure 10.9, trials 16–22).

There is some variation between individuals (people or animals) in the rate at which extinction of the same conditioned response will occur. There is also considerable variation between the rates at which different responses will be extinguished. For example, the simple behaviour of blinking in response to a knuckle or pencil being tapped on a table (as demonstrated by Learning Activity 10.1) will be extinguished relatively quickly. However, a more complex behaviour pattern, such as an intense fear response to being in bathrooms because they are associated with cyclones (as in Learning Activity 10.3), is likely to take longer to extinguish.

Spontaneous recovery

Extinction of a conditioned response is not always permanent. In classical conditioning, **spontaneous recovery** is the reappearance of a CR when the CS is presented, following a rest period (that is, when no CS is presented) after the CR appears to have been extinguished. For example, a participant in the practical activity involving conditioning of an eye-blink response might suddenly blink again to the sound of a tap alone (that is, without a puff of air) some time after extinction was achieved at the completion of the experiment.

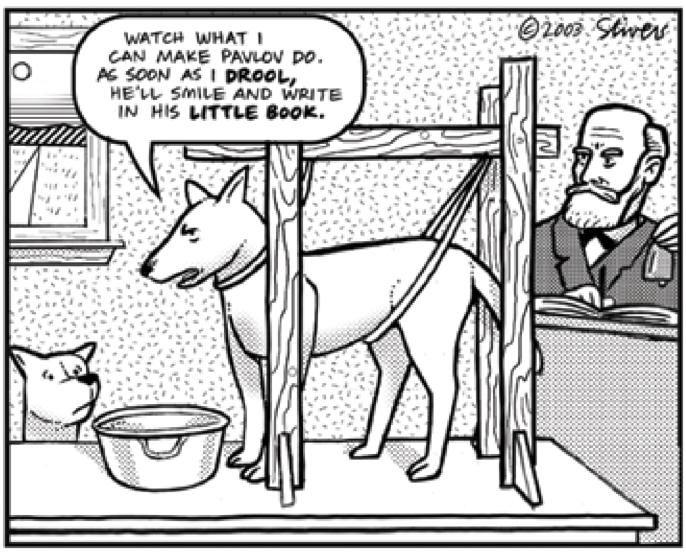


Figure 10.8

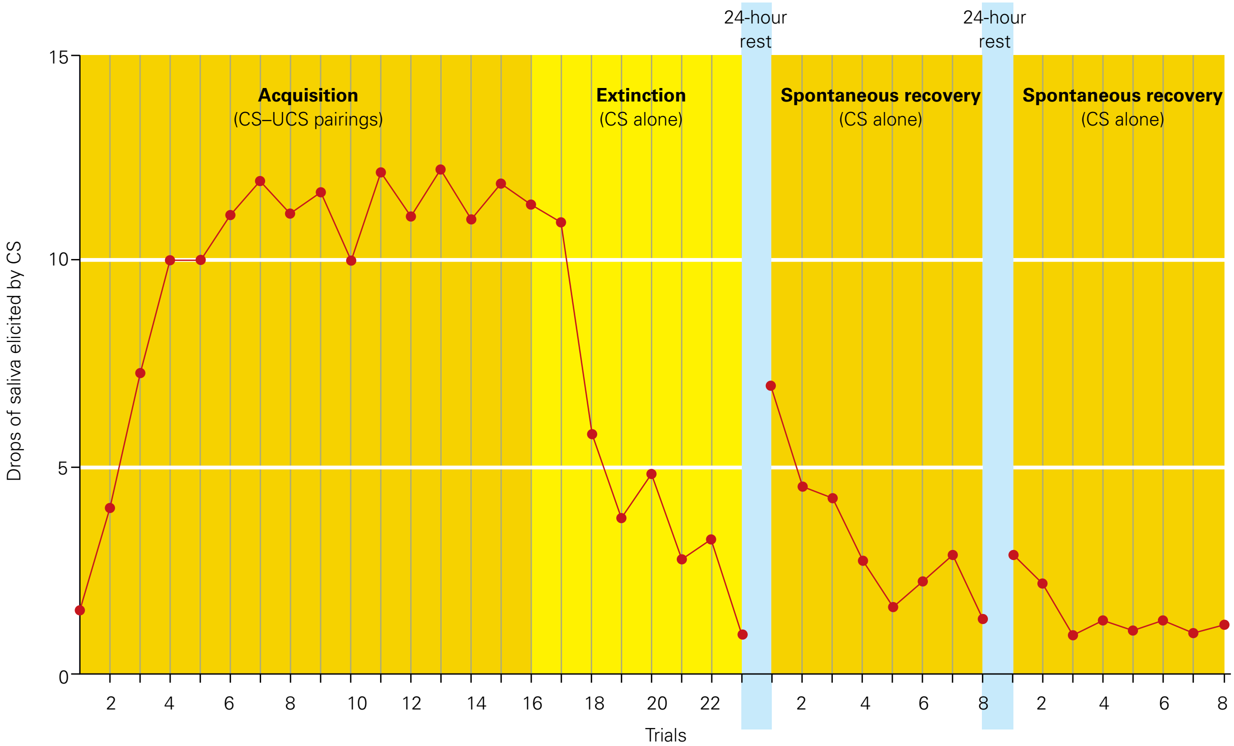


Figure 10.9 The results reported by Pavlov (1927) for one of his experiments. Note the amount of saliva produced by a dog in response to the conditioned stimulus (CS) and the unconditioned stimulus (UCS) during the first 15 trials. Trials 16 to 22 show the decline in the salivation response when the UCS is removed and only the CS is presented. The graph then shows two separate instances of spontaneous recovery, each of which is punctuated by a 24-hour rest period.

Spontaneous recovery does not always occur, and when it does it is often short-lived. Furthermore, the CR tends to be weaker than it was originally (during acquisition). If the extinction procedure is repeated several times, eventually the CR will disappear altogether and spontaneous recovery will not occur. The two separate instances of spontaneous recovery shown in figure 10.9 illustrate the relative weakness of the conditioned response compared with its strength during the acquisition phase.

Stimulus generalisation

Once a person or an animal has learned to respond to a conditioned stimulus, other stimuli that are similar to the CS may also trigger the CR, but usually at a reduced level. For instance, Pavlov observed that his dogs salivated to other noises that sounded like the bell. This phenomenon is called stimulus generalisation. **Stimulus generalisation** is the tendency for another stimulus—one that is similar to the original CS—to produce a response that is similar (but not necessarily identical) to the CR. In stimulus generalisation, the greater the similarity between stimuli, the greater the possibility that a generalisation will occur. For example, if stimulus generalisation to the sound of a bell occurred with one of Pavlov's dogs, the dog might also salivate in response to the ringing of a front doorbell. However, the amount of saliva produced by the dog would tend to be less than the amount produced by the original bell to which the dog was conditioned.

Stimulus generalisation is evident in various aspects of everyday life. Many kinds of loud noises can make us flinch, and many kinds of food can make us salivate, even if it's something we've never eaten before. While stimulus generalisation is rarely an intentional or even a conscious process, it has a valuable adaptive role. For example, a child who suffers burns while playing with a lit match is likely to generalise the painful response to other potentially harmful objects that have naked flames, such as a lit gas stove, a fire in

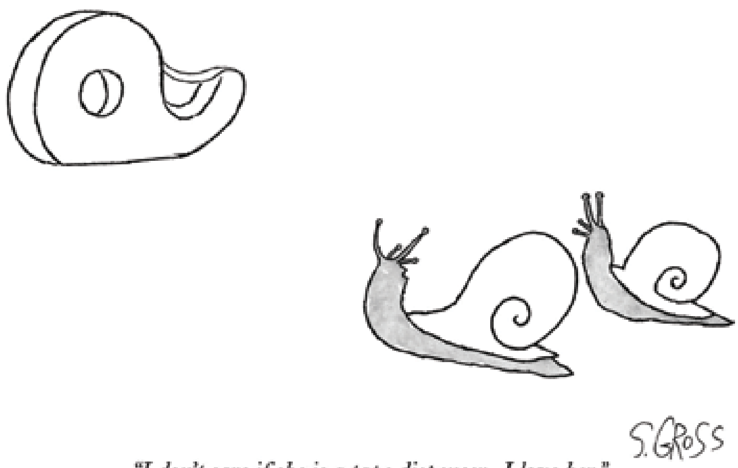


Figure 10.9 *"I don't care if she is a tape dispenser. I love her."*

a fireplace, and so on. In some situations, however, stimulus generalisation may be detrimental or even harmful. For example, a dog that instinctively snaps at annoying flies may also snap at a wasp, with painful consequences. Similarly, people are also susceptible to stimulus generalisation that is detrimental. For example, a young girl who was pecked by her family's pet duck developed a bird *phobia* (an intense, irrational fear) as an adult. Her phobia was so strong that she could not even tolerate being near caged birds such as a pet canary or caged hens at the market. This example also illustrates how stimulus generalisation can help us understand why some fear responses can be triggered by non-threatening stimuli.

Stimulus discrimination

In classical conditioning, **stimulus discrimination** occurs when a person or animal responds to the CS only, but not to any other stimulus that is similar to the CS. For example, in a classical conditioning experiment, stimulus discrimination would be observed when a dog salivated *only* in response to the sound of the 'experimental' bell, and not in response to any other similar sound such as a front doorbell, the sound of a telephone ringing or the bell of an ice-cream van. Similarly, stimulus discrimination in everyday life would be evident if someone who has a fear of a particular dog that has frightened them doesn't flinch at the sight of other breeds of dog.

Box 10.2

Factors influencing classical conditioning

Many factors influence learning by classical conditioning. Key factors include the nature of the response, the association or linking of stimuli, and the frequency and timing of the stimulus presentation.

Nature of the response

For classical conditioning to occur, the UCR must initially be an automatic or involuntary response, such as a reflex response. In Pavlov's experiments, salivation (UCR) that resulted from the smell or taste of food (UCS) was a reflexive response over which a dog had no control. The behaviour shown in the UCR occurs without the need for prior learning, and the behaviour sometimes serves a protective or survival function.

Association of stimuli

Another important factor influencing classical conditioning is the association of two different stimuli. If the individual does not associate the two stimuli, conditioning will not occur. The reason two stimuli (that may normally have no connection at all) become linked is said to be due to contiguity. *Contiguity* refers to the formation of a connection or an association between two events when the events occur close together in time and/or space. The two events become linked so that it is difficult to think of one event without thinking of the other. In Pavlov's experiments, it is said that contiguity is evident because in time, a dog associates or links the CS (the bell) with the UCS (presentation of meat powder).

Frequency and timing of stimulus presentation

How often the CS and UCS are linked is an important factor in establishing the connection between these two stimuli in classical conditioning. For example, if Pavlov's dogs had not regularly heard the bell prior to receiving the food, they might not have linked the two stimuli.

As described on page 460, the timing of the CS and UCS presentation is also important. Ideally, the CS should occur *before* the UCS by not more than half a second in order for the association to be made. According to Pavlov's research, longer time intervals were less effective for the dogs in establishing the links.

Learning Activity 10.4

Review questions

1. a Explain the meaning of the term acquisition in relation to classical conditioning.
   b What is being acquired?
   c How is this acquired?
   d Describe the relationship between timing and acquisition.
2. a What does extinction mean in classical conditioning?
   b When is extinction evident in classical conditioning?
3. a What does spontaneous recovery mean in classical conditioning?
   b When is spontaneous recovery evident in classical conditioning?
4. What is the key difference between spontaneous recovery and extinction? Explain with reference to an example not used in the text.
5. Explain the meaning of the terms stimulus discrimination and stimulus generalisation, in relation to classical conditioning. Ensure you refer to an example from everyday life, but not one used in the text.

Learning Activity 10.5

Key terms in classical conditioning

Select the five correct terms from the list below to complete the sentences in each of the following scenarios.

- acquisition
- conditioned response
- extinction
- unconditioned stimulus
- spontaneous recovery
- conditioned stimulus
- stimulus generalisation
- stimulus discrimination
- neutral stimulus

1. When she was about eight years old, Elizabeth decided to help her mother at the florist's store where her mother worked. She first helped her mother on Valentine's Day. Elizabeth did such a good job bringing in all the red roses for her mother to arrange that she was paid $20. But at the end of the day, nearly every finger on Elizabeth's hands was bleeding because of the thorns on the red roses. On Mother's Day that year, Elizabeth worked at the florist's store again. Although she earned another $20, her hands were again very sore at the end of the day from the thorns on the red roses.

The following week when her mother asked Elizabeth to assist with the preparation of flowers for a very large wedding, Elizabeth replied that she would help as long as there were no red flowers involved. Elizabeth's refusal to handle red flowers is an example of ______________________________.

2 One group of dogs was exposed to two different experimental conditions. In condition 1, an experimenter who always wore a white coat regularly fed the dogs. In condition 2, an experimenter who always wore a black coat prepared the food and got the feed bowls ready, but another experimenter then came in and actually gave the food to the dogs.
The dogs were exposed to these conditions in random order twice daily for ten days. The amount of saliva produced by the dogs each time the experimenter approached was measured and recorded. These results, together with the baseline data that were collected before the experiment began, are shown in the table below. The results in the table show that the dogs demonstrated

______________________________.

Baseline condition (before conditioning)	Experimental condition 1 (white coat)	Experimental condition 2 (black coat)
3.2 mL	6.8 mL	3.5 mL

3 a In attempting to classically condition an eye-blink response to the sound of a pencil tap, Elke was the experimenter and Peta was the participant. Elke noticed that Peta's conditioned response (CR) (the eye-blink to the pencil tap alone) was becoming stronger as the number of pairings of the two stimuli increased. In this experiment, Peta was in the

____

stage of classical conditioning.

b Once the experiment was over, Elke was concerned that Peta might continue to blink every time she heard a pencil tap. Elke made sure this wouldn't happen by presenting the pencil tap alone for some time until she was sure that the stage of

____

had been achieved.

c The following week in their Psychology class, Elke accidentally tapped her pencil and noticed that Peta blinked. This suggests that ____________________ may have occurred.

Learning Activity 10.6

Summarising key processes of classical conditioning

Construct a table similar to the one below to summarise the key processes of classical conditioning.

Name of process	Description of process	Example of process	Key factors influencing the process
acquisition			
extinction			
spontaneous recovery			
stimulus generalisation			
stimulus discrimination			

Applications of classical conditioning

Classical conditioning is a systematic procedure through which associations between stimuli, or events in the environment, are learned, resulting in a conditioned response. It is considered to be a relatively simple type of learning, but one which accounts for many of our learned responses and behaviours. Behaviours that have been classically conditioned may occur so automatically that they appear to be reflexive. In fact, Pavlov used the term *conditioned reflex* to describe what has since come to be known as a conditioned response. Essentially, classically conditioned responses *are* conditioned reflexes that are acquired through associative learning; that is, they are 'conditional' upon an organism's experience.

Conditioned responses are reflexive in the sense that they are automatic, involuntary and involve little conscious thought or awareness on the part of the organism. For example, when you are driving behind another vehicle, you learn to rely on its brake lights as a signal that the vehicle is slowing down. It does not take long as a driver for us to put our foot on the brake as soon as we see the brake lights illuminated on the vehicle in front. It becomes such an automatic response that we rarely give it much thought. However, forming and responding to the connection between the brake lights of a car illuminating and that car slowing down (or stopping) is not necessarily without any thought. We learn to *expect* that a car with illuminated brake lights is slowing down and may stop (or even stop suddenly) in certain situations. In this sense, classically conditioned responses are now described as involving *anticipatory behaviour*. The behaviour of touching the brake whenever we see the brake lights of the vehicle in front involves anticipatory behaviour in the same way that Pavlov's dog salivated at the sound of the bell or the laboratory technician in anticipation of food (but not at the sound or sight of Pavlov). Consequently, learning through classical conditioning may be involuntary and relatively simple, but conditioned reflexes or responses acquired through classical conditioning may not necessarily be 'thoughtless', and are therefore not as 'mechanistic' as Pavlov believed them to be.

By learning to associate stimuli through everyday experience, we gain information about our environment, some of which we take for granted but which is nevertheless valuable. Classical conditioning can account for the learning of many relatively simple responses in everyday life, such as learning to pack up your books at the sound of the bell to end the lesson, to answer the doorbell or phone when it rings, to leave your umbrella at home when there is a clear blue sky, that a flash of lightning signals an impending crack of thunder and that a specific tone means that you have just received a text message on your mobile phone. However, classical conditioning can also account for more complex behaviours such as fears and phobias. Its principles have also been applied to the development of therapies used by psychologists and psychiatrists. In this section, we consider applications of classical conditioning. We start with one of the most researched conditioned responses: the conditioned emotional response.

Sometimes, an emotional reaction such as fear or anger to a specific stimulus is learned through classical conditioning. A *conditioned emotional response* is an emotional reaction that usually occurs when the autonomic nervous system produces a response to a stimulus that did not previously

Figure 10.11 The ringing sound is the conditioned stimulus (CS) that triggers the conditioned response (CR) of reaching out to pick up the telephone.

Figure 10.13 Because of the pain experienced on a previous visit to the dentist, this young girl has developed a conditioned emotional response (fear) that is now elicited before she even arrives at the dental surgery.

Figure 10.12 Advertisers often use classical conditioning in their attempts to make us associate their products with positive stimuli. By repeatedly pairing a product with images and ideals we are likely to feel positive about, the advertiser attempts to make people have those good feelings toward the product itself.

trigger that response. For example, many people cringe at the sound of the dentist's drill. This is not a naturally occurring response to the noise. One reason for the fear of the sound of the dentist's drill is the association we make between the sound and potential pain. In this case, the sound of the dentist's drill has become a conditioned stimulus, which, through association with the unconditioned stimulus (the drilling of the tooth), produces a conditioned emotional response (fear).

While it may be beneficial to form a fear of something that could harm you, such as illegal drugs and poisonous spiders, it may be psychologically harmful to form a fear about something that does not normally harm you, such as soft, furry animals or a cuddle.

Box 10.3

Higher order conditioning

Higher order conditioning is so named because there is another level of the associative process of classical conditioning. Higher order conditioning involves the introduction of another (or several) conditioned stimulus. In *higher order conditioning*, a second conditioned stimulus (CS2) is presented immediately after the first conditioned stimulus (CS1) until it alone produces the response.

For example, suppose your pet dog is accustomed to a routine each morning in which she goes to the local shop with you to get the newspaper. She becomes aware that you are about to depart and gets excited when you put on her leash. This has become the conditional stimulus (CS1) associated with the actual walk (UCS) that produces the excitable response (CR). Because these two events occur regularly, close together and always in the same order, the dog has learned to associate the sound of the small change jar being rattled with the leash. Eventually the sound of small change alone (CS2) produces the excitable behaviour (CR). In this case, one conditioned stimulus has been replaced by another.

A third order of conditioning is also possible. For example, your departure from the breakfast table may become the signal (CS3) for a walk, if this is what you regularly do immediately before getting the newspaper money.

Higher order conditioning is important because it can help explain how certain stimuli can acquire their ability to trigger responses, even when they don't seem to have been paired with any obvious unconditioned stimulus.

Before conditioning

UCS (walk) ⟶ leads to ⟶ UCR (excitement)

During conditioning (acquisition)

UCS (walk) ⟶ leads to ⟶ CR (excitement)
is associated with
CS1 (leash)

Higher order conditioning

CS1 (leash) ⟶ leads to ⟶ CR (excitement)
is associated with
CS2 (small change)

Learning Activity 10.7

Review questions

1 Explain why Pavlov used the term conditioned reflex rather than conditioned response. What might he have called the UCS?

2 Explain how classical conditioning may account for acquisition of the conditioned response referred to in each of the following scenarios.

a Tran loves chocolate sundaes. One hot summer's day he eats six of them. Later that night he experiences cramping pains in his stomach, is nauseated and eventually vomits. Consequently, the mere thought of a chocolate sundae makes his stomach turn, and brings back the feelings of nausea.

b A person under treatment for a gambling addiction often feels an urge to play the pokies whenever he again encounters cues such as driving past a gaming venue where he experienced a huge 'buzz' after hitting a jackpot, and hearing about someone else's big win on the machines.

c After swimming in the lake near his home one day, Glen emerged from the water covered with slimy blood-sucking leeches all over his back and legs. He was revolted as he removed the leeches. Now, every time he passes the lake, Glen shudders in disgust.

d When Mardi and her sisters were toddlers, their mother frequently used their nap time to vacuum. Now, when Mardi and her sisters hear vacuum cleaners, they feel sleepy.

e Every time three-year-old Sienna heard the doorbell ring, she raced to open the front door. On Halloween night, Sienna answered the doorbell and encountered a scary monster that intentionally startled her. Sienna screamed in fear and ran away. Now Sienna whimpers and hides whenever the doorbell rings.

f A flashing light suddenly appearing on the control panel triggers a burst of adrenaline in an aeroplane pilot.

Watson's 'Little Albert' experiment

One of the most controversial and best-known studies that used classical conditioning to intentionally condition an emotional response was first reported in 1920 by American psychologist John B. Watson and his graduate student Rosalie Rayner. Their research was designed to test the belief that fears can be acquired through classical conditioning. Watson wanted to demonstrate experimentally that humans undergo the same process in acquiring fears as animals do. The research participant was Albert B. ('Little Albert'), the 11-month-old son of a woman who worked at the same clinic as Watson. Watson and Rayner considered Albert to be a suitable participant for their series of experiments because, in their terms, he was:

> *on the whole stolid and unemotional … No-one had ever seen him in a state of fear and rage. The infant practically never cried … His stability was one of the principal reasons for using him as a subject. We felt that we could do him relatively little harm by carrying out [these] experiments.*

After pre-testing Albert to ensure he was actually capable of producing a fear response (UCR), Watson and Rayner placed him on a mattress in a room where a white laboratory rat (CS) was within reaching distance. Albert showed no initial fear of the furry animal and played with it contentedly. As the infant was playing with the white rat, one of the experimenters distracted him, while the other experimenter stood behind Albert and:

> *struck a hammer upon a suspended steel bar four feet [about 1 metre] in length and three-fourths of an inch [about 2 centimetres] in diameter.*

This produced a loud noise (UCS) that would startle most people regardless of what they were doing. Albert responded as follows:

> *The child started violently, his breathing was checked and the arms were raised in a characteristic manner. On the second stimulation the same thing occurred, and in addition the lips began to pucker and tremble. On the third stimulation the child broke into a sudden crying fit. This is the first time an emotional situation in the laboratory has produced any fear in Albert.*

Encouraged by this result, Watson and Rayner began a series of fear-conditioning experiments with Albert when he was 11 months and three days old. The experiments were held irregularly over a 17-day period. Following are the laboratory notes describing the first experiment:

1 *White rat suddenly taken from the basket and presented to Albert. He began to reach for rat with left hand. Just as his hand touched the animal the bar was struck immediately behind Albert's head. The infant jumped violently and fell forward, burying his face in the mattress. He did not cry, however.*

2 *Just as the right hand touched the rat the bar was again struck. Again the infant jumped violently, fell forward and began to whimper.*

In the next experiment, which was held one week later, the loud noise was again sounded every time Albert attempted to play with the white rat. After seven pairings, Albert showed a distinct fear (CR) in response to the rat (CS) being placed anywhere near him.

The instant the rat was shown the baby began to cry. Almost instantly he turned sharply to the left, fell over on the left side, raised himself on all fours and began to crawl away so rapidly that he was caught with difficulty before reaching the edge of the table.

Watson and Rayner concluded that this response by Albert:

was as convincing a case of a completely conditioned fear response as could have been theoretically pictured. [Furthermore] it is not unlikely, had the sound been of greater intensity or of a more complex clang character, that the number of joint stimulations might have been materially reduced.

In subsequent experiments, Watson and Rayner (1920) conducted 'tests' to find out if Albert's fear response would be generalised to other stimuli that were similar in some way to the white laboratory rat. They reported that Albert produced quite fearful reactions to a white rabbit, a dog and a sealskin coat. He showed slightly less fearful reactions to cottonwool balls and a Santa Claus mask, but showed reactions nonetheless.

Eventually, Albert's mother left her job at the clinic and the city of Baltimore where the experiments were being conducted. Watson and Rayner reported that they were denied the opportunity:

of building up an experimental technique by means of which we could remove the conditioned emotional responses.

Other psychologists, however, have disputed this, stating that Watson and Rayner knew a month in advance that Albert's mother would be leaving, yet took no steps to extinguish Albert's fear response (Harris, 1979; Cornwell & Hobbs, 1976).

It is believed that Albert's mother may not have been fully aware that her son was to be used in experiments on conditioning a fear response. But the issue of informed consent is not referred to in the original journal article reporting the experiment, so a judgment about this ethical consideration cannot be made.

It is possible also that Albert was more vulnerable to psychological harm as a result of the experimental procedures than another infant

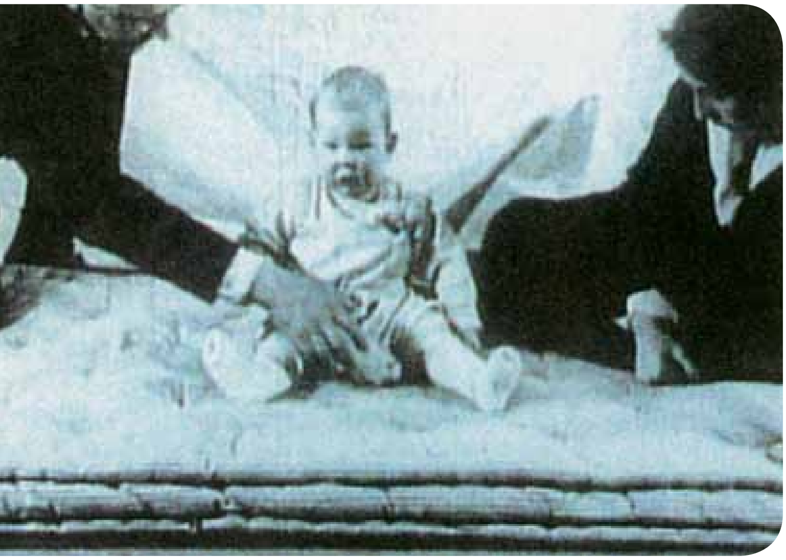


Figure 10.14 Watson and Rayner introduce Albert to the white rat as he sits placidly on a mattress.

Figure 10.15 Watson tests Albert's reaction to a scary mask.

might have been. This is suggested by the notes the researchers made in their 1920 journal article (below). Yet Albert was subjected to severe anxiety and distress, and the experimenters made no attempt to end the experiment and attend to his distress in an appropriate way. Watson and Rayner reported an observation during the research that whenever Albert was emotionally upset he would:

> *continually thrust his thumb into his mouth … [thus becoming] impervious to the stimuli producing fear. Again and again … we had to remove the thumb from his mouth before the conditioned response could be obtained.*

This seems to contradict Watson and Rayner's description of Albert as a suitable research participant on the grounds that he was 'stolid and unemotional'. Although some psychologists have suggested that Albert's conditioned fears might have disappeared over time (if, in fact, he had acquired conditioned fears), it is reasonable to assume that Albert was not only emotionally traumatised by the experimental procedures to which he was subjected, but was also likely to have suffered some kind of lasting psychological harm.

Watson and Rayner had apparently demonstrated that a fear can sometimes result from learning, although results of later experiments by other researchers who attempted to replicate the procedure indicated that the learning process is not as simple as reported by Watson and Rayner (Samelson, 1980).

Importantly, experiments using any human participant in this way would be considered unethical today and would not be permitted. At the time of Watson and Rayner's experiments with Albert, professional associations for psychologists such as the American Psychological Association were only in their formative stages, and ethical guidelines and standards for the professional conduct of researchers and practising psychologists had not yet been fully established.

Box 10.4

Face slapping for eye-blink conditioning

Prominent American psychologist Clark Hull (1884–1952) was interested in developing a comprehensive mathematical model of animal learning that would predict exactly what an animal will learn in any given situation. He conducted an intensive program of research on learning in humans and animals, seeking to test and refine drafts of his mathematical models. In one of his experiments on classical conditioning in the 1920s, Hull (standing with visor) conditioned one of his students (seated) to blink in anticipation of a slap to the face. For practical as well as ethical reasons, researchers no longer use the face slap as a UCS in human eye-blink conditioning. Instead, they use an air puff and electromyograph, such as that shown in figure 10.7 (page 457).

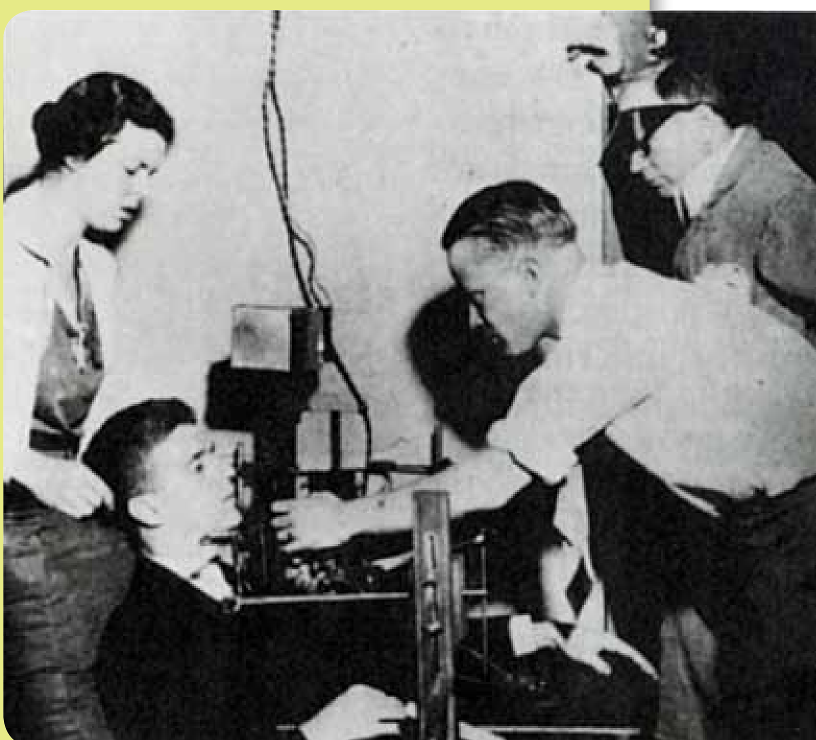


Figure 10.16 In an experiment on classical conditioning in the 1920s, Hull (standing with visor) conditioned one of his students to blink in anticipation of a slap to the face.

Learning Activity 10.8

Review questions

1. Draw a diagram like that in figure 10.6 to illustrate the classical conditioning of Little Albert's fear response to the white rat.
2. To which objects did Albert demonstrate stimulus generalisation?
3. Consider Watson and Rayner's (1920) study from an ethical perspective. To what extent were ethical principles for psychological research applied in the 'Little Albert' experiment? Explain with reference to both ethical guidelines and procedures used by Watson and Rayner.
4. Suggest an ethically acceptable procedure involving classical conditioning that could be used to extinguish Albert's fear response to white furry objects. You should present your answer in diagram form and indicate the CS, UCS, CR and UCR.

Graduated exposure

In most cases, a conditioned response acquired through classical conditioning will extinguish if the UCS is not paired with the CS at least occasionally. However, the association is sometimes so strong and well-established that it persists over time and is difficult to extinguish unless there is some kind of intervention. This is most often necessary when the conditioned response interferes with 'normal' functioning in everyday life, such as with conditioned responses involving fear, especially when severe anxiety reactions accompany exposure to the feared object or event, or some other object or event of concern to an individual. This has led psychologists to apply classical conditioning processes in developing therapies for treating phobias and other mental health problems in which fear and/or anxiety play a prominent part. One of these therapeutic techniques is a type of *exposure therapy* called graduated exposure.

Graduated exposure involves presenting successive approximations of the CS until the CS itself does not produce the conditioned response. Essentially, the technique involves progressively, or 'gradually', introducing, or 'exposing', the client to increasingly similar stimuli that produce the conditioned response requiring extinction, and ultimately to the CS itself. In this way, the client is gradually 'desensitised' to the fear- or anxiety-producing object or event. Graduated exposure has been successfully used to eliminate a range of disorders involving fear and anxiety responses, such as fear of flying, fear of heights, public speaking anxiety, and paruresis, or shy bladder syndrome (see box 10.5).

In the first phase of the graduated exposure technique, the therapist will work with the client to 'break down' then organise the anxiety- or fear-producing situation into a hierarchy of increasingly difficult encounters. For example, consider a person with a fear such as flying in aeroplanes. The therapist might ask the person to describe what part of the experience of flying in aeroplanes is most frightening, what is the second most frightening, the next most frightening and so on. The therapist then arranges these in hierarchical order from least frightening to most frightening, as in the example shown in figure 10.17.

The second phase of the technique involves step-by-step exposure to each of the fear-producing situations, starting with the least frightening. This is performed at the client's own pace and with support from the therapist. It may involve either imagining each situation using visual imagery

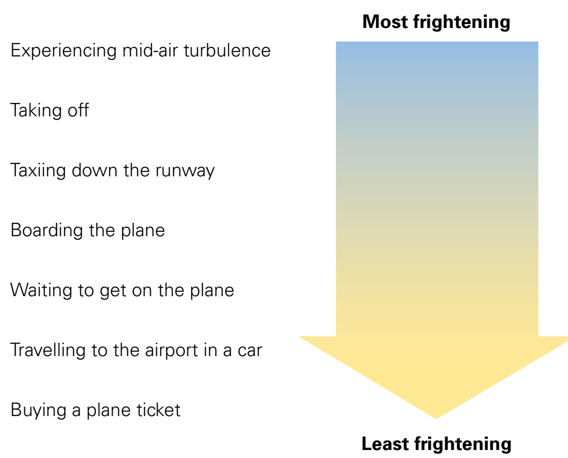


Figure 10.17 A hierarchy of fear of flying

Figure 10.18 A pilot talks to a woman about her fear of flying in aeroplanes.

(**imaginal exposure**), real-life exposure to each fear-producing situation (**in vivo exposure**) or the use of virtual reality technology (as shown in figure 13.22 on page 663).

The best results appear to occur using real-life graduated exposures. To achieve this, the therapist might start by sitting in a plane with the person. Then the person might take their first flight with the therapist. The therapist would help the person to remain calm and to engage in muscle relaxation throughout the flight. Furthermore, the therapist might arrange for the person to meet the pilot for reassurance.

By allowing the client to confront their fears under such supportive circumstances, the client learns to tolerate these fearful situations or stimuli and the fear of flying is eventually overcome.

Box 10.5

Paruresis—shy bladder syndrome

Paruresis is an anxiety disorder that involves difficulty or inability to urinate when another person (or people) is around. The individual usually has no difficult urinating when at home alone, but will experience hesitancy or difficulty or will be unable to urinate when there is a visitor in their home and, most often, when required to use a toilet in a public place such as at school, a workplace, a sport venue, a concert hall and so on.

Also called avoidant paruresis, shy bladder syndrome, bashful bladder syndrome, psychogenic urinary retention, urophobia and pee-phobia, paruresis is a type of social phobia, often described as involving performance anxiety, not unlike ‘stage fright’. Most people occasionally experience at least some hesitancy in a public toilet, but this differs from paruresis in relation to degree and context. A person who every now and then must wait an extra second or two before being able to urinate does not have the condition. Rather, paruresis causes distress during everyday activities such as double lessons at school, long meetings in the workplace, social engagements and travel. It also interferes in a significant way with the individual’s ability to carry on with these everyday activities. Generally, people with paruresis try to adjust to their problem by urinating as much as possible when at home and, before leaving their home toilet, restricting the intake of fluids, and refusing invitations to prolonged social events.

Many also perform a series of rituals such as locating vacant restrooms whenever away from home, thinking of water when trying to urinate and running a tap to increase the likelihood of urinating under adverse conditions. Most commonly, though, people with paruresis cope by avoiding public restrooms at all costs (Soifer, Zgourides & Himle, 2010).

Paruresis is believed to be a common type of social phobia, ranking second only to the fear of public speaking. Studies show that up to 7% of the general population, or about 1.5 million Australians, may experience a mild, moderate or severe form of paruresis. The condition is common among both males and females, and has no ethnic or cultural boundaries. Paruresis is different to *prostatitis*, which is a physiological disorder involving inflammation of the prostate that blocks the flow of urine.

As with many other types of phobias, systematic desensitisation is a commonly used treatment method. This is a type of graduated exposure therapy that involves deliberately trying to urinate in increasingly more difficult situations, each time associating the event with a relaxation response. However, in order to use systematic desensitisation in this way, a person has to produce a substantial amount of urine. This is usually accomplished by drinking plenty of fluid prior to an exposure session. Furthermore, in order to practise urinating with someone else nearby, a 'pee partner', such as a family member or trusted friend, is usually enlisted. About eight out of every ten people with paruresis is helped by *systematic desensitisation*.

The Better Health Channel (2010), which is funded by the Victorian Government, offers the following advice for people with paruresis.

- Rank urination locations from easiest to most difficult and start with the easiest locations (e.g. home) and work up in degrees to the most difficult (crowded public toilet).
- Ask a 'pee partner', such as a family member or trusted friend, to support you as you work your way up the ranked scale of difficult locations until you can successfully urinate in a crowded and noisy public toilet.
- Drink plenty of water before 'practising' to make sure that your bladder is full.
- Avoid any negative self-talk while trying to urinate. Paruresis is a common social phobia and you are not abnormal or 'the only one'.
- Take it slowly, step by step. Don't pressure yourself. You should see considerable improvement after about 12 or so practice sessions.

Further information is available in the Better Health Channel (2010) fact sheet called *Paruresis – shy bladder syndrome*, at www.betterhealthchannel.com.au/bhcv2/bhcarticles.nsf/pages/Paruresis_shy_bladder_syndrome?OpenDocument.

Flooding

Flooding is another type of exposure therapy for treating fears, phobias and other mental health problems in which fear and/or anxiety play a prominent part. **Flooding** involves bringing the client into direct contact with the anxiety- or fear-producing stimulus and keeping them in contact with it until the conditioned response is extinguished. The contact may be for 2 hours or longer, depending on the stimulus and the individual involved. It is believed that people will stop fearing the stimulus and experiencing the anxiety associated with it when they are exposed to them directly and made to realise that they are actually quite harmless. Like graduated exposure, flooding can be conducted using visual imagery, in vivo (real life) or using a virtual reality device.

In one case, a 31-year-old man reported a fear of being in fallen lifts. The fear developed when he was trapped in a lift on the seventh floor for about an hour. He became increasingly fearful that it would fall. His treatment involved confronting his fear by riding in lifts for a period of 90 minutes. After just one session, his fear of lifts disappeared (Sue, Sue & Sue, 2006).

Aversion therapy

When people develop behaviours that are habitual and harmful to themselves or to others, such as substance (drug) dependence, a gambling addiction or socially inappropriate sexual behaviours, it is often difficult to help them permanently stop the unwanted behaviour. This is especially so when the behaviour is immediately followed by a sense of pleasure or by relief from discomfort. **Aversion therapy** is a form of behaviour therapy that applies classical conditioning processes to inhibit ('block') or discourage undesirable behaviour by associating (pairing) it with an aversive (unpleasant) stimulus such as a feeling of disgust, pain or nausea. The aim of aversion therapy is to suppress or weaken the undesirable behaviour. For example, to stop an unwanted behaviour such as nail biting, your fingernails could be painted with a foul-tasting substance. The association between the unwanted behaviour (nail biting) and the unpleasant taste is learned very quickly. Before long, even the thought of biting your nails (and its unpleasant consequences) will be a strong enough deterrent for you to avoid the undesirable behaviour (hence the term 'aversion').

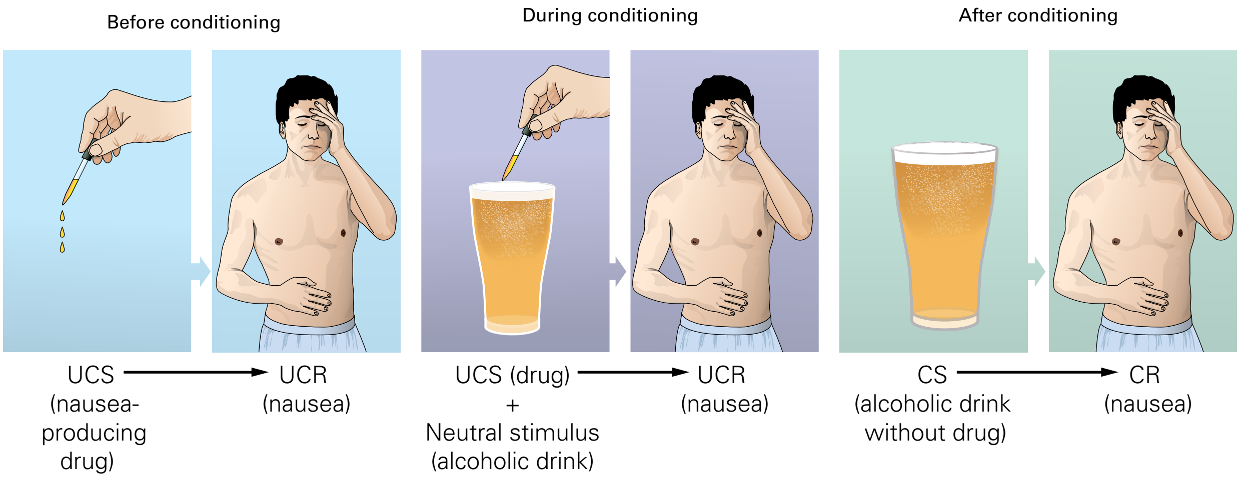
Aversion therapy was first used in the 1930s to treat alcoholism by giving individuals with an alcohol addiction an aversive stimulus (painful electric shocks) whenever they could see, smell or taste alcohol. Today, instead of electric shocks, nausea-inducing drugs are paired with alcohol consumption to make the individual feel ill. The idea is that alcohol, which was originally neutral with respect to nausea, becomes the conditioned stimulus. After repeated pairings of alcohol (CS) with a drug (UCS) that causes nausea (UCR), an association is established between alcohol and nausea. This association becomes so strong that the person begins to anticipate nausea as an inevitable result of consuming alcohol. This is the intention of the therapy; that is, to establish an anticipation of nausea that is so distasteful to the person that they choose not to drink the alcohol.

In a study by Wiens and Menustik (1983), 685 participants with an alcohol addiction were treated with aversion therapy using a nausea-inducing drug. A year after the therapy, two-thirds of the original group had not had an alcoholic drink, and after three years, one-third of them had still abstained from alcohol. According to Cannon and Baker (1981), using drugs that cause intestinal distress associated with nausea appears to be more effective in establishing an aversion to alcohol than using external sources of discomfort such as electric shocks. However, research using aversion therapy has produced conflicting results. Forrest (1985) conducted research on the effectiveness of aversion therapy with individuals with an alcohol addiction using a drug called Antabuse. Antabuse induces severe flushing, dizziness, nausea and headaches shortly after alcohol consumption. While this may seem like a deterrent, longitudinal (long-term) studies indicate that individuals who have been addicted to alcohol for a long time ('chronic alcoholics') tend to avoid alcohol when on Antabuse, but they tend to return to drinking alcohol soon after they stop taking the drug.

One of the limitations found with aversion therapy is that the learned aversion often fails to generalise to situations other than those under which the learning took place. This may be due to the conditioning being dependent on cues that indicate the aversive stimulus will follow. People may experience the aversion only when they *know* that the UCS (nausea-inducing drug) is going to coincide with alcohol consumption.

Figure 10.19 Through aversion therapy, the association between an unwanted behaviour such as nail biting and an aversive stimulus (foul-tasting nail paint) is learned very quickly.

Aversion therapy may also be used to help people quit smoking. Using aversion therapy, the therapist might have the person smoke a cigarette from a device that also holds a second cigarette containing a nausea-inducing chemical. When the client smokes using this device, they inhale chemicals from both cigarettes and experience nausea soon after. However, this pairing of the CS (regular cigarette) with the UCS (nausea-inducing cigarette) may only have short-term results. The client may learn that the nausea is only experienced when they smoke two cigarettes in this type of apparatus, and not when they smoke a single, regular cigarette.



Source: Huffman, K. (2004). *Psychology in Action* (7th ed.). New York: John Wiley, p. 542.

Figure 10.20 Using classical conditioning, a nausea-producing drug is paired with alcohol to create an aversion to drinking.

Box 10.6

Neuroimaging studies of classical conditioning

Researchers have long used neuroimaging to study brain areas and structures involved in learning. Generally, the results of these studies indicate that many areas of the brain are involved in learning, the same brain area may be involved in different types of learning and that a specific type of learning may activate several different neural pathways and brain areas, depending on what is being learnt (Breedlove, Rosenzweig & Watson, 2007).

Neuroimaging studies of classical conditioning using PET and *f*MRI have found that classical conditioning activates areas of the *cerebral cortex* and lower brain structures including the *cerebellum*, *thalamus*, *hippocampus*, *hypothalamus* and *amygdala* (see figure 10.21). For example, in one study of classical conditioning, Norwegian psychologist Kenneth Hugdahl (1998) paired a tone (NS) with a shock to the wrist (UCS) and used PET scans to determine which brain areas were activated during the acquisition of a conditioned response. He recorded significant brain activation in specific areas of the *frontal lobe* in the *right cerebral hemisphere*. In another study, participants were presented with either neutral words (no conditioning) or with threat-related words (conditioning). When the *f*MRI images were compared for the two different experimental conditions, it was found that the threat words activated a different part of the cerebral cortex than the neutral words.

Many studies of eye-blink conditioning have shown that the *cerebellum* is activated during the process. The cerebellum plays a vital role in maintaining coordinated movement and balance, such as when someone make a series of fast voluntary movements in weaving through opponents to set up a shot at goal at a basketball match. Conversely, many studies of fear conditioning have found that the *amygdala* is activated. For example, in one study, volunteers were shown pictures of fearful and neutral faces, such as those in figure 10.22(a), while brain activity was recorded by *f*MRI. As shown in figure 10.22(b), the amygdala was more active during the viewing of fearful faces than the viewing of neutral faces. However, so was an area of the cerebral cortex in the frontal lobe that is involved in interpreting emotions (Williams & others, 2001).

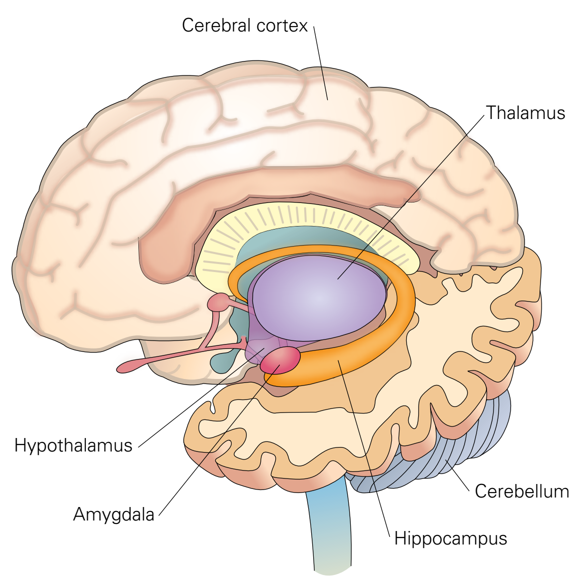


Figure 10.21 Brain areas and structures involved in classically conditioned responses

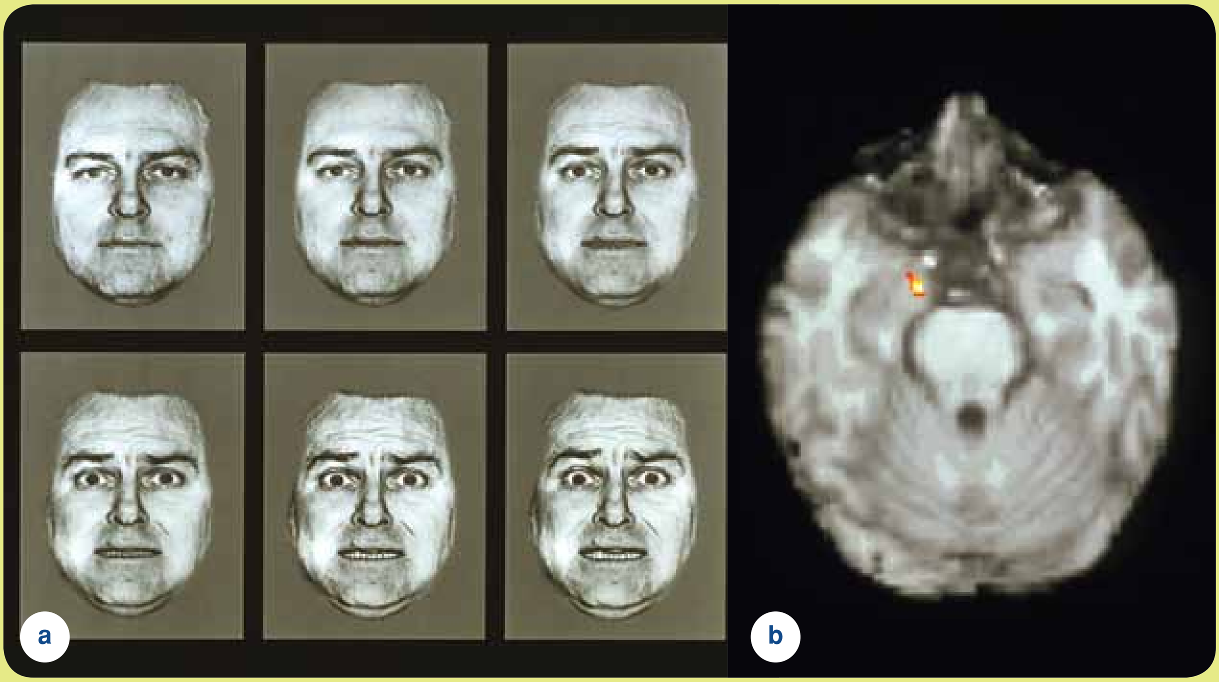


Figure 10.22 (a) Volunteers were shown pictures of fearful and neutral faces while brain activity was recorded by *f*MRI; (b) the left amygdala (coloured red/yellow) and medial prefrontal cortex were more active during the viewing of fearful faces, suggesting that the prefrontal cortex is involved in interpreting emotions.

Learning Activity 10.9

Review questions

1 Explain the meaning of exposure therapy with reference to the key feature of graduated exposure and that of flooding.

2 **a** Define graduated exposure with reference to an example not used in the text.

b Construct a hierarchy of frightening situations (such as that for fear of flying in figure 10.17) for someone with one of the following fears:
- dogs
- heights
- swimming.

3 **a** Define flooding with reference to an example not used in the text.

b Give an example of how flooding might be used to eliminate a conditioned response associated with your choice of fear for question 2(b).

4 Distinguish between imaginal and in vivo exposure.

5 Refer to figure 10.20 and draw a diagram to illustrate the use of aversion therapy to treat someone with an addiction to cigarette smoking or an over-the-counter medication.

6 Draw a diagram like that in figure 10.6 to describe how withdrawal of the gill in *Aplysia* could be classically conditioned.

7 **a** Refer to box 10.6 and identify brain areas and structures involved in classical conditioning, as indicated by neuroimaging studies.

b Suggest why it is difficult to conclude with confidence that brain areas activated in a neuroimaging study of classical conditioning are actually involved in the learning process.

c Explain how TMS could be used to study brain areas involved in learning.

Learning Activity 10.10

Visual presentation on a therapeutic application of classical conditioning

Prepare a visual presentation using a pamphlet or fact-sheet format outlining classical conditioning processes that can be used to treat a conditioned response involving fear and/or anxiety. The presentation should focus on a specific behaviour not referred to in the text, and outline:
- a description of the conditioned response and possible symptoms
- two suggestions on how the behaviour may have been acquired through classical conditioning
- explanations of three treatment options
- a potential advantage and limitation of each treatment option.

Ensure that each treatment option is explained in a user-friendly way for individuals who have not studied psychology and that each suggested option is adequately and accurately explained. Other references and sources may be used in preparing your presentation.

Trial and error learning

While classical conditioning provides a useful explanation for learned behaviour in which an originally neutral stimulus becomes associated with a reflexive or involuntary response, there are many other learned behaviours that cannot be explained by classical conditioning. Classical conditioning cannot adequately explain behaviour that is acquired voluntarily—behaviour we can control. Many behaviours are also complex in nature and do not occur automatically in response to a particular stimulus; for example, reading a book, giving a gift, playing tennis or robbing a bank.

Much of our learning occurs by trial and error. When we try something new and it gains the approval of others, the chances are it won't be the last time we do it. For example, when you wear a new outfit that earns compliments, it is likely you will wear it more often than an outfit that receives no comment. Likewise, a joke that produces genuine laughter will tend to be retold, whereas one that produces a neutral or no response will probably be forgotten. We all make adjustments to our behaviour according to the outcomes or consequences it produces. The adjustments usually result in an increase or decrease in the likelihood of that behaviour occurring again. The process through which we (and other organisms) learn to make responses in order to obtain or avoid consequences is known as *instrumental conditioning*, but is now more commonly referred to as *operant conditioning*. Key principles and processes of instrumental or operant conditioning are based on studies of trial and error learning.

Trial and error learning involves learning by trying alternative possibilities until the desired outcome is achieved. As the name suggests, trial and error learning usually involves a number of attempts (trials) and a number of incorrect choices (errors) before the desired outcome is achieved, such as the solution to a problem. Once learned, the behaviour will usually be performed quickly and with fewer errors.

Trial and error learning is a relatively simple way of learning to adjust to the environment and deal with everyday challenges. It involves *motivation* (a desire to attain some goal), *exploration* (an increase in activity—either purposeful or random), incorrect and correct *responses*, and *reward* (the correct response is made and rewarded). Receiving a reward of some kind leads to the repeated performance of the correct response, strengthening the association between the behaviour and its outcome. Although a lot of the research on trial and error learning has been with animals, it is not a type of learning that is restricted to animals. For example, Thomas Edison tried thousands of different kinds of materials for the filament of a light bulb before he found one that worked (carbon).

Thorndike's experiments with cats

The first studies of trial and error learning were conducted in the early 1900s by American psychologist Edward Lee Thorndike. Thorndike was studying animal intelligence at about the same time as Pavlov was studying the digestive system of dogs. Thorndike put a hungry cat in a 'puzzle box' (see figure 10.24) and placed a piece of fish outside the box where it could be seen (and smelt) but was just out of the cat's reach. In order to get to the food, the cat had to learn to escape from the box

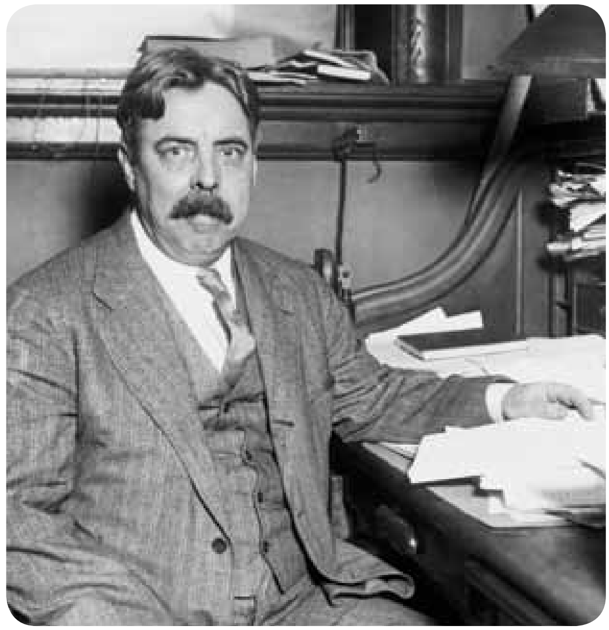


Figure 10.23 Edward Thorndike (1874–1949) identified the process of instrumental learning through observations of cats using trial and error learning. Instrumental learning later came to be known as operant conditioning.

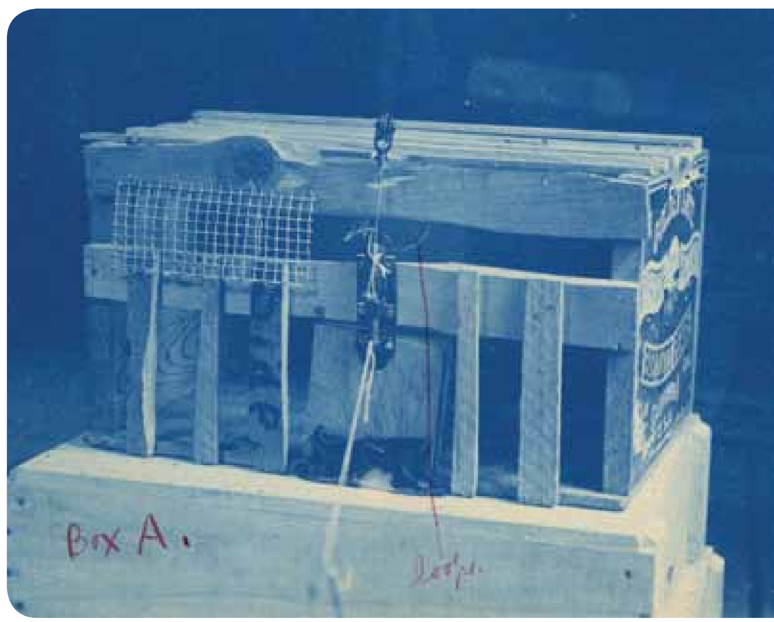


Figure 10.24 Thorndike constructed this apparatus, known as a puzzle box, from a wooden shipping crate. It was used in experiments that led him to describe the law of effect, a learning principle central in instrumental learning.

by operating a latch to release a door on the side of the box. This could be done by pushing down on a paddle (kind of lever) inside the box. To measure learning in this situation, Thorndike recorded the time it took the cat, on consecutive trials, to escape from the box.

Initially, the cat tried numerous ineffective strategies (trial and error). For instance, it tried to squeeze through the bars or stretch its paws to reach the food. At one time, it clawed and bit the bars for 10 minutes. Eventually, the cat accidentally pushed the lever, and the door opened. The cat was rewarded with both its release and the fish treat that awaited it. When the cat was put back in the box, it went through another series of incorrect responses before eventually pushing the lever again, and again being rewarded with the food. The cat became progressively quicker at escaping from the box and, after about seven trials, it would go directly to the lever, push it, and get out of the box immediately. Pushing on the lever was no longer part of a random pattern of behaviour. It had become a deliberate response that the cat had learnt due to the consequences of making the response. When the correct response was followed by a reward (escape and food), the cat demonstrated this behaviour with increasing frequency until pushing the lever was the only response it made when placed in the box. The gradual nature of the learning and the kinds of responses being made initially led Thorndike to use the term 'trial and error learning'.

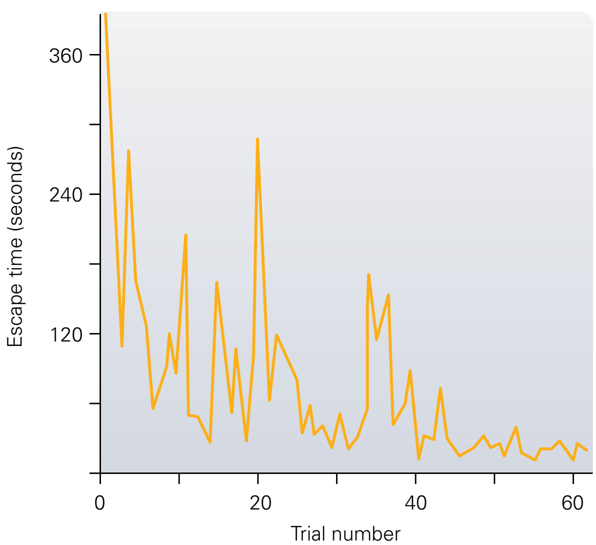


Figure 10.25 The graph shows the gradual decline in the time taken for the cat to escape from the puzzle box. Note the marked fluctuations in the learning curve. Learning curves for individual data are rarely smooth. A smooth learning curve would be produced by averaging the results of many cats' responses in the puzzle box.

The results of his experiments led Thorndike (1911) to develop the law of effect. The **law of effect** essentially states that a behaviour that is accompanied or closely followed by 'satisfying' consequences is more likely to recur (strengthened) and a behaviour that is accompanied or closely followed by 'annoying' consequences or discomfort is less likely to recur (weakened). In the puzzle-box experiments, behaviour that enabled the cat to escape and get to the food ('satisfying' consequences) was more likely to recur, and behaviour that kept the cat in the box ('annoying' consequences) was less likely to recur. Thorndike used the term **instrumental learning** to refer to the process through which an organism learns the association between behaviour and its consequences. In the puzzle-box experiments, the cat became 'instrumental' in obtaining its release to get to the food.

Learning Activity 10.11

Review questions

1. Define trial and error learning with reference to a personal example of trial and error learning in everyday life.
2. a Explain the meaning of the term instrumental learning.
   b Is instrumental learning simply another term for instrumental conditioning? Explain your answer.
   c What is the key difference between classical conditioning and instrumental learning?
3. What is the law of effect?
4. Explain the relationship between instrumental learning and the law of effect.
5. In Thorndike's puzzle-box experiments, what role did the reward (the fish) serve in the learning process?
6. What does the graph in figure 10.25 indicate about the trial and error learning process of a cat seeking to escape from a puzzle box?

Operant conditioning

The term 'operant conditioning', as instrumental learning is most often called today, was not introduced until some years after Pavlov's experiments with salivating dogs and Thorndike's experiments with cats escaping from puzzle boxes. Operant conditioning was a term coined by American psychologist Burrhus Frederic Skinner (1904–1990). Skinner referred to the responses observed in trial and error learning as operants. An **operant** is a response (or set of responses) that occurs and acts ('operates') on the environment to produce some kind of effect. Essentially, an operant is a response or behaviour that generates consequences. Before conditioning, an organism might make many operant responses. For example, clawing a box and biting a bar are both operants.

Operant conditioning is based on Thorndike's law of effect that an organism will tend to repeat a behaviour (operants) that has desirable consequences (such as receiving a treat), or that will enable it to avoid undesirable consequences (such as being given detention). Furthermore, organisms will tend *not* to repeat a behaviour that has undesirable consequences (such as disapproval or a fine).

Three-phase model of operant conditioning

The theory of operant conditioning has been expressed as a three-phase model based on Thorndike's law of effect. The **three-phase model of operant conditioning** has three components: (1) the stimulus (S) that precedes an operant response, (2) the operant response (R) to the stimulus, and (3) the consequence (C) to the operant response. This can be expressed as stimulus (S) → response (R) → consequence (C). S may refer to a single stimulus or set of stimuli and R can refer to a single response or set of responses. Sometimes, the three-phase model is described as S → R → S, with the latter S referring to a stimulus in the form of a consequence. In more formal terms, the three-phase model of operant conditioning means that the probability of an operant response (R) to a stimulus (S) is a function of ('depends on') the consequence (C) that has followed (R) in the past. In the case of a cat in a puzzle box, S is the box, R is the sequence of movements needed to open the door, and C is escape and food.

Table 10.2 The three-phase model of operant conditioning

	Stimulus (S)	Operant response (R)	Consequence (C)	Effect on future behaviour
Definition	The environmental stimulus that precedes an operant response	The action that can have an effect on the environment	The environmental stimulus or event that follows the operant response	Reinforcement increases the likelihood of the operant being repeated; punishment or lack of reinforcement decreases the likelihood of the operant being repeated.
Examples	Puzzle box	Pushing on lever to open door	Escape and food	Positive reinforcement—more likely to push on lever again
	Presence of potty seat	Urination	Praise	Positive reinforcement—more likely to seek potty seat when bladder is full
	Petrol gauge almost on empty	Fill car with petrol	Avoid running out of petrol	Negative reinforcement—more likely to fill car when petrol gauge on empty
	Soft-drink vending machine	Put in $2	Get no soft drink and lose money	Punishment (negative)—less likely to use that vending machine again
	In a small group in the schoolyard	Tell a 'sick' joke	Ridiculed by others	Punishment (positive)—less likely to tell 'sick' jokes to the group

Skinner's experiments with rats

Skinner was attracted to and inspired by Thorndike's work. In the 1930s he began his own experiments but used the term *operant conditioning* instead of instrumental learning. He did this to emphasise that animals and people learn to *operate* on the environment to produce desired or satisfying consequences.

Skinner proposed that in Thorndike's experiments, the cat 'operated' on the environment to allow it to escape from the box and to get the fish reward. The relevant operant that became conditioned was the behaviour of pushing on the lever to open the door. In this sense, the cat's behaviour had an effect on its environment (that is, opened the door). The fact that the consequences of the cat's action were positive (escape and food) increased the likelihood of the response occurring again. Similarly, a student might behave very cooperatively and work well in class if this behaviour operates on the environment to produce the desired consequence of an early dismissal. The behaviour of being cooperative and diligent is the operant response that will become conditioned by the early dismissal.

Skinner also contrasted operants with respondents in classical conditioning. *Respondents* are behaviours produced by known or recognised stimuli. For instance, compare the behaviours of Pavlov's dogs and Thorndike's cats. The dogs first responded by salivating to the meat powder and later to a bell. Their salivation in either case was produced by an identifiable stimulus (the meat powder, then the bell). But the cats made many different responses that were not prompted by a particular stimulus. In classical conditioning, the organism's behaviour does not have any environmental consequences. Thus, in Pavlov's procedure, the dog simply receives food and responds by salivating. It will receive a consequence (food) whether or not it has learned the conditioned response. This is why Skinner referred to classical conditioning as *respondent conditioning*. In operant conditioning (or instrumental learning) by contrast, the consequence occurs only if the organism performs the response. Consider also responses in eye-blink conditioning. A participant may hear the tap of a pencil (CS) that is reliably followed by a puff of air (UCS) and the participant may learn to make an eye-blink response (CR) to the tap. However, the air puff follows the tap whether or not the response occurs. This is one important way of differentiating operant conditioning from classical conditioning. In operant conditioning, if responses are not made, the consequence doesn't happen. In classical conditioning, responses occur regardless of responding.

Skinner believed that *all* behaviour could be explained by the relationships between the behaviour, its antecedents (the events that come before it) and its consequences. He argued that any behaviour that is followed by a consequence will change in strength (become more, or less, established) and frequency (occur more, or less, often) depending on the nature of that consequence (reward or punishment).

For his pioneering experiments on operant conditioning, Skinner created an apparatus called a Skinner box (as shown in figures 10.26 and 10.27). A **Skinner box** is a small chamber in which an experimental animal learns to make a particular response for which the consequences can be controlled by the researcher. It is equipped with a lever that delivers food (or water) into a dish when pressed. Some boxes are also equipped with lights and buzzers, and some have grid floors for delivering a mild electric shock. The lever is usually wired to a cumulative recorder, an instrument with constantly moving chart paper on which a pen makes a special mark each time a desired response (usually lever-pressing) is made. The recorder can indicate how often each response is made (frequency) and the rate of response (speed). Most of Skinner's early experiments using the Skinner box were done with rats, while his later experiments were performed using pigeons. Rats were usually conditioned to press the lever, and pigeons were conditioned to peck at a disk.

In 1938, Skinner used the Skinner box in a well-known experiment to demonstrate operant conditioning. When a hungry rat was placed in the box, it scurried around the box and randomly touched parts of the floor and walls. Eventually, the rat accidentally pressed a lever mounted on one wall. Immediately, a pellet of rat food dropped into the food dish and the rat ate it. The rat continued its random movements and eventually pressed the lever again. Another pellet dropped immediately and was eaten. With additional repetitions of lever-pressing followed by food, the rat's random movements began to disappear and were replaced by more consistent lever-pressing. Eventually, the rat was pressing the lever as fast as it could eat each pellet. The pellet was a reward for making the correct response. Skinner referred to different types of rewards as *reinforcers*.

Skinner had an interest in demonstrating the impact of reinforcement, and his laboratory apparatus was able to reward the animals according to different types of programs or schedules of reinforcement; for example, providing a reinforcer every time a correct response was made as compared with every second correct response or several seconds after a correct response is made. Thorndike's cats could see the reinforcer from the time they were placed in the puzzle box. So although it still took them many trials to reach it, their motivation was clearly

Figure 10.26 B.F. Skinner with a laboratory rat in a Skinner box

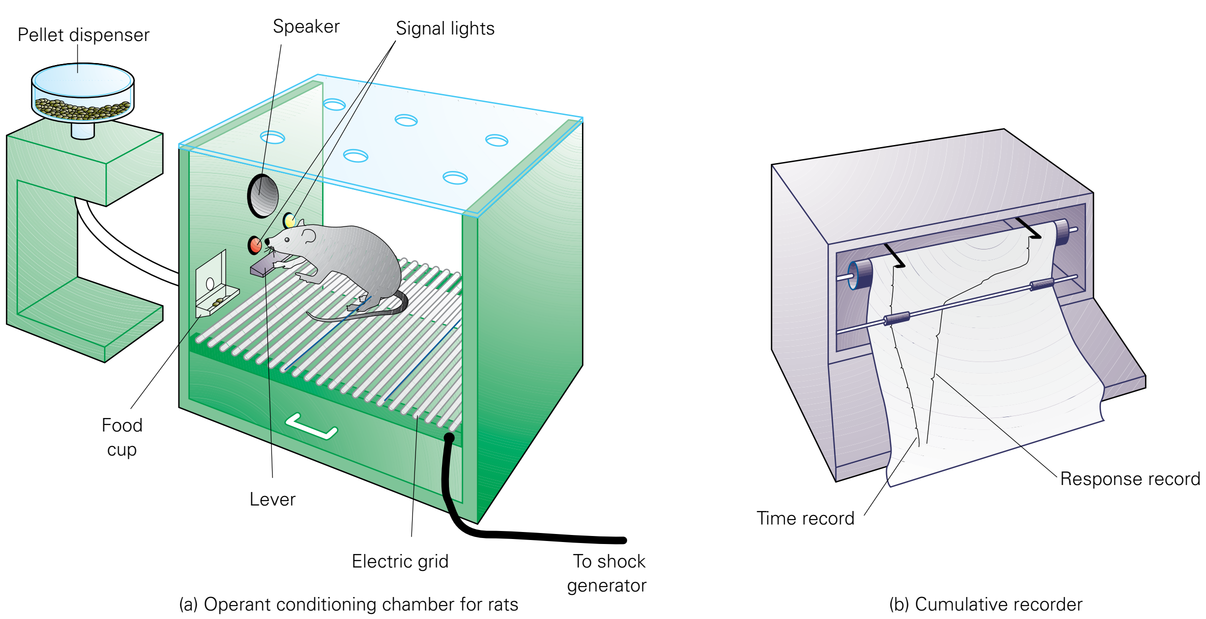


Figure 10.27 (a) The key components of an operant conditioning chamber, often referred to as a Skinner box; (b) A cumulative recorder that is connected to the lever in the box. It electronically records the correct responses and the rate at which they occur (their frequency). This type of cumulative recorder has been replaced with a computer.

Figure 10.28 Skinner and assistants at work in an operant conditioning laboratory preparing a pigeon for research in an experiment.

evident. But Skinner's laboratory animals just chanced upon the discovery of the reinforcer by a random action. That is, the laboratory rat was not able to see the food pellets in the same way Thorndike's cat could see the fish. This is why Skinner had to use hungry rats. Their hunger was their motivation for frantic activity. This high rate of activity increased the likelihood (probability) that the lever would eventually be pressed and the food reward dispensed.

Skinner believed that there was no need to search for internal agents (factors within an organism) to explain changes in behaviour. This view was based on the notion that behaviour can be understood in terms of environmental, or external, influences, without any consideration of internal mental processes.

The fundamental procedure used by Skinner in his 1938 experiment has been repeated thousands of times by Skinner, his colleagues and subsequent researchers. The records of their observations and measurements enabled Skinner and other researchers to identify reliable principles of operant conditioning that have been generalised to humans.

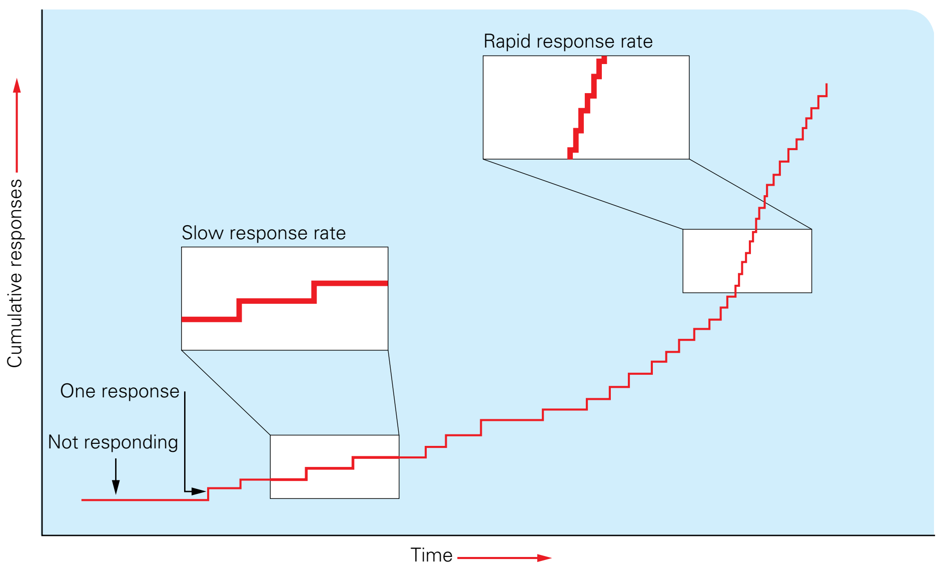


Figure 10.29 Typical response curve for a rat in a Skinner box learning to press a lever in order to get a reward

Learning Activity 10.12

Review questions

1 Explain the meaning of the term operant conditioning.

2 Why did Skinner adopt the term operant conditioning rather than instrumental learning? In your answer, include a definition of an operant with reference to an example not used in the text.

3 Consider toddler Alex who is being toilet-trained by her parents using operant conditioning. Her parents wait until after Alex has had a drink and her bladder is full, then put her on a potty seat and wait for nature to take its course. When Alex urinates in the potty, her parents provide verbal praise ('What a good girl you are, Alex!') or even some stickers that she loves. She is also punished when she has a wetting accident by verbal disapproval ('Mommy is very disappointed in you, Alex.'). Gradually, Alex learns enough bladder control to recognise when urination is imminent, and to withhold the response long enough for a quick trip to the potty seat—thus obtaining a reward and avoiding punishment. Eventually, the behaviour becomes automatic enough that Alex continues to use the potty seat. Explain Alex's successful toilet training using the three-phase model of conditioning. Ensure you refer to each component with reference to the relevant aspect(s) of Alex's toilet training.

4 Briefly outline a procedure for an experiment using a Skinner box to:
   a operantly condition a rat to produce a particular response
   b operantly condition a rat *not* to produce a particular response.

5 In Skinner's view, what are the main driving forces behind behaviour?

6 a Identify the independent and dependent variables in Skinner's (1938) experiment with the hungry rat outlined on pages 481–2.
   b Explain the rat's learning through operant conditioning using the three-phase model of conditioning.

Elements of operant conditioning

Central to operant conditioning is reinforcement, because learning through operant conditioning occurs as a result of the consequences of behaviour. A response that is rewarded is strengthened, whereas one that is punished is weakened. Both reinforcement and punishment can be delivered in a number of different ways.

Reinforcement

When you are training your dog to 'shake hands' and you give it a treat, pat it on the head or say 'good dog' when it behaves the way you want it to, you are using reinforcement. Similarly, using an umbrella to prevent yourself from getting wet when it rains is a kind of reinforcement. So, reinforcement may involve receiving a pleasant stimulus (the dog receiving a treat) or 'escaping' an unpleasant stimulus (avoiding getting wet by using an umbrella). In either case, the outcome is one that is desired by the organism performing the behaviour.

Reinforcement is said to occur when a stimulus (object or event) strengthens or increases the frequency or likelihood of a response that it follows. This may involve using a positive stimulus or removing a negative stimulus to subsequently strengthen or increase the frequency or likelihood of a preceding response or operant. An essential feature of reinforcement is that it is only used *after* the desired or correct response is made.

A **reinforcer** is any stimulus (object or event) that strengthens or increases the frequency or likelihood of a response that it follows. The term 'reinforcer' is often used interchangeably with the term 'reward'. Although they are not technically the same, many psychologists accept that they are similar enough to be used interchangeably. One difference is that a reward suggests an outcome that is positive, such as satisfaction or pleasure. A stimulus is a reinforcer if it *strengthens* the preceding behaviour. In addition, a stimulus can be rewarding because it is pleasurable, but it cannot be said to be a reinforcer unless it increases the frequency of a response or the likelihood of a response occurring. For example, a person might enjoy eating chocolate and find it pleasurable, but chocolate cannot be considered to be a reinforcer unless it promotes or strengthens a particular response.

The way the reinforcement is delivered in experimental settings (as well as in everyday life) is referred to as the schedule of reinforcement. A **schedule of reinforcement** is a program for giving reinforcement, specifically the frequency and manner in which a desired response is reinforced. The schedule that is used will influence the speed of learning (the response acquisition rate) and the strength of the learned response.

Schedules of reinforcement

Reinforcement may be provided on a continuous schedule (that is, after every correct response) or on a partial reinforcement schedule (that is, only on some occasions for performing the correct response). Each type of reinforcement schedule influences the speed with which a response is acquired, as well as the strength of the response.

Early in the conditioning process, learning is usually most rapid if the correct (or desired) response is reinforced every time it occurs (that is, continuously). The reinforcer is typically provided immediately after every correct response. This schedule of reinforcing every correct response after it occurs is called **continuous reinforcement**.

Once a correct response consistently occurs, a different reinforcement schedule can be used to maintain, increase or strengthen the response; for example, by reinforcing only some correct responses. Skinner (1956) unintentionally observed this property of reinforcement when he ran out of food pellets for his rats during an experiment and was forced to deliver reinforcement less often. It is now widely established that responses maintained through a program of partial, or intermittent, reinforcement are stronger and less likely to weaken or cease than those maintained by continuous reinforcement. **Partial reinforcement** is the process of reinforcing some correct responses but not all of them. Partial reinforcement may be delivered in a number of ways or by different schedules.

Reinforcement can be given after a certain *number* of correct responses have been made (that is, as a *ratio*) or after a certain amount of *time* has elapsed following the last correct response (that is, after an *interval*). Furthermore, reinforcement may be given on a *regular* basis, such as after every sixth correct response, or every 30 seconds following a correct response (that is, *fixed*); or it may be *unpredictable* (that is, *variable*). Behaviour that is conditioned or maintained on a schedule of partial reinforcement is generally considered to be the most difficult to change.

There are four basic schedules of partial reinforcement. Each of these schedules produces a different effect on the response acquisition rate and the strength of the response. Although they are different reinforcement delivery procedures, they each *strengthen* the response that they follow.

Table 10.3 The four schedules of partial reinforcement

Schedule	Ratio (number)	Interval (time)
Fixed (set)	Fixed ratio	Fixed interval
Variable (unpredictable)	Variable ratio	Variable interval

Fixed-ratio schedule

A **fixed-ratio schedule** is when the reinforcer is given after a set (‘fixed’), unvarying number (‘ratio’) of desired responses have been made. In laboratory experiments, a ratio of 1:10 (one reinforcement for every ten correct responses made) will soon see the rat press a lever (correct response) ten times in rapid succession in order to receive a food pellet (reinforcer). However, the ratio needs to be a relatively frequent one in the acquisition phase of the learning process. Once learning is complete, the frequency of reinforcement can be extended; for example, from 1:10 to 1:15.

Anyone who is employed on a ‘piecework’ basis is on a fixed-ratio schedule. In this situation, payment (reinforcement) is based solely on commission (for example, $20 for every 100 newspapers sold) or a certain amount of production (for example, $5 for each bucket of cherries picked).

Figure 10.30 These factory workers are paid according to a fixed-ratio schedule of reinforcement.

Variable-ratio schedule

A **variable-ratio schedule** is when the reinforcer is given after an unpredictable ('variable') number ('ratio') of correct responses. There is also a constant *mean* number of correct responses (a ratio) for giving reinforcement. For example, the schedule might reinforce, on average, ten correct responses in a total of 100 correct responses, but sometimes after one, five, 13, or any other number of correct responses, as long as the average of ten correct responses is maintained. This schedule is a very effective system of reinforcement in terms of the speed with which a response is acquired and the length of time taken for the response to cease. It seems that uncertainty of when the next reinforcement will occur actually keeps organisms responding steadily in the desired way, and extinction of the behaviour takes longer.

Psychologists have often described many forms of gambling as demonstrating the application of the variable-ratio schedule in real life. For example, each spin of the roulette wheel, toss of the pennies in 'two up', throw of the dice in 'craps' or purchase of Tattslotto ticket could be the 'big one'. The variable-ratio schedule that is a part of such gambling games leaves the player guessing as to when the payout (reinforcement) will occur. Players gamble that it will be after the next response, or 'sooner rather than later', usually with an underlying belief that the more often they gamble on each spin or toss, the more opportunities they have to win. More recently, some psychologists have proposed that many gambling activities (such as playing poker machines and roulette) actually involve a *random-ratio reinforcement schedule*. In these 'games', the reinforcer is given after a random number ('ratio') of correct responses but *each* response has an *equal chance* of reinforcement (see chapter 15, pages 755–6).

Fixed-interval schedule

The **fixed-interval schedule** involves delivery of the reinforcer after a specific, or 'fixed', period of time has elapsed since the previous reinforcer, provided the correct response has been made. For example, the first correct response made after a period of 2, 7, 10 or 20 seconds has elapsed is reinforced. Any response before the given time interval has elapsed, even if it is correct, is not reinforced.

In the laboratory, this type of schedule generally produces a moderate response rate that is often erratic. Once the organism realises that time is the key factor, it stops responding for a while after the delivery of each reinforcer, but quickly responds as the time for the next reinforcer approaches.

A fixed-interval schedule would be apparent among workers who receive monthly performance reviews and show more productive behaviours in the days leading up to their evaluations than immediately afterward. Another example of the fixed-interval schedule is apparent in baking a cake without a timer. For instance, suppose you know from the recipe that the cake needs to bake for 30 minutes. Because you don't have a timer, you need to estimate when the cake is ready—you don't want it to burn. There is little point in checking after the first 5 or 10 minutes, but it might be worth checking after you estimate 20 or 25 minutes have passed. And as it gets closer and closer to 30 minutes, you might check more and more frequently, not wanting to leave the cake in the oven past the deadline. In this example, the response is checking the cake, the reinforcement is taking out a perfectly baked cake, and only the response that occurs immediately after the end of the baking interval is reinforced—the rest as 'wasted' responses (Gluck, Mercado & Myers, 2008).

Variable-interval schedule

A **variable-interval schedule** is when reinforcement is given after irregular, or 'variable', periods of time ('intervals') have passed, provided the correct response has been made. Like the variable-ratio schedule, there is also a mean period of time for the availability of reinforcement; for example, an average of once every 10 seconds—but at variable unpredictable times (on the 11th second, 17th second, 38th second, and so on). Responses made before the scheduled delivery time are not reinforced, even if the responses are correct.

Since reinforcement cannot be predicted, a variable-interval schedule produces a low but very steady rate of responding. Weakening or cessation of a particular response under this schedule is gradual and much slower than under a fixed-interval schedule.

Fishing involves a variable-interval schedule. For example, when someone goes fishing, they do not know whether a fish will bite after 20 seconds, after 20 minutes, or not at all. Under these conditions, assuming the person wants a fish, they may steadily check their line every few minutes. Similarly, checking email messages is another example of the variable-interval schedule in real life. Suppose that, on average, you received ten messages a day from friends, but you can never be sure exactly when the messages will arrive. You want to read these messages promptly, but you don't want to waste your whole day sitting in front of the computer just in case a new message arrives. By periodically checking your emails at a steady rate—say, once an hour—you will minimise the time an unread message sits in your inbox, while you are free to do other things in the meantime (Gluck, Mercado & Myers, 2008). Variable-interval schedules involving aversive or negative stimuli include the use of 'surprise tests' by a teacher and 'portable' speed cameras on our roads.

Figure 10.32 In real life, reinforcement is not necessarily a one-way street. Children and parents continually reinforce each other. By stopping a tantrum when they get their way, the child negatively reinforces the parent. However, by giving in to the child and providing what was sought, the parent is positively reinforcing the tantrum-throwing behaviour.

Positive reinforcement

The food pellet in the Skinner box is a positive reinforcer for the hungry rat pressing the lever. A high grade on an exam is a positive reinforcer for a person who studies conscientiously, as is thanking a friend for doing you a favour. These examples also illustrate why the term *reward* is often used to describe a positive reinforcer. A **positive reinforcer** is a stimulus that strengthens or increases the

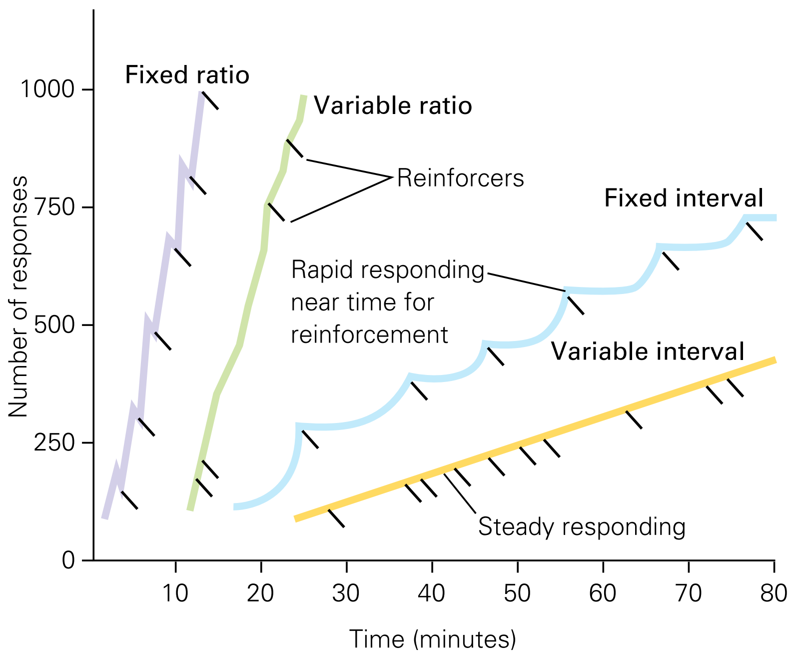


Figure 10.31 Learning curves produced by different schedules of reinforcement. The steeper the slope of the curve, the faster the response rate. Each pause indicated by a line shows the point at which reinforcement was given. These response patterns were produced by Skinner's pigeons when placed on each of the four reinforcement schedules respectively.

frequency or likelihood of a desired response by providing a satisfying consequence. **Positive reinforcement** occurs from giving or applying a positive reinforcer after the desired response has been made.

Negative reinforcement

On a rainy day, if you want to avoid the unpleasant experience of having wet clothes, you could use an umbrella. If the umbrella successfully kept you dry, the next time it rained you would probably use it again. The increased likelihood of using an umbrella makes this behaviour one that has been negatively reinforced. The increase in its likelihood is based on the avoidance of something unpleasant (wearing wet clothes). A **negative reinforcer** is any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a desired response. For example, a Skinner box has a grid on the floor through which a mild electrical current can be passed continuously. If a rat is placed in the box it can be given a foot shock that is an unpleasant stimulus. When the rat presses the lever on a wall of the box, the electric current is switched off and the mild shock is taken away. The removal of the shock (negative reinforcer) is referred to as negative reinforcement. **Negative reinforcement** is the removal or avoidance of an unpleasant stimulus. It has the effect of increasing the likelihood of a response being repeated and thereby strengthening the response. Thus, the likelihood of the lever-pressing response will increase because the negative reinforcer (the shock) is removed as a consequence of this lever-pressing behaviour.

The important distinction between positive and negative reinforcement is that positive reinforcers are *given* and negative reinforcers are *removed* or *avoided*. However, because both procedures lead to desirable or satisfying consequences, each procedure strengthens (reinforces) the behaviour that produced the consequence.

Negative reinforcement is evident in many aspects of everyday life. For example, when you turn off a scary movie, cover your eyes or walk away, you remove a negative event (fear associated with the movie) and the avoidance behaviour is negatively reinforced. The next time you watch a movie and a frightening scene comes on, you are more likely to repeat your avoidance behaviour. Similarly, if after taking an aspirin the pain from a headache subsides, the behaviour of taking an aspirin has been negatively reinforced, and it is likely that you will take an aspirin the next time you have a headache. And when a P-plate driver decides not to drink alcohol at a party for fear of losing their licence if they are caught driving with alcohol in their blood, a negative reinforcer (loss of licence) is at work. In these examples, the *removal* of the negative reinforcer is providing a satisfying or desirable consequence.

To help you remember this difference, you could link the terms with mathematical symbols: positive (+) reinforcer = adding something pleasant; negative (–) reinforcer = subtracting something unpleasant. In mathematics, two negatives make a positive. The same applies to the concept of negative reinforcement—the *subtraction* of a *negative* (unpleasant) stimulus results in a *positive* (desirable) consequence or outcome.

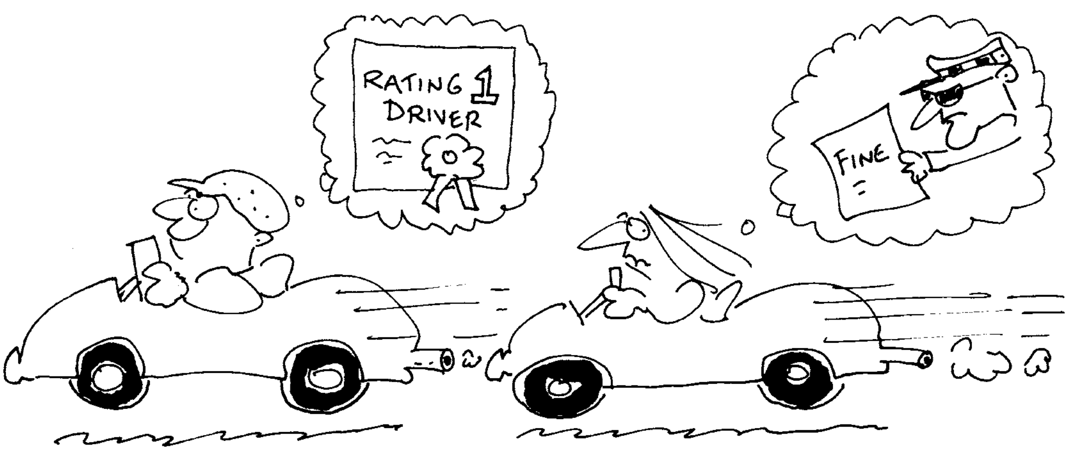


Figure 10.33 Vasco drives safely and obeys all the road laws so that he can become a 'Rating 1' driver and save on his insurance premium (positive reinforcement). Emma drives safely and obeys all the road laws to avoid getting any more traffic fines and licence demerit points (negative reinforcement).

Learning Activity 10.13

Review questions

1 Define the term reinforcement with reference to an example.

2 Define the terms positive reinforcement and negative reinforcement.

3 In what way are positive reinforcers and rewards similar and in what way are they different?

4 a What do positive and negative reinforcers have in common in terms of their consequences?

b Identify three positive and negative reinforcers that you have observed teachers use in the classroom and three that you have observed in other real-life contexts.

c How are positive and negative reinforcers different?

5 What does the term schedule of reinforcement refer to?

6 a Distinguish between continuous and partial reinforcement with reference to a relevant example in a laboratory setting.

b Give two examples of continuous and partial reinforcement in everyday life.

c Which is more effective in strengthening a response once it has been acquired: continuous or partial reinforcement? Explain your answer with reference to research findings.

d When in the operant conditioning process is it most advantageous to use continuous reinforcement?

7 Construct a table in which you summarise and distinguish between the four basic schedules of reinforcement. Include two examples of each schedule in your table.

8 What are some possible effects of a long delay in the presentation of a reinforcer?

9 At what stage of the learning process should a reinforcer be presented to be most effective? Explain your answer.

10 How might the use of an inappropriate reinforcer affect the learning process?

Learning Activity 10.14

Identifying schedules of reinforcement

Name the schedule or reinforcement operating in each of the following examples.

- an author who takes a break after writing each chapter of a novel
- a radio station gives a prize to the 13th telephone caller
- a teacher who checks on a student every so often and praises them for the work being completed.
- a netballer who takes a break every time she shoots ten goals consecutively
- a salesperson who is paid a retainer (base salary) plus a commission for each sale
- a Mormon who knocks on the doors of homes to talk with the occupants
- an assembly-line worker who is paid for every carton of goods completed
- a quiz-show contestant who scores ten points for every correct answer
- a teacher on yard duty who checks the toilets every so often during lunchtime
- a coffee shop proprietor who gives a free cup of coffee after every tenth purchase

Learning Activity 10.15

Using reinforcement to change behaviour

A toddler cries in the middle of the night. A parent wakes and responds by bringing the toddler into their bed. The parent would prefer the toddler to sleep in her own bedroom but the toddler continues crying unless moved to the parent’s room.

1 Explain, with reference to reinforcement, how this situation may have developed.

2 Describe a reinforcement strategy the parent could use to change the unwanted behaviour of their toddler.

Learning Activity 10.16

Data analysis

Refer to the learning curves produced by four different schedules of reinforcement, as shown in figure 10.31 on page 486.

1. Do the curves indicate continuous or partial reinforcement? Explain your answer.
2. Which schedule of reinforcement is the most effective for the quickest acquisition of a desired response and which is least effective? Explain each answer with reference to relevant curves and theory on the schedules.
3. Assuming the graph shows the learning curves of four different pigeons reinforced for pecking responses, suggest which pigeon's behaviour will be most resistant to extinction (cessation or elimination) and which pigeon's behaviour will be least resistant. Explain each answer.

Punishment

If you are caught exceeding the speed limit while driving, you will receive a fine and demerit points. Both of these are an unpleasant consequence that is intended to reduce speeding behaviour in future. Alternatively, if you continue to speed after receiving a number of speeding fines and demerit points, you may have your licence to drive (a satisfying consequence) removed (an unsatisfying consequence). In each example, the consequence is punishment of the unwanted behaviour with the intention of weakening, reducing the frequency of or eliminating the behaviour.

Punishment is the delivery of an unpleasant consequence following a response, or the removal of a pleasant consequence following a response. Punishment has the same unpleasant quality as a negative reinforcer, but unlike a negative reinforcer, the punishment is given or applied, whereas the negative reinforcer is prevented or avoided. The consequence or outcome of punishment is the opposite to removal of a negative reinforcer. When closely associated with a response, punishment *weakens* the response, or *decreases* the probability of that response occurring again over time.

As with reinforcement, Skinner (1953) distinguished between positive and negative punishment. Again, as with reinforcement, remember to think in mathematical terms of adding (+) and taking away (–), rather than good and bad or the 'feelings' of the recipient. **Positive punishment** involves the presentation (or introduction) of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again. For example, an electric shock for a rat in a Skinner box, your having to run extra laps around a basketball court for being late to training and being given extra chores at home for doing something wrong all involve positive punishment. **Negative punishment** involves the removal of a stimulus and thereby decreasing (or weakening) the likelihood of a response occurring again. For example, taking food away from a hungry rat, not allowing you to join in basketball training because you were late and your parents taking away your computer privileges for doing something wrong all involve negative punishment. Note that in *both* positive and negative punishment, the intended effect on the punished behaviour is to weaken and prevent it from recurring.

Since negative punishment involves taking a stimulus away or not obtaining a reinforcer as a consequence of behaviour, it is often referred to as response cost. More specifically, **response cost** may be described as involving any valued stimulus being removed, whether or not it causes the behaviour.

Figure 10.34 A speeding fine is negative punishment involving response cost.

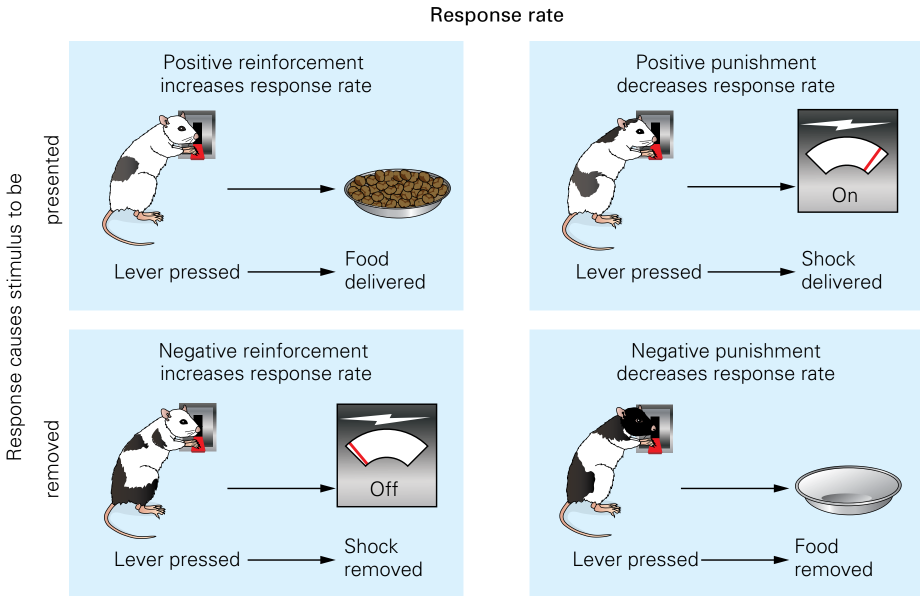


Figure 10.35 Comparing types of reinforcement and punishment.

For example, if you get a speeding fine, your money (a valued stimulus) is taken away from you. In addition, the stimulus of money was unlikely to have been the reason (or 'cause') for your speeding! Therefore, a speeding fine is considered to be a response cost, but also negative punishment as something of value has been taken away.

Factors that influence the effectiveness of reinforcement and punishment

Any type of reinforcement is intended to increase the likelihood of a behaviour being repeated and any type of punishment is intended to decrease the likelihood of behaviour being repeated. It is therefore important to understand the various conditions that influence their effectiveness.

In operant conditioning, what happens *after* the correct or desired response is performed is very important in determining the strength of learning and the rate at which it occurs. In addition, it is not just *whether* a response is reinforced or punished that influences the learning process; other factors associated with reinforcement also play important roles in affecting learning. For instance, *when* in the process of operant conditioning the consequence (reinforcement or punishment) is presented, the *time lapse* between the response and consequence, and the *appropriateness* of the consequence used are all important in determining the effectiveness of reinforcement or punishment and therefore learning through operant conditioning.

Order of presentation

To use reinforcement and punishment effectively it is essential that either be presented *after* a desired response, never before. This helps to ensure that the organism learns the consequences of a particular response. For example, suppose you want to condition someone to say 'I' in a conversation more often than they normally would. If you reinforce them with a smile or nod in agreement every time they say 'I', it will increase the frequency of 'I …' statements, but not if the smile and nod occurs before they say the word 'I'. Similarly, suppose you successfully increase the frequency of 'I …' statements and then withhold the reinforcement. Eventually, the person will make 'I …' statements less often and the response will return to the level it was before conditioning.

Timing

Reinforcement and punishment are most effective when given *immediately after* the response has occurred. This timing helps to ensure that the organism associates the response with the reinforcer or punisher, without interference from other factors during the time delay. Timing also influences the strength of the response. If there is a considerable *delay* between the response and the consequence, learning will generally be very slow to progress and in some cases may not occur at all.

In a laboratory setting, the timing of the consequence can be controlled precisely in relation to each response. However, this is not often the case in everyday life. There are many situations in which it is not practical or possible to provide reinforcement immediately after the response. For example, consider potential positive reinforcers for working conscientiously to achieve good VCE grades. The positive reinforcer(s) may be pride and other feelings associated with achievement, a place in a preferred tertiary course or a material reward such as money. In any case, there will be a considerable time delay during which exams are taken, grades finalised, results announced and tertiary places offered. What helps to overcome the effect of the delay in receiving the reinforcement is our knowledge that the reward will eventually come. Unlike most other species, humans are very capable of learning even when behavioural consequences are delayed.

A similar situation exists with the application of punishment in everyday life. Detentions for misbehaviour at school may occur days after the misdemeanour happened. Similarly, punishments handed down in our law courts may happen months, or even years, after the criminal behaviour occurred.

Appropriateness

For any stimulus to be a reinforcer, it must provide a pleasing or satisfying consequence (reward) for its recipient. For example, a place in a course at a university would not be an effective reward to a student who intends to work in their family's business at the end of Year 12. However, a holiday on the Gold Coast before the student started paid work might be considered much more desirable, and would therefore be a more effective reinforcer.

Technically, it will not be known if something will act as a reinforcer until after it has been used. For example, we won't know if stickers will act as a reinforcer to a child for completing homework until these are presented as a reward once the homework is completed. Furthermore, it cannot be assumed that a reinforcer that works in one situation will work in another. Importantly, the characteristics of the individual involved and the particular situation need to be taken into account when deciding on the best kind of reinforcer(s) to be used.

Figure 10.36 For any stimulus to be an appropriate reinforcer, it must provide a pleasing or satisfying consequence for its recipients, such as fruit provides for monkeys.

Similarly, for any stimulus to be an appropriate punisher, it must provide a consequence that is unpleasant and therefore likely to decrease the likelihood of the undesirable behaviour. An inappropriate punisher can have the opposite effect and produce the same consequence as a reinforcer. For example, a talkative, attention-starved Year 8 student may respond to being verbally reprimanded in class—his teacher's intended punisher—by increasing his talkative behaviour. For him, the verbal scolding at least gives him the attention he craves, and this attention then acts as a reinforcer for the talkative behaviour.

Although punishment may temporarily decrease the occurrence of unwanted responses or behaviour, it doesn't promote more desirable or appropriate behaviour in its place. Throughout his career as a behavioural psychologist, Skinner remained strongly opposed to the use of punishment in everyday life. Instead, he advocated the greater use of positive reinforcement to strengthen desirable behaviours or to promote the learning of alternative behaviours to punishable behaviours (Hockenbury & Hockenbury, 2006).

Figure 10.37 Reinforcement and punishment can be achieved by the addition or removal of particular stimuli.

Learning Activity 10.17

Review questions

1 **a** Define the term punishment.
b Explain what punishment involves and why it is used, with reference to an example not given in the text.

2 Distinguish between positive and negative punishment with reference to an example not used in the text.

3 **a** What is response cost?
b Explain why it is a form of negative punishment with reference to an example not used in the text.

4 How does punishment differ from negative reinforcement? Explain with reference to an example.

5 How does punishment differ from extinction? Explain with reference to an example.

6 Describe three key factors involved in effective punishment.

7 **a** Describe a situation in which a punisher might *reinforce* a behaviour rather than weaken it or reduce its frequency.
b Describe a situation where an effective punisher could *reduce* the incidence of behaviour recurring.

8 **a** Describe three ways in which punishment may be used ineffectively.
b Suggest practices other than punishment that could be used by a parent to deal with a child who persistently engages in one of the following behaviours: teasing, swearing, keeping their bedroom messy, being late home.

9 What was Skinner's view on the use of punishment in everyday life?

Learning Activity 10.18

Reinforcement and punishment

Identify the operant conditioning process that is being illustrated in each of the following examples. Choose from positive reinforcement (PR), negative reinforcement (NR), positive punishment (PP) and negative punishment (NP). Write the initials of the correct responses in the spaces provided.

1 When Lina turns the shopping trolley down the lolly aisle, her two-year-old son, Ali, starts screaming, 'Want lollies! Lollies!' Lina moves to another aisle, but Ali continues to scream. As other customers begin staring and Lina starts to feel embarrassed, she finally gives Ali a bag of M&Ms. Ali is now more likely to scream in a supermarket when he wants lollies because he has experienced ______________.

2 If Lina is more likely to give in to Ali's temper tantrums in public situations in the future, it is because she has experienced ______________.

3 Feeling sorry for an apparently homeless person sitting outside a bakery, Chris offers him a $2 coin. The person snarls at Chris and tries to grab his leg in a threatening manner. Chris no longer offers money to homeless people in the street because of ______________.

4 Justin is caught using Facebook on his computer at work and is reprimanded by his boss. Justin no longer accesses Facebook on his work computer because of ______________.

5 As you walk down the corridor between classes, you spot a student whom you greatly dislike. You immediately duck into an empty classroom to avoid an unpleasant interaction with them. Because ______________ has occurred, you are more likely to take evasive action when you encounter people you dislike in the future.

6 Having watched Superman fly in a movie, three-year-old Tran climbs onto the kitchen table, then launches himself into the air, only to fall onto the tiles and hurt himself. Because Tran experienced ______________, he tried this stunt only once.

7 Thinking she was making a good impression in her new job by showing how knowledgeable she was, Sana corrected her supervisor in two different meetings. Not long after the second meeting, Sana was retrenched because the company said it was making her position redundant. Because she experienced ______________, Sana no longer publicly corrects her superiors.

Source: adapted from Hockenbury, D.H. & Hockenbury, S.E. (2006). *Psychology* (4th ed.). New York: Worth, p. 218.

Learning Activity 10.19

Concept summary

Copy the table below and provide appropriate descriptions and examples to illustrate your understanding of the different concepts and processes involved in reinforcement and punishment.

Concept	Description	Example
Positive reinforcement		
Negative reinforcement		
Positive punishment		
Negative punishment		
Response cost		

Learning Activity 10.20

Applying operant conditioning

1. Choose one of the examples presented below and explain how operant conditioning principles could be used for a solution. Your explanation should use operant conditioning terms where appropriate.
   - Increase the number of people who use public transport
   - Increase the number of people who use a car-pooling arrangement to travel to and from work
   - Encourage energy conservation in homes and at work
   - Encourage drivers and passengers to use seatbelts
   - Encourage students to use rubbish bins in the schoolyard during recess and lunchtime
   - Discourage cigarette smoking by teenagers
   - Discourage gambling on poker machines
   - Improve the study habits of a VCE student
2. A teacher cannot conduct her lesson because the students are rowdy and inattentive in the last period, so she lets them out early. What are the students learning? Which operant conditioning principles are at work here?
3. Analyse and describe each of the following scenarios in terms of the S → R → C three-phase model of operant conditioning. You should also indicate whether each scenario is an example of positive or negative reinforcement or punishment.
   - Zeta's dog Belle keeps escaping from the backyard by crawling through a gap under the fence. Zeta purchases a small detector that she places either side of the gap and puts a collar on Belle that makes a high-pitched noise whenever she gets too close to the gap. The first time Belle tries to escape under the gap, the noise plays and distresses her. Soon Belle learns to avoid the noise by staying inside the backyard.
   - During a close soccer match, an opponent tackles Jack roughly. Jack retaliates by starting a fight with the opponent. Jack's coach considers the behaviour unacceptable and suspends him for one match, which also means Jack won't get paid for playing at a time when he needs the money. When Jack next plays and is again tackled roughly, he reacts by telling off the player and complaining to the referee, stopping short of starting another fight.

Key processes in operant conditioning

The same key processes (acquisition, extinction, stimulus generalisation, stimulus discrimination and spontaneous recovery) are involved in both operant conditioning and classical conditioning. However, the way in which these processes occur is slightly different in operant conditioning.

Acquisition

As in classical conditioning, acquisition in operant conditioning refers to the overall learning process during which a specific response, or pattern of responses, is established. However, the means by which behaviour is acquired in operant conditioning differs from that of classical conditioning. Furthermore, the types of behaviours acquired through operant conditioning are usually more complex than the reflexive involuntary responses that became learned responses in classical conditioning.

In operant conditioning, **acquisition** is the establishment of a response through reinforcement. The speed with which the response is established depends on which schedule of reinforcement is used. Some behaviours that become operantly conditioned are too complex to be performed completely at the beginning of the acquisition process. Instead, a simpler version of the behaviour or a step towards the target behaviour is attempted and reinforced continuously until it is established. This involves a procedure called *shaping* and is described in the next section.

Extinction

In operant conditioning, extinction may also occur, and the process is similar to its occurrence in classical conditioning. In operant conditioning, **extinction** is the gradual decrease in the strength or rate of a conditioned (learned) response following consistent non-reinforcement of the response. Extinction is said to have occurred when a conditioned response is no longer present. In classical conditioning, extinction takes place over a period of time when the unconditioned stimulus (UCS) is withdrawn or is no longer present. With operant conditioning, extinction also occurs over time, but after reinforcement is no longer given.

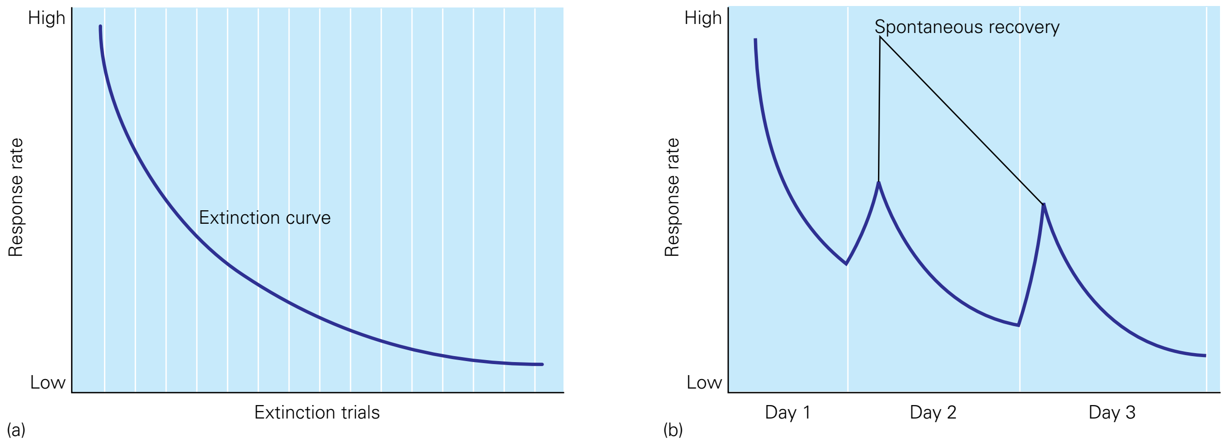


Figure 10.38 (a) The curve for the extinction of an operantly conditioned response following the withdrawal of the positive reinforcer. (b) The spontaneous recovery of a conditioned response following the extinction of that response. Note that the response does not last very long and appears to be weaker than the original response.

For instance, when Skinner stopped reinforcing his rats or pigeons with food pellets, their conditioned response (for example, of lever-pressing or turning circles) was eventually extinguished.

Depending on whether continuous or partial reinforcement is used, the response rate can actually increase in the initial phase of extinction after reinforcement is stopped. Having learned that the conditioned response has satisfying consequences, there is often reluctance to stop the response altogether after just a few non-reinforced responses. Frustration and anger may also accompany the increased response rate. You may have experienced this if you have ever lost money in a vending machine.

Extinction is less likely to occur when partial reinforcement is used; that is, when reinforcement does not regularly follow every correct response. The uncertainty of the reinforcement leads to a greater tendency for the response to continue. This is one reason why gambling is such a difficult behaviour to extinguish. The gambler is highly motivated to win, knows that there's a chance of a big reward, and has an expectation that the reward will occur sooner or later. The gambler is also used to the rewards being highly unpredictable.

Spontaneous recovery

As in classical conditioning, extinction is often not permanent in operant conditioning. After the apparent extinction of a conditioned response, **spontaneous recovery** can occur and the organism will once again show the response in the absence of any reinforcement. The response is likely to be weaker and will probably not last very long. A spontaneously recovered response is often stronger when it occurs after a lengthy period following extinction of the response than when it occurs relatively soon after extinction.

Stimulus generalisation

In operant conditioning, **stimulus generalisation** occurs when the correct response is made to another stimulus that is similar (but not necessarily identical) to the stimulus that was present when the conditioned response was reinforced. This response usually occurs at a reduced level (frequency or strength), as illustrated by the following experiment.

A pigeon was trained to peck at a switch mounted on the wall of a Skinner box (see figure 10.41). The switch was lit by a green light. When the pigeon was presented with lights of varying colours, it generalised the original stimulus (pecking the switch lit by a green light), and pecked at the other coloured switches as well. However, as shown in figure 10.40, as the stimulus (light) shifted further away from the original colour (green), the less frequent was the pigeon's response (Olson & King, 1962).

Outside the laboratory, in our everyday life, we frequently generalise our responses from one stimulus to another. For example, the sound of a car backfiring as it goes past an athletics carnival may well cause the athletes to generalise this sound to that of the starter's pistol and begin running!

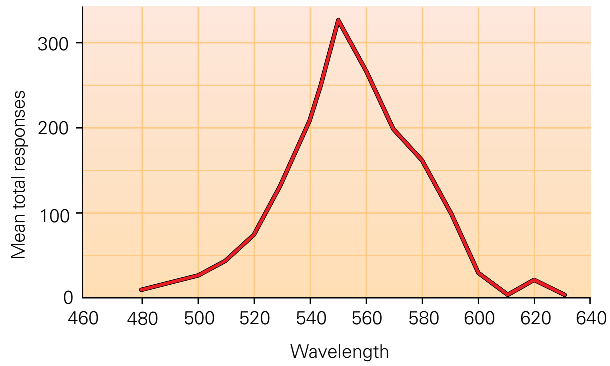


Figure 10.39 Results showing the pigeon's generalisation of the original stimulus of a green light to other colours; wavelengths of light indicate different colours.

Stimulus discrimination

In operant conditioning, **stimulus discrimination** occurs when an organism makes the correct response to a stimulus and is reinforced, but does not respond to any other stimulus, even when stimuli are similar (but not identical).

Skinner taught laboratory animals to discriminate between similar stimuli by reinforcing some responses and not others. For example, a pigeon in a Skinner box could be taught to discriminate between a red and a green light (as people do at traffic lights). If the pigeon was reinforced every time it pecked at a switch while a green light was illuminated, but never reinforced for pecking the switch when a red light shone, it would soon learn to discriminate by responding only when the green light was on.

A useful application of stimulus discrimination can be observed in the use of sniffer dogs by drug detection units and anti-terrorist agencies to find hidden illegal drugs and explosives respectively. These dogs are used at airports and container terminals throughout the world to detect the smuggling or planting of such goods. Sniffer dogs are also used by the Australian Quarantine and Inspection Service to detect prohibited fruit and vegetables, meat, foliage, live birds and eggs concealed in travellers' baggage. The discriminative ability of sniffer dogs indicates highly specialised operant conditioning with animals that already have a highly developed olfaction (smell) sense.

People are also very adept at stimulus discrimination. We choose our stimuli according to those we think will lead to a reinforcing response. This is seen, for example, in the type of clothes we wear and the way we behave in particular company.

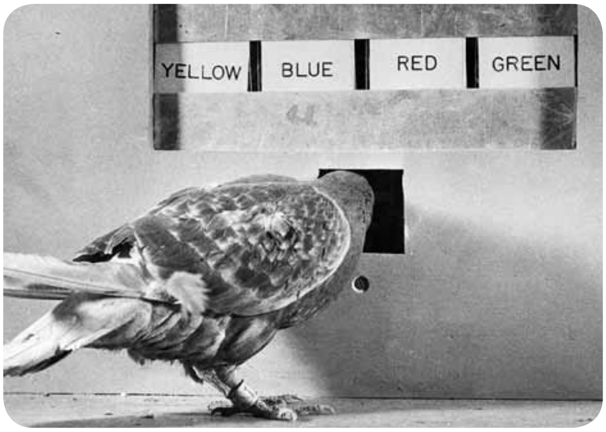


Figure 10.40 By reinforcing a desired response every time it occurred, this pigeon was taught to peck the correct sign when the corresponding colour was lit.

Figure 10.41 Stimulus discrimination is demonstrated by sniffer dogs trained to detect the presence of illegal drugs or banned produce.

Learning Activity 10.21

Review questions

1 Define each of the following terms in relation to operant conditioning and give an example of their occurrence in (a) a laboratory experiment, and (b) everyday life:
- acquisition
- extinction
- spontaneous recovery
- stimulus generalisation
- stimulus discrimination.

2 Which of the following scenarios involve stimulus generalisation? Which involve stimulus discrimination?
   a Lauren asks Gino out on a date but he declines. Lauren decides that she won't ask another boy out again.
   b Toula is paid for doing chores around the home and expects to be paid for doing chores at her auntie's place when she stays there.
   c Jackson is scared of the sound of a lawnmower but not the sound of an electric toothbrush.
   d Sam is scared of the sound of his dad's electric drill. When his dad stops using the drill he relaxes. Sam's dad then reaches for the electric saw. As soon as Sam sees this, he is scared and runs inside.

3 Mr Ying is a young, handsome Psychology teacher who has just been appointed to a girls' college. Unfortunately, his Psychology class is so distracted by his appearance that they find it difficult to focus on their work and on his instructions. There is a lot of giggling, whispering and a general lack of attention. Mr Ying is determined to make a good impression with his classroom control and with his teaching methods. He decides to use detention as a means of pulling the girls' behaviour into line. He runs a lunchtime detention session for six girls whose behaviour has been the worst. In the next class, not only do these six girls misbehave, but they are joined at the next detention by four others. This trend continues until it's not long before almost the entire class is on detention.
   a Which operant conditioning process is Mr Ying trying to use to change the girls' behaviour?
   b Provide a description of its effectiveness and an explanation as to why this is so.
   c How could Mr Ying change his strategy with the girls and still use operant conditioning?

4 Maria had enjoyed attending the same P-12 college for ten years. Quite suddenly this year, her friendship group had drifted away from her and she is now being bullied by some other girls because she has become a 'loner'. After an unsuccessful attempt to solve her problems by speaking with her year-level coordinator, Maria started to take days off school, telling her mother she wasn't feeling well. Her absenteeism increased. Although she was concerned about missing school, she couldn't face the unpleasant actions of the bullies.
   a Which operant conditioning process explains the increase in Maria's behaviour of deceiving her mother and staying home from school? Explain how this process worked in Maria's situation.
   b Which operant conditioning process describes the consequence of the bullying behaviour for Maria? Explain its effect on Maria's attendance behaviour.

Applications of operant conditioning

The principles of operant conditioning were originally developed with animals in laboratory experiments but they have since been applied to people in numerous everyday settings, both formally and informally. Some applications have been described briefly throughout this chapter in illustrating various operant conditioning principles and processes. Others are considered in more detail in the chapters on mental illness. In this section, we consider two applications in detail: the use of shaping and token economies to change behaviour.

Shaping

In one experiment, Skinner decided to train a pigeon to turn a full circle in an anticlockwise direction. This behaviour, like most other behaviour in everyday life, does not occur spontaneously.

Figure 10.42 Shaping was used to train this rat to sniff out landmines; something it would never do without such training.

In order to provide reinforcement and condition the desired behaviour, Skinner would have had to wait around for a long time for that behaviour to occur spontaneously. When Skinner placed the pigeon in a Skinner box its behaviour was, not surprisingly, entirely random. In order to get the pigeon to perform what Skinner called the *target behaviour*, he used an operant conditioning procedure called shaping to gradually 'mould' or 'edge' responses to the target behaviour. **Shaping** is a procedure in which a reinforcer is given for any response that successively approximates and ultimately leads to the final desired response, or target behaviour. Consequently, shaping is also known as the *method of successive approximations*. In using a shaping procedure, Skinner initially continuously reinforced the pigeon. He reinforced it with a food pellet, which was delivered through a mechanically operated door every time it turned slightly to the left. All other responses were ignored. Once the pigeon's response of making a slight turn to the left had been conditioned, reinforcement was no longer provided for this response. Instead, Skinner waited until the pigeon turned a little further left before giving any further reinforcement. By limiting reinforcement to only those responses that gradually edged towards the target behaviour, and ignoring all other responses, Skinner was able to train the pigeon to turn complete circles regularly. The pigeon learned to perform the desired response because it was reinforced for each successive step leading to the target behaviour, but not for any of the former responses. This reinforcement strategy increased the likelihood of progressive steps ('approximations') being taken towards the final response of turning a full circle in an anticlockwise direction.

Shaping is used when the desired response has a low probability of occurring naturally. It is essentially a method for indicating to a person or animal those responses which lead to a desired behaviour. Shaping is an effective procedure in and out of the laboratory, with people as well as animals. Through programmed use of successive reinforcements, animals and people can learn to perform many complex behaviours, as long as the organism is capable of performing the behaviour. For example, it would not be possible to train a koala, or a newborn infant, to swim using the butterfly stroke or to safely paraglide. Many tricks performed by animals in television and movie productions, and in animal shows such as at Sea World, have been learned through shaping. The shaping to train animals has not been restricted to entertainment purposes. It has also been used to benefit society. For example, shaping is used to teach dogs tracking skills for use in search-and-rescue operations and detection skills to 'sniff out' bombs, drugs and restricted items at airports, and to do guide work and be companions for individuals with serious visual impairments.

In everyday life, shaping has numerous applications. Although it is a formal training procedure, learning strategies involving shaping can be observed in many situations. For example, consider the case of a child who is just learning to write. Initially, a teacher may praise the production of poorly formed letters, but as time passes only more accurately formed letters are reinforced. Similarly, shaping is often used when teaching young children to swim. Initially, the approximation that is reinforced may be an act such as sitting on the edge of the pool or touching the water. Later, reinforcement might be given to a child for placing their face under the water and holding their breath. Eventually, enough gradual steps have been reinforced and the target behaviour has been achieved (for example, dog-paddling across the pool). This behaviour will then be reinforced until a new goal is established.

Many parents use shaping with their children without being aware that this is what they are doing. For example, consider walking—a behaviour that depends on maturation and not on learning, but one whose onset parents try to promote, or 'speed up'. Once an infant can stand with support, a parent no longer gets excited or makes a fuss when the infant simply remains upright. Standing without support becomes the act that gets attention. When the infant progresses, such as attempting to take steps while holding on to furniture, this act is greeted with enthusiasm, but later, taking steps while supported receives much less attention. After each small accomplishment (approximation) towards the final response of walking without support, the parent revises their expectation upwards. The infant must attain more before the parent becomes excited and praises them.

Box 10.7

Operant conditioning lends a helping hand

Aila is a 10-year-old capuchin monkey. She has been operantly conditioned by Alison Payne (pictured below) at the Helping Hands organisation in Boston, USA, to help quadriplegics like Travis Roy (also pictured below). Conditioning the monkeys takes between 18 months and 2 years. By using shaping, complex target behaviours such as retrieving articles from the fridge, turning lights on or off, playing and ejecting audio cassettes, videotapes, CDs and DVDs, and turning the pages of a book can all be learned. Simple tasks such as putting a ball in a cup are conditioned first. Monkeys are trained to follow a laser pointer so that the quadriplegic can point the laser beam at articles they want brought to them.

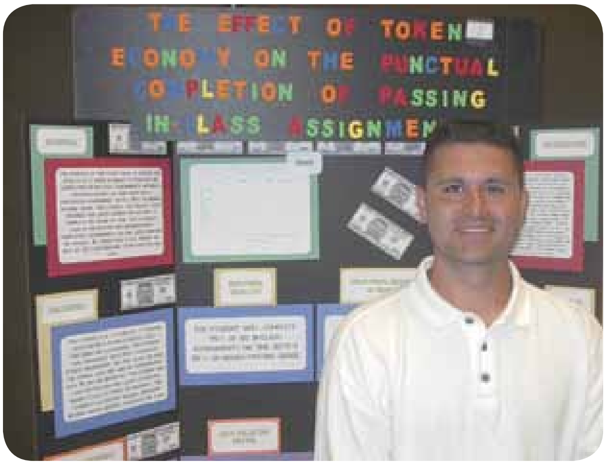


Figure 10.43 Token economies are used by teachers in special education classes to encourage students to complete and pass assignments.

Token economies

Token economies are a form of behaviour modification using reinforcement tokens to influence behaviour change. A token economy functions like a miniature economy that is similar in some ways to an actual larger economy in the real world. A **token economy** is a setting in which an individual receives tokens (reinforcers) for desired behaviour and these tokens can then be collected and exchanged for other reinforcers in the form of actual, or 'real', rewards. For example, in a prison, a token (or 'points') may be received for being quiet after lights-out and this may be 'cashed in' for rewards such as cigarettes and privileges. In a psychiatric unit, certain psychotic symptoms of a person with schizophrenia may be reduced by ignoring their descriptions of delusions (false beliefs) and positively reinforcing appropriate 'social talk' by providing tokens when this occurs. Tokens may also be withdrawn and, in many cases, penalties are used and individuals are 'fined' a certain number of tokens for inappropriate behaviour. The advantage of using tokens in a large-group situation is that real, tangible rewards can be difficult to administer immediately when a desired behaviour occurs. Furthermore, using a range of rewards for which tokens can be exchanged helps to ensure that the reinforcement is appropriate and satisfying for all the different individuals participating in the token economy. Once a desired behaviour is established, tokens can be phased out and replaced by more 'natural' and easily administered reinforcers, such as praise or a smile.

Token economies have been successfully established in a variety of settings such as schools, play therapy groups, psychiatric units, prisons and family homes. They have been used to increase reading by students, decrease television watching by children, improve social skills of people with an intellectual disability, and so on.

In one experiment, psychologists used a token economy to motivate boys who had been labelled as 'uneducable' and placed in a special school. The boys received points for good grades on tests and could exchange these for rewards such as snacks and items in a mail-order catalogue. Within a few months, most of the students showed a significant improvement in test results. The boys continued to make gains in subsequent months, demonstrating that they were in fact educable (Cohen & Filipczac, 1971).

In another experiment, psychologists worked with play therapy groups consisting of shy and withdrawn eight-year-olds. They found that giving brass tokens to children for social behaviour, such as approaching another child, effectively altered the children's behaviour. As the experiment progressed, the children approached the therapist less often and made more approaches to other children in the group (Goodlet, 1972).

Although token economies have been successfully established in different settings, American psychologists Carole Wade and Carol Tavris (1990) provide evidence that they sometimes fail or backfire. They suggest that operant conditioning procedures that appear simple are often difficult to apply in practice because 'People may feel manipulated and refuse to cooperate. Situations are often so complex and uncontrolled that well-planned programs can go wrong'. In one study, a token economy system that had worked well with adolescent offenders in a detention centre fell apart when it was tried in a different institution. The people in charge neglected to smile as they handed out the tokens, and apparently the adolescent males took their expressions as an insult. Wade and Tavris add that operant conditioning procedures may also fail when the underlying cause of a behaviour is not altered. For example, rewarding cheerfulness may not do much good if someone's gloominess is caused by a boring job. The real solution may be for the person to change jobs.

Learning Activity 10.22

1 a Define the term shaping.
  b Under what circumstances would shaping be used to promote learning?
  c What is a disadvantage of shaping?
  d Give an example of when you have used shaping to modify either a person's or an animal's behaviour and describe the shaping procedure used.

2 a What is a token economy? Explain with reference to key operant conditioning principles and processes.
  b Under what circumstances might the use of a token economy be ineffective?

3 Throughout his career, Skinner proposed numerous applications of operant conditioning. For example, during World War II, he developed the idea of 'Project Pigeon'. This was a secret project in which he conditioned pigeons to guide missiles towards an enemy target. The birds were placed in the nose of a missile, harnessed in front of a screen on which the moving image of a target flashed. When the missile was in flight, the pigeons would peck the moving image, which produced corrective signals that would keep the missile on course. The US Department of Defense determined that pigeons could play an effective role, but they were never used in actual warfare because the development of electronic missile guidance systems made it unnecessary.

  Suggest how shaping may have been used to train the pigeon to be comfortable within the confines of a missile nose and to peck at the correct target on a screen to keep the missile on the required flight path.

4 Consider the different applications of operant conditioning procedures included throughout the chapter. Form small groups and discuss one or two laboratory or everyday situations that involve operant conditioning procedures and that involve (or may involve) issues of ethical concern. Your group should then briefly report the identified issues to the rest of the class.

Learning Activity 10.23

Data analysis

The following two scenarios describe educational settings in which operant conditioning principles have or could have been applied to change behaviour. Choose one of the scenarios and answer the questions about it.

Scenario 1: changing a teacher's behaviour

An inexperienced teacher was having difficulties controlling the behaviour of students in his Year 10 English class. This was stressing him considerably so he consulted a psychologist, who agreed to help him. In order to precisely identify the nature of the difficulties experienced by the teacher, the psychologist unobtrusively observed him in the classroom for twelve 50-minute lessons over a period of three weeks. He prepared a report from which extracts are presented below. Read the report and answer the questions that follow.

Teacher: male, 24 years old, fully qualified with a Bachelor of Arts and a Diploma of Education, one month's experience as a replacement teacher and four months' full-time teaching experience

Students: 14 boys and 16 girls with a mean age of 16.2 years; many have reading difficulties or other language problems; two students are repeating Year 10; all live locally

Class behaviour: measurements of students' behaviour during class time included:
Inappropriate talking: 29% of class time
Inappropriate turning around: 17% of class time
Walking around the classroom without permission: 12% of class time
Calling out to the teacher: 9% of class time

Teacher's behaviour: responded to inappropriate talking about 25% of the time, usually with 'shhh' and 'be quiet'—most of these responses were directed at the whole class and rarely to offending individual students. Responded to 6% of the turning around behaviour, always with the comment 'turn around'. Other inappropriate student behaviour was generally ignored and he continued trying to teach 'over the top' of this. On eight occasions he made general threats; for example, detention for the class, not allowing the class to go on a planned excursion. These were never carried out. During the observation period in which the baseline data was recorded, he was never observed to take notice of appropriate behaviour; for example, give praise for not talking.

1 What is the purpose of baseline data?

2 Explain the difficulties experienced by the teacher with reference to three operant conditioning principles.

3 Make two suggestions involving operant conditioning principles to help the teacher overcome the difficulties with his class.

Scenario 2: changing a student's behaviour

A group of preschool teachers worked with a team of psychologists in applying operant conditioning principles to help a young girl overcome her shyness when playing with her peers (Allen & others, 1964). The girl spent most of her time at the preschool standing close to her teachers rather than playing with children her own age, and the teachers were concerned that this was interfering with her social development. Like most young children, the girl enjoyed teacher praise, so it was decided that the teachers would only praise her when she played with her peers, and ignore her when she stayed close to them. The results of using praise in this way are shown in figure 10.44.

In order to measure learning of the desired response, the teachers initially recorded the frequency with which the little girl played with other children and the frequency with which she interacted with adults. They then began using praise whenever she played with her peers, but gave her very little attention for other interactions. To be certain that the praise alone was responsible for the behavioural change, the teachers stopped using it for a time and then reintroduced it. This is shown in the third and fourth sections of figure 10.44. These graphs indicate that the little girl began interacting with adults again once the praise ceased (third section), and recommenced interacting with her peers once the praise was used again (fourth section).

1 What is the independent variable?

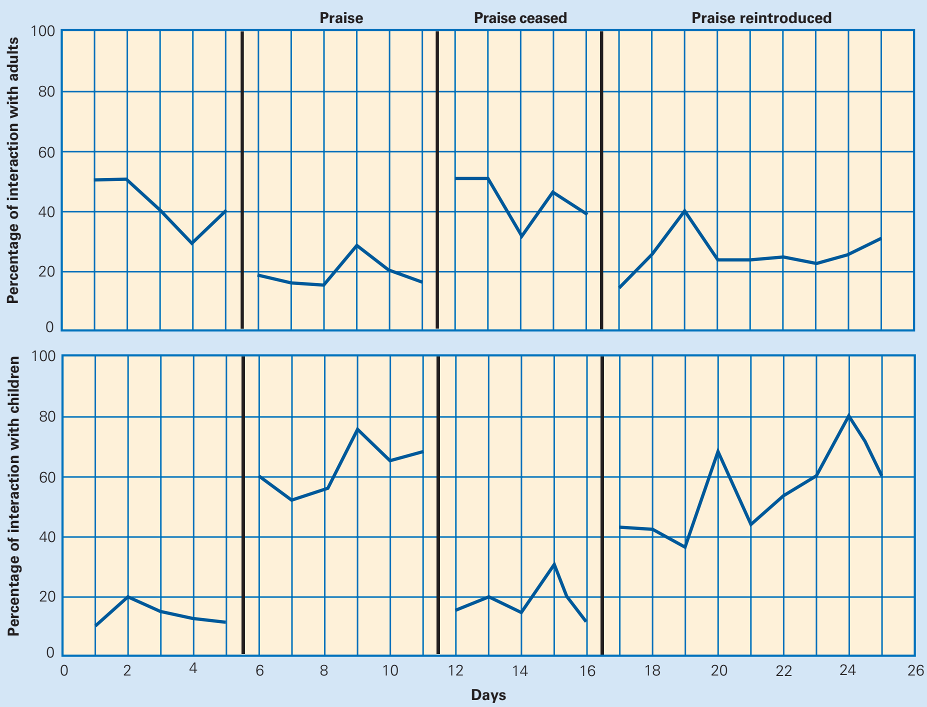
2 On which trial numbers was the 'control' condition conducted? What was the purpose of this?

3 Identify the key elements of operant conditioning evident in this scenario.

4 On which trial was the young girl's interaction with other children at its lowest? At its highest? What do these data tell you about the success or failure of the program devised by the team of psychologists and undertaken by the teachers?

5 Why did the teachers stop using praise with the young girl for a period of time and then recommence its use?

Figure 10.44 Effect of praise on social interaction



Comparison of classical and operant conditioning

While classical and operant conditioning are two different types of learning, there are some common features. In both classical and operant conditioning there is an *acquisition* process whereby a response is conditioned or learned. In classical conditioning, the association of two stimuli, the CS and UCS, provides the basis of learning. In operant conditioning, the association is with an operant response to a stimulus and the consequence that follows the response, as described by Skinner's three-phase model of S → R → C. In both types of conditioning, *extinction* of the learned response can occur. In classical conditioning, extinction takes place over a period of time when the UCS is withdrawn or is no longer present and the CS is repeatedly presented alone. For instance, when this happened in Pavlov's experiments, the dog eventually ceased salivation (CR) in response to the bell (CS) alone (which had been previously paired with the UCS). In operant conditioning, extinction also occurs over time, but after reinforcement is no longer given. For instance, when Skinner stopped reinforcing his rats with food, their lever-pressing was eventually extinguished. In both classical and operant conditioning, extinction can be interrupted by *spontaneous recovery*. Although not unique to conditioning, in both classical and operant conditioning *stimulus generalisation* and *stimulus discrimination* can occur. In addition, both types of conditioning are achieved as a result of the repeated *association* of two events that follow each other closely in time.

These similarities in the two types of conditioning have led some psychologists to propose that both classical and operant conditioning are variants of a single learning process. Furthermore, classical and operant conditioning often occur in the same situation. For instance, when 'Little Albert' learned to fear the rat, his response (trembling) was classically conditioned. But when he learned to avoid the rat by crawling away (a response that had the effect of reducing his fear), that was an example of operant conditioning.

Figure 10.45 Is this an example of classical or operant conditioning?

However, some major differences between classical and operant conditioning need to be emphasised. In operant conditioning the *consequence* of a response is a vital component of the process in that a behaviour becomes more or less likely, more or less frequent, or strengthened, depending on its consequence. In classical conditioning, the behaviour of the organism does not have any environmental consequences. For example, in Pavlov's experiments, the dog receives food whether or not it salivated. But in operant conditioning, the organism's response (such as lever-pressing) operates or produces effects on the environment (such as the dispensing of a food pellet). These effects or consequences, in turn, influence the recurrence of the response.

Classical and operant conditioning also generally involve different types of responses. In classical conditioning, the response is *involuntary*; an automatic reaction to something happening in the environment (such as the sight of food or the sound of a bell). Operant conditioning, however, involves *voluntary* responses that are initiated by the organism (such as throwing a tantrum or doing homework), as well as involuntary responses.

The role of the learner

In classical conditioning, the learner is a *passive* participant in the conditioning process. The learner does not have to do anything for the CS or UCS to be presented. Furthermore, the response made by the learner occurs automatically without the learner having to make any effort or actively do anything. The learner essentially has no control over the learning process. In operant conditioning, the learner is an active participant in the learning process. The learner must operate on the environment before reinforcement or punishment is received. The learner is neither reinforced nor punished without performing the behaviour that produces the consequence. In this sense, the learner has control over the learning process.

Timing of the stimulus and response

In classical conditioning, the response (for example, salivation) depends on the presentation of the UCS (meat powder) occurring first. In operant conditioning, the presentation of the reinforcer or punisher depends on the response occurring first. The response (for example, pushing the lever) occurs in the presence of a stimulus (for example, the lever). The reinforcement (for example, the food pellet) or punisher received as a consequence of the response strengthens or weakens the stimulus–response association.

In classical conditioning, the timing of the two stimuli (CS, then UCS) produces an association between them that conditions the learner to anticipate the UCS and respond to it even if it is not presented. In operant conditioning, the association that is conditioned is between the stimulus (that is, the lever in a Skinner box) and the response (to push the lever). The response is either strengthened by reinforcement or weakened through punishment.

In classical conditioning the timing of the two stimuli (CS, then UCS) needs to be very close (ideally about half a second) and the sequencing is vital—the CS must come before the UCS. In operant conditioning, while learning generally occurs faster when the reinforcement or punishment occurs soon after the response (behaviour), there can be a considerable time difference between them (especially in humans).

The nature of the response

In classical conditioning, the response by the learner is usually a reflexive involuntary one (for example, salivating or blinking). In operant conditioning, the response by the learner is usually a voluntary one (for example, pressing a lever, using an umbrella) but may also be involuntary.

In classical conditioning, the response is often one involving the action of the autonomic nervous system, and the association of the two stimuli is often not conscious or deliberate. In operant conditioning, the response may involve the autonomic nervous system but usually involves the central nervous system (for example, the brain) and is conscious, intentional and often goal-directed.

Learning Activity 10.24

Comparing classical and operant conditioning

Copy the table below and complete each row to summarise similarities and differences between classical and operant conditioning.

Feature	Classical conditioning	Operant conditioning
Process of acquisition		
Extinction		
Stimulus generalisation		
Stimulus discrimination		
Spontaneous recovery		
Role of learner		
Timing of stimulus and response		
Nature of response (reflexive/voluntary)		

Learning Activity 10.25

Classical versus operant conditioning

Consider each of the following scenarios and state whether the behaviour that is described is *best* explained by classical conditioning, operant conditioning or a combination of both these types of learning. Give a reason for each answer.

1. Sally cries whenever she hears a barking dog. Prior to this beginning, Sally had seen a stray dog, reached out to pat it, and the dog barked and bit her hand.
2. Hamish's ex-girlfriend always wore a musk perfume. Hamish still cringes whenever he comes across someone wearing musk perfume.
3. A father refuses to let his daughter borrow his car after she has 'borrowed' it previously and returned it with a near empty petrol tank.
4. Momin feels sick at the smell of oysters. The last couple of times he ate an oyster, Momin vomited.
5. Emilia arrives home on time after having been grounded for being home late the last time she went out with her friends.

Learning Activity 10.26

Matching exercise

Match the classical and operant conditioning terms in the left-hand column with the descriptions in the right-hand column. The answers are on page 823.

1 operant conditioning	**a** presentation of a stimulus that decreases the likelihood of a response recurring
2 shaping	**b** a system of providing reinforcers that can be exchanged for other reinforcers
3 negative punishment	**c** the reappearance, following extinction, of a conditioned response
4 negative reinforcement	**d** the correct response is made to another stimulus that is similar to the stimulus that was present when the conditioned response was reinforced
5 positive reinforcement	**e** when successive responses that come closer and closer to the desired response are rewarded
6 fixed-interval reinforcement	**f** when a reinforcer is given after an unpredictable number of correct responses
7 operant	**g** the gradual decrease in the strength or rate of a conditioned response following absence of the UCS or consistent non-reinforcement of the response
8 token economy	**h** when the likelihood of a particular behaviour occurring is determined by the consequences of that behaviour
9 variable-ratio reinforcement	**i** when a reinforcer is given after a specific time-period has lapsed since the previous reinforcer
10 stimulus discrimination	**j** removal of a stimulus and thereby decreasing the likelihood of a response recurring
11 stimulus generalisation	**k** introducing a stimulus that increases the likelihood of a response occurring again
12 spontaneous recovery	**l** a response that may occur in the absence of a specific stimulus but has an effect on the environment in some way
13 extinction	**m** removal of a negative stimulus following a response in order to increase the likelihood of the response occurring again
14 positive punishment	**n** detecting the difference between two stimuli that are similar

One-trial learning and taste aversion

Many of us have a dislike for certain foods. Sometimes there is a good reason for disliking the food, such as genuinely not liking the taste or smell of it. Sometimes the dislike is associated with the texture of the food (for example, oysters or calamari) or the origin of the food (for example, tripe or haggis). At other times there is simply an unwillingness to eat something perceived as disgusting (for example, snails, witchetty grubs or frogs' legs), or possibly it is rejected on moral grounds (for example, kangaroo, whale, bear paws or monkey brains).

All these reasons for the dislike of certain foods are personal and subjective. In a different circumstance, however, our dislike of a particular food occurs suddenly and decisively, yet with very little consideration or judgment. The term used for such a response is 'taste aversion'.

A **taste aversion** is a conditioned response that results from a person or animal establishing an association between a particular food and being or feeling ill after having consumed it at some time in the past. The association is usually the result of a single experience, and the particular food will be avoided in the future.

Taste aversion arises from a learning experience that is similar to classical conditioning; that is, there is an *association* between a CS (the smell or taste of the food) and UCS (the nausea-producing substance). However, it tends to happen with just one experience or 'trial'—hence the term 'one-trial learning'. **One-trial learning** is a type of learning involving a relatively permanent change in behaviour that occurs as a result of one experience only.

One-trial learning is like classical conditioning but is not classical conditioning nor a type of classical conditioning. A classically conditioned response usually takes a number of associations or pairings to become established, and the response can extinguish relatively quickly. In contrast, a conditioned response (taste aversion) occurring through one-trial learning is acquired extremely quickly and is considerably resistant to extinction. This occurs because the UCS (feeling or being ill) due to the CS (the nausea-producing substance) is very powerful. Importantly, in classical conditioning, the CS and UCS occur closer together. In one-trial learning, however, the CR (the feeling of illness that becomes mentally associated with the food) could occur as much as a day or so after the food (CS) was consumed.

Although classical conditioning and one-trial learning both involve automatic involuntary responses that are acquired in a passive manner, there are other aspects of one-trial learning that do not seem to involve classical conditioning processes. For example, in addition to the number of trials involved in the two types of learning and the potential long time lapse between the CS and UCS in one-trial learning, the ability to generalise the CS to other, similar stimuli following classical conditioning does not usually hold for one-trial learning. It is clear that in classical conditioning, a wide range of stimuli can be used to associate with the UCS. As long as the person or animal is capable of responding to the CS, then it is legitimate to use it. However, in the case of taste aversion acquired through one-trial learning, other stimuli do not substitute for food as the CS.

The conditioning of a taste aversion is sometimes known as the *Garcia effect*, named after John Garcia, an American psychologist who conducted pioneering research into the phenomenon. Garcia has proposed that the type of learning that occurs in the conditioning of a taste aversion is quite different from that of classical conditioning. Furthermore, his research findings suggest that animals tend to associate aversive stimuli in certain ways that foster their survival, but do not associate aversive stimuli if these do not threaten their survival. Learned taste aversions based on just one experience can be very adaptive. That is, animals that quickly learn what not to eat or drink will probably live longer and produce more offspring (Kosslyn & Rosenberg, 2003).

Figure 10.46 The coyote has been exposed to taste aversion conditioning. It is showing species-specific disgust responses to the carcass of a sheep—responses that can be learned in one trial.

The best-known study of conditioned taste aversion was conducted by Garcia and his colleague Robert Koelling (1966) using 20 thirsty 90-day-old male rats. The rats were allocated to one of two experimental groups. Both groups were offered saccharine-flavoured water to drink from a tube. Whenever the rats in either group licked the tube, a bright light flashed and an unfamiliar clicking noise sounded. Later, rats in one group received a painful shock to their feet, while those in the other group received a dose of illness-inducing radiation via X-rays. When they were offered saccharine-flavoured water on a subsequent occasion, all rats refused it after just smelling the water tube. It seemed that rats in both groups had been conditioned to acquire a taste aversion for saccharine-flavoured water. The CS for each group was a combination of the saccharine flavour, the bright light and the clicking noise. But had the rats learned to avoid all parts of the CS, or just some of them?

Garcia and Koelling next tested the same rats under a different condition. The rats were given either saccharine-flavoured water that was *not* paired with either light or noise, or unflavoured water that *was* paired with the same light and noise that had been present during the previous condition. Rats that had originally been given the painful shock refused water when it was given with the light and the noise, but they had no objection to the saccharine flavour. Rats that had become ill because of the effects of the radiation avoided the saccharine flavour, but were quite content to drink water accompanied by the same light and noise. In general, the results indicated that the UCS influenced what the rats had learned. More specifically, the results suggest that rats may tend to associate stimuli in particular ways that foster survival. For one group of rats, illness was associated with the saccharine taste. For the other group of rats, pain was associated with lights and noise.

Figure 10.47 John Garcia

Box 10.8

Cancer patients and taste aversion

Cancer patients often develop aversions to normal foods in their diets to such an extent that they become anorexic or malnourished. Their aversions are, in part, a serious consequence of their chemotherapy treatments, which produce nausea and which often follow meals.

Psychologists are working to prevent the development of aversions to nutritious foods—necessary in the diets of children with cancer—by arranging for meals not to be given just before the chemotherapy and by presenting the children with a 'scapegoat' aversion. They are given lollies or ice-cream of unusual flavours to eat before the treatments so that the taste aversion becomes conditioned only to those special flavours.

Research conducted with children undergoing chemotherapy investigated whether they would associate a novel taste with the nausea induced by chemotherapy (Bernstein, 1978). Children were allocated to one of three groups. The first group ate ice-cream with a maple–walnut flavour (referred to as 'mapletoff') before each chemotherapy session. The second group ate the same ice-cream on the days when they did not receive chemotherapy. The third group never had the ice-cream offered to them. From two to four weeks after the start of the experiment, the children were given the choice of playing a game or having the 'mapletoff' ice-cream. Later (on average, ten weeks after the first chemotherapy session), the children were asked to choose between 'mapletoff' and another novel-tasting ice-cream. The results are summarised in table 10.4.

These results indicate that taste aversion is stronger in response to novel-tasting foods than to familiar-tasting foods. Consequently, it may be appropriate to give cancer patients novel-tasting food before they receive their chemotherapy. They might then experience the taste aversion only to the novel-tasting food instead of to familiar foods. By establishing the taste aversion to a novel-tasting food, patients might maintain their appetite for the nutritious foods normally found in their diet (that is, familiar foods). In fact, Bernstein reported that she achieved this outcome with children undergoing chemotherapy by using lollies that had unusual flavours such as coconut (Broberg & Bernstein, 1987). She refers to the novel-flavoured tastes as 'scapegoat' flavours, since they become the aversive stimuli, rather than food in the patient's regular diet (Sdorow & Rickabaugh, 2002).

Table 10.4 Results of Bernstein's investigation on the association of a novel taste with the nausea induced by chemotherapy

Option 1	Chose to play a game (%)	Chose to eat 'mapletoff' ice-cream (%)
Group 1	79	21
Group 2	27	73
Group 3	33	67
Option 2	**Chose another novel ice-cream flavour (%)**	**Chose 'mapletoff' ice-cream (%)**
Group 1	75	25
Group 2	50	50
Group 3	34	66

Learning Activity 10.27

Review questions

1 Define the term one-trial learning.
2 Define the term taste aversion.
3 Explain how a conditioned taste aversion can be acquired through one-trial learning, as compared with classical conditioning.
4 In what way(s) is one-trial learning similar to classical conditioning?
5 Describe the features of one-trial learning that make this type of learning distinctly different from classical conditioning.
6 a Construct an operational hypothesis that could have been tested in Garcia and Koelling's (1966) experiment.
b Outline the experimental procedure.
c Identify the type of experimental design.
d Does the experiment have external validity? Explain your answer.

Learning Activity 10.28

Classical conditioning versus one-trial learning

Draw up a table like the one below. List the key similarities and differences between classical conditioning and one-trial learning.

Type of learning	Similarities	Differences
Classical conditioning		
One-trial learning		

Observational learning

We also learn by watching and listening as someone else does something. Through observation, we can acquire new responses without having to personally experience them. Responses acquired by observing those of others include physical routines such as a particular dance style, socially appropriate behaviours such as shaking hands when being introduced to someone, and emotional responses such as a fear of spiders. Furthermore, many of the behaviours expected of us in the roles we undertake throughout life as females or males, students, friends, employees, partners, parents and so on are established by observing others performing those roles. Watching the actions of others can help us to learn skills such as how to make a milkshake, ride a skateboard or drive a car. Similarly, in many work situations the most effective learning takes place through observing more experienced personnel. For example, medical students learn surgery by watching competent surgeons perform various procedures with patients; trainee teachers observe qualified teachers in the classroom; and apprenticeship programs for trades such as carpentry, pastry cooking and motor mechanics involve learning by watching qualified tradespeople. Many of our habits, values and beliefs are also the products of observing others.

This type of learning is called observational learning. **Observational learning** occurs when someone uses observation of another person's actions and their consequences to guide their future actions. The person being observed is referred to as a *model*. Consequently, observational learning is often called *modelling* (or *social learning*). Observational learning does not necessarily occur by simply observing someone, then imitating or copying them. Some people are perceived as more significant or important than others, and therefore their behaviour is more likely to be imitated.

Figure 10.48 Observational learning has played an important role in training medical students for well over a century.

Learning by observing someone is an extremely useful process for complex behaviours because it can be a lot more efficient than learning by trial and error, or waiting until reinforcement or punishment is given. The way we use language and the language that we use are examples of the efficiency of observational learning. This does not apply to learning to speak, but rather to the way we tend to pick up specific phrases, often from people we admire or respect. For example, over the years, adolescents have tended to have a repertoire of phrases, sayings and words that are specific to their own subculture. Such terms as 'awesome', 'cool' and 'sick'—and their own unique, non-literal meanings—are associated with entertainers on television, whether they be cartoon characters, rap artists or movie stars. Their status and image provide the motivation for the adolescent to observe and retain the behaviour and to reproduce it (that is, to say or write the words) whenever the opportunity arises.

In other instances, the model is not as important in motivating the learner, and the motivation simply arises from a need to know. For example, watching someone burn a DVD and then burning one successfully yourself will provide its own reinforcement of satisfaction and added convenience.

Learning Activity 10.29

Reflecting on observational learning

Describe five different behaviours you probably learned by observational learning. Try to think of a variety of behaviours, ranging from relatively simple to more complex. For each of the five behaviours, who was the person you observed, what was observed, and how similar were your responses to theirs?

Observational learning has been extensively researched and described by Canadian-born psychologist Albert Bandura. Bandura has proposed that from the time we are born we are surrounded by other people displaying a huge variety of behaviours, all of which we are able to observe. This provides us with a rich source of information about our environment. Through observation we learn many behaviours, not by actually carrying out the behaviour and experiencing the consequences, but simply by watching the behaviour and its consequences being experienced by someone else.

Figure 10.49 Canadian-born psychologist Albert Bandura has extensively researched and described observational learning and explained how it occurs.

Figure 10.50 A young boy observes his father shaving. Note that the child has even reproduced the father's stance.

Bandura believes that modelling is not a totally separate form of learning from conditioning. His experiments have demonstrated that both classical and operant conditioning can occur *vicariously*, or indirectly, through observational learning. This means that observational learning involves being conditioned indirectly by observing someone else's conditioning. During **vicarious conditioning**, the individual watches another person displaying behaviour that is either reinforced or punished, and then subsequently behaves in exactly the same way or in a modified way, or refrains from the behaviour as a result of what they have observed. Bandura uses the terms vicarious reinforcement and vicarious punishment to describe the different processes of vicarious conditioning.

Vicarious reinforcement increases the likelihood of the observer behaving in a similar way to a model whose behaviour is reinforced. Thus, the observer is conditioned through observing someone else being reinforced without personally experiencing the reinforcement or consequence directly. For example, a student who sees another student being allowed to leave a class early after correctly finishing all their work may be more inclined in another class to model the behaviour and respond in a similar way if they consider leaving class early a desirable outcome (a reinforcer). Similarly, **vicarious punishment** occurs when the likelihood of an observer performing a particular behaviour decreases after having seen a model's behaviour being punished. For example, a student may observe someone else in class receiving detention for calling out without permission. The observer is likely to refrain from that behaviour in the future if they view detention as an undesirable outcome (a punisher).

Psychologists have conducted many experiments on observational learning over a number of years. One of the best-known investigations was a series of experiments that Bandura conducted with young children.

Learning Activity 10.30

Review questions

1. Define observational learning, with reference to an example.
2. Why is observational learning also referred to as modelling?
3. According to Bandura, why do we tend to model some people and not others?
4. Explain the role of conditioning processes in observational learning.
5. Give two examples of learned behaviours that are *not* acquired through observational learning. Explain your choice of examples.

Bandura's experiments with children

In the 1960s, Albert Bandura conducted a series of experiments with colleagues Dorothea Ross and Sheila Ross to investigate different aspects of observational learning by young children. In a typical experiment, children were required to passively sit and watch a model engaging in aggressive behaviour, and then given an opportunity to imitate the model. Different types of models, such as cartoon characters and real-life male and female adults were used, and responses by male and female children were measured to study sex differences in observing male and female models.

In their first experiment, Bandura, Ross and Ross (1961) exposed children to aggressive and non-aggressive adult models and then tested the children for the amount of 'imitative learning' in a new situation in the absence of the model. They aimed to find out whether children who are passive observers to aggressive acts by an adult will imitate this aggressive behaviour when given an opportunity to do so. More specifically, the study used the following hypotheses:

- participants exposed to aggressive models will reproduce aggressive acts resembling those of the models
- the observation of non-aggressive models will have a restraining effect on the participants' subsequent behaviour
- participants will imitate the behaviour of a same-sex model to a greater degree than a model of the opposite sex
- boys will be more predisposed than girls towards imitating aggression.

The participants used in the study were enrolled at a preschool at Stanford University, which is where the researchers were employed. Tested were 36 boys and 36 girls aged between 37 and 69 months, and the mean age was 52 months. The researchers used one male adult and one female adult to act as the models. One female experimenter conducted the study for all 72 children.

The study used a complicated experimental design in which there were three major experimental conditions and three independent variables were tested. Generally, there was a group exposed to an aggressive model, a group exposed to a non-aggressive model and a control group. In the control condition, the children were in the room on their own with no model. Each group of children who were exposed to the models was further subdivided into males and females and by the gender of the model to which they were exposed so that sex differences could be tested. Table 10.5 shows a summary of the groups.

In order to control individual participant differences in pre-existing aggression, which could distort the results if any of the groups contained a disproportionate number of children who were normally quite aggressive, the researchers pre-tested all the children for aggressiveness. All children were rated on four 5-point rating scales by the female experimenter and a preschool teacher 'both of whom were well-acquainted with the children'. The rating scales were for physical aggression, verbal aggression, aggression towards inanimate objects (that is, non-living objects) and aggressive inhibition (that is, the tendency to not be aggressive). On the basis of their scores, participants were organised into 'matched-triplets'. One member of each triplet was then randomly allocated to either of the two experimental groups or to the control group.

There were three stages in the experimental procedure. All participants were tested individually in each stage. In stage 1, the experimenter escorted each child to the experimental room which was set up for play. One corner was arranged as the child's play area, with a table and chair, potato prints and stickers. These had been previously determined as having high interest for the children. The adult

Table 10.5 Bandura, Ross and Ross's (1961) eight experimental groups

Control group: 24 participants **Eight experimental groups: each with 6 participants** • **Aggressive model condition: 24 participants** • **Non-aggressive model condition: 24 participants**			
Aggressive model condition			
6 boys with same-sex model	6 boys with opposite sex model	6 girls with same-sex model	6 girls with opposite sex model
Non-aggressive model control			
6 boys with same-sex model	6 boys with opposite sex model	6 girls with same-sex model	6 girls with opposite sex model

model was escorted to the opposite corner where there was a small table and chair, a tinker toy construction set which was popular at the time, a mallet and an inflated Bobo doll (see figure 10.51). The experimenter then left the room.

With participants in the *non-aggressive condition*, 'the model assembled the tinker toys in a quiet, subdued manner, ignoring the Bobo doll'. In contrast, with participants in the *aggressive condition* the model started to assemble the tinker toys, but after one minute turned to the Bobo doll and spent the rest of the time being physically aggressive with it in an obvious way (for example, picked up the mallet and struck the doll on the head), and verbal (for example, 'Kick him' and 'Sock him in the nose'). Thus, in the aggressive condition, participants were preoccupied with activities they enjoyed but at the same time exposed to the model's aggressive behaviour, which could be learnt through observation. In each condition, after 10 minutes the experimenter returned and took the child to another games room for stage 2.

In stage 2, each participant was subjected to 'mild aggression arousal to insure that they were under some degree of instigation to aggression'. The child was taken to a room with attractive toys, but after starting to play with them, the child was told that these were the experimenter's very best toys and she had decided to reserve them for the other children.

Then the child was taken to the next room for stage 3 of the experiment. The experimenter stayed in the room, 'otherwise a number of children would either refuse to remain alone, or would leave before termination of the session'. In this room there was a variety of toys, both non-aggressive (for example, crayons and plastic farm animals) and aggressive toys (for example, a mallet, dart guns and a Bobo doll). The child was kept in this room for 20 minutes, and their behaviour was observed by judges through a one-way mirror. Observations were made at 5-second intervals.

The observers recorded three measures of imitation in which they looked for responses from

Figure 10.51 These photographs were taken during the Bandura, Ross & Ross (1961) experiment. The top series shows the adult model being aggressive with the Bobo doll. The middle series shows a young boy imitating the model. The bottom series shows a young girl imitating the model.

the child that were *very similar* to the display by the adult model:

- imitative for physical aggression (for example, striking the Bobo doll)
- imitative verbal aggression (for example, 'Kick him')
- imitative non-aggressive verbal responses (for example, 'He sure is a tough fella').

The observers also recorded responses that *partially imitated* the adult model:

- mallet aggression
- sits on Bobo doll.

In addition, three types of behaviour that were *not imitations* of the adult model were recorded:

- pushes Bobo doll
- non-imitative physical and verbal aggression (for example, strikes something else)
- aggressive gun play.

The results are summarised in table 10.6 and showed the following:

- The children who saw the aggressive model performed more aggressive acts than the children who saw the non-aggressive model.
- Boys performed more aggressive acts than girls.
- The boys in the aggressive conditions showed more aggression if the model was male than if the model was female.
- The girls in the aggressive conditions also showed more *physical* aggression if the model was male but more *verbal* aggression if the model was female.
- The exception to this general pattern was the observation of how often they punched the Bobo doll. In this case, the effects of gender were reversed.

Bandura, Ross and Ross concluded that aggressive behaviour can be learnt through exposure to aggressive models and that there are sex differences in aggressive behaviour.

Table 10.6 Mean aggression scores for experimental and control group participants in the Bandura, Ross and Ross (1961) experiment

Response category	Experimental groups				Control group
	Aggressive		Non-aggressive		
	Female model	Male model	Female model	Male model	
Imitative physical aggression					
Female participants	5.5	7.2	2.5	0.0	1.2
Male participants	12.4	25.8	0.2	1.5	2.0
Imitative verbal aggression					
Female participants	13.7	2.0	0.3	0.0	0.7
Male participants	4.3	12.7	1.1	0.0	1.7
Mallet aggression					
Female participants	17.2	18.7	0.5	0.5	13.1
Male participants	15.5	28.8	18.7	6.7	13.5
Punches Bobo doll					
Female participants	6.3	16.5	5.8	4.3	11.7
Male participants	18.9	11.9	15.6	14.8	15.7
Non-imitative aggression					
Female participants	21.3	8.4	7.2	1.4	6.1
Male participants	16.2	36.7	26.1	22.3	24.6
Aggressive gun play					
Female participants	1.8	4.5	2.6	2.5	3.7
Male participants	7.3	15.9	8.9	16.7	14.3

Source: Bandura, A., Ross, D., & Ross, S.A. (1961). Transmission of aggression through imitation of aggressive models. *Journal of Abnormal and Social Psychology, 63*(3), 575–582.

It was also found that behaviour may be learnt through observation but may not be demonstrated until there is an opportunity to do so, as occurred in their experiment. In relation to this finding, the study obtained evidence that children exposed to aggressive models in one setting performed the aggressive responses they had learnt through observation to a new setting in which the model was absent.

With regard to the effect that the sex of the model had on the children, the researchers noted that the aggression of the female model had a confusing effect on the children. For example, one of the children said, 'Who is that lady? That's not the way for a lady to behave. Ladies are supposed to act like ladies …', and another child said, 'You should have seen what that girl did in there. She was just acting like a man. I never saw a girl act like that before. She was punching and fighting but no swearing'. Conversely, the aggressive behaviour of the male model fitted more comfortably into a cultural stereotype of appropriate behaviour. For example, one boy said, 'Al's a good socker, he beat up Bobo. I want to sock like Al', and one of the girls said, 'That man is a strong fighter, he punched and punched and he could hit Bobo right down to the floor and if Bobo got up he said, "Punch your nose". He's a good fighter like Daddy'. These types of comments indicate that the children in this study already had an expectation that men will behave more aggressively than women.

In sum, the Bandura, Ross and Ross (1961) study provides evidence in support of observational learning and some of the processes involved in this type of learning, at least of aggressive behaviour. There is, however, no evidence of the long-term effects of the study; that is, the relative permanency of the learning that occurred through observation.

In their second experiment, Bandura, Ross and Ross (1963a) aimed to find out the extent to which observation of aggressive models presented in films by real-life and cartoon characters influences aggressive behaviour by children. The study used a similar number of children of both sexes from the same preschool and the experiment used procedures similar to those of the 1961 experiment. However, different hypotheses were tested. These included:

- the more remote the model was from reality, the weaker would be the tendency for participants to imitate the behaviour of the model
- male participants would be more imitative of aggression than females.

In order to test the hypotheses, the child participants were divided into three experimental groups and one control group of 24 participants each:

- Experimental group 1: observed human ('real-life') aggressive models
- Experimental group 2: observed the same human models but the models portrayed aggression on film
- Experimental group 3: viewed a film depicting an aggressive cartoon character
- Control group: no exposure to the aggressive models.

As in the first experiment, the experimental groups were further subdivided into male and female participants so that half the participants in the two conditions involving human models were exposed to same-sex models, while the remaining participants viewed models of the opposite sex. Again, participants in the experimental and control groups were matched individually on the basis of ratings of their aggressive behavior.

There were two stages in the experimental procedure. All participants were tested individually in each stage. In stage 1, the experimenter escorted each child to the experimental room which was set up for play, in much the same way as in the first experiment. With participants in the *real-life aggressive condition,* the model started to assemble the tinker toys but after a minute, turned to the Bobo doll and spent the remainder of the session being aggressive towards it 'with highly novel responses which are unlikely to be performed by children independently of the observation of the model's behavior'. For example, the model sat on the Bobo doll and punched it repeatedly in the nose, repeatedly hit it on the head with a mallet and then tossed the doll up in the air aggressively and kicked it about the room. This sequence of physically aggressive acts was repeated three times, interspersed with verbally aggressive responses such as, 'Hit him' and 'Kick him'. In contrast, participants in the *human–film aggressive condition* were shown a 10-minute colour movie, with the same models used in the real-life aggressive condition portraying the same aggressive behaviour as in their real-life performances. Participants in the *cartoon–film aggressive condition* were shown a TV portrayal of the same sequence of aggressive acts as in the other two conditions. However, the aggressive acts were portrayed by a female model dressed as a black cat similar to the many cartoon cats shown on TV in the 1960s.

In stage two, each child was taken to a room filled with both aggressive and non-aggressive toys, as in the first experiment. The child was then left alone for 20 minutes during which time observers viewed the child's behaviour through a one-way mirror in an adjoining observation room. Responses were recorded with reference to a checklist with categories that were the same as those used in the first experiment.

The results obtained from the experiment are summarised in table 10.7. On the basis of these results, Bandura, Ross and Ross concluded that exposure of the children to aggressive models increased the probability that they will respond aggressively when given the opportunity to do so on a later occasion. Furthermore, children can learn aggressive behaviour through observation of aggression by both real-life models and film-portrayed models. For example, children who viewed the aggressive human and cartoon models on film demonstrated nearly twice as much aggression than did children in the control group who were not exposed to the aggressive film content. As in their first experiment, significant sex differences in aggressive behaviour were also found across the various categories of aggressive behaviour that were observed and recorded.

According to Bandura, Ross and Ross, 'filmed aggression, not only facilitated the expression of aggression, but also effectively shaped the form of the participants' aggressive behavior. The finding that children modeled their behavior to some extent after the film characters suggests that pictorial mass media, particularly television, may serve as an important source of social behavior'.

Table 10.7 Mean aggression scores for subgroups of experimental and control group participants in the Bandura, Ross and Ross (1963a) experiment

Response category	Experimental groups					Control group
	Real-life aggressive		Human–film aggressive		Cartoon–film aggressive	
	Female model	Male model	Female model	Male model		
Total aggression						
Girls	65.8	57.3	87.0	79.5	80.9	36.4
Boys	76.8	131.8	114.5	85.0	117.2	72.2
Imitative aggression						
Girls	19.2	9.2	10.0	8.0	7.8	1.8
Boys	18.4	38.4	34.3	13.3	16.2	3.9
Mallet aggression						
Girls	17.2	18.7	49.2	19.5	36.8	13.1
Boys	15.5	28.8	20.5	16.3	12.5	13.5
Sits on Bobo dolls						
Girls	10.4	5.6	10.3	4.5	15.3	3.3
Boys	1.3	0.7	7.7	0.0	5.6	0.6
Non-imitative aggression						
Girls	27.6	24.9	24.0	34.3	27.5	17.8
Boys	35.5	48.6	46.8	31.8	71.8	40.4
Aggressive gun play						
Girls	1.8	4.5	3.8	17.6	8.8	3.7
Boys	7.3	15.9	12.8	23.7	16.6	14.3

Source: Bandura, A., Ross, D., & Ross, S.A. (1963a). Imitation of film-mediated aggressive models. *Journal of Abnormal and Social Psychology, 66* (1), 6.

The third experiment by Bandura, Ross and Ross (1963b) was designed to study the influence of reward and punishment on observational learning. Procedures and participants similar to those of the first two experiments were used to compare children's responses when the model's aggressive behaviour was either rewarded or punished. The 40 boys and 40 girls with a mean age of 51 months were randomly allocated to one of two experimental or control groups. These groups were:

- Experimental group 1: the *aggressive-model rewarded* condition, in which an aggressive male model is rewarded by another male model with biscuits, soft drink and toys.
- Experimental group 2: *aggressive-model punished* condition, in which the aggressive model is punished by the other model with a severe spanking.
- Control group 1: *non-aggressive-model* condition, in which two male models engaged in vigorous but non-aggressive play and there were no consequences—the models were neither rewarded nor punished.
- Control group 2: *no-model* condition, in which the children did not view any film and therefore had no exposure whatsoever to modelling of any aggressive behaviour (or consequences).

As in the previous two experiments, following the screening of the films, each child was placed individually in a room that had many aggressive and non-aggressive toys. Each child's behaviour was then individually observed by the experimenters.

The results, shown in table 10.8, indicate that observational learning was influenced by the consequences (or lack of them) for the adult model(s). The children who observed the aggressive model being rewarded imitated more aggressive behaviour than did children in the other three groups. There was not a significant difference between the other three groups in this response category. In addition, the children were more inclined to reproduce the behaviour of the rewarded model than the punished model. These findings support Bandura's proposal that observational learning involves conditioning processes. Although the boys were more aggressive than the girls in three of the conditions, there was little difference between girls and boys in the aggressive-model punished condition.

Each child who participated in the treatment conditions (experimental group 1 or 2) was later interviewed about the behaviour of the two models and asked to select the character they would prefer to be like. The most aggressive model in the reward condition was selected. According to Bandura, Ross and Ross, the children's answers to questions about their choice of model revealed that this model's success in gaining and controlling rewarding resources was a crucial factor that influenced their choice, rather than the fact that this model was more aggressive.

Table 10.8 Mean aggression scores for children in the experimental and control groups in the Bandura, Ross and Ross (1963b) experiment

Response category	Experimental groups		Control groups	
	Aggressive model: rewarded	Aggressive model: punished	Non-aggressive model	No model
Imitative aggression	15.4	8.4	7.2	5.3
Boys	16.2	7.8	10.0	5.6
Girls	14.5	8.9	4.4	4.9
Non-imitative aggression	59.9	45.2	59.2	56.6
Boys	75.6	45.6	81.7	62.0
Girls	44.1	44.7	36.7	51.2
Total aggression	75.2	53.5	66.4	61.8
Boys	91.8	53.4	91.7	67.6
Girls	58.6	53.6	41.1	56.1

Source: Bandura, A., Ross, D., & Ross, S.A. (1963b). Vicarious reinforcement and imitative learning. *Journal of Abnormal and Social Psychology, 67*(6), 601–607.

Learning Activity 10.31

Summary of experiments by Bandura, Ross and Ross

Make a copy of the following table to summarise key aspects and findings of the three experiments conducted by Bandura, Ross and Ross on observational learning of aggressive behaviour. If information is not described in the text, suggest a possibility. For example, you should construct a hypothesis for the 1963b experiment.

Aspect	Experiment		
	1961	1963a	1963b
Aim(s)			
Hypotheses			
Participants			
Experimental conditions			
Type of experimental design			
Findings			

Learning Activity 10.32

Evaluation of experiments by Bandura, Ross and Ross

1. Explain why it was important to control 'pre-existing aggression' in each experiment and describe how was this variable was controlled.
2. **a** Is the sample for each experiment biased in any way? Explain your answer.
   b Is it possible that the same children participated in more than one experiment? If so, how could this influence the results?
3. Is the sample size for each experiment adequate for testing sex differences and for making generalisations about sex differences in modelling aggressive behaviour? Explain your answer.
4. Why were control groups used in each experiment? Explain your answer.
5. To what extent can the results of the experiments be generalised? Explain your answer with reference to the experimental procedures used and to each of the following sources of extraneous and potential confounding variables:
   - participants
   - sampling procedure
   - artificiality
   - demand characteristics
   - use of standardised instructions and procedures.
6. What are the three independent variables in the 1961 experiment?
7. What ethical guidelines may have not been followed by the researchers? Explain your answer.
8. Prepare a flow-chart summary of one of the experiments, ensuring you refer to the aim(s), hypothesis(es), sampling procedure, participant allocation, pre-testing, experimental conditions and key findings.

Learning Activity 10.33

Data analysis

Consider the results of the Bandura, Ross and Ross 1963a experiment as summarised in table 10.7 on page 516 and answer the following questions, with reference to the results.

1. What is a mean aggression score?
2. The researchers concluded that the effects of observing violence by aggressive models presented in films are 'to some extent a function of the sex of the model, sex of the child, and the reality cues of the model'.
   a Explain the meaning of this conclusion.
   b Which results provide evidence for the influence of the different variables referred to in this conclusion?

Elements of observational learning

According to Bandura, four elements account for observational learning: attention, retention, reproduction and motivation–reinforcement. All these elements form part of the process of observational learning and are essential if observational learning is to occur. They can be seen in operation when applied to the children in Bandura's experiments, who learned to imitate the aggressive behaviour they observed in models. The children *attended* to (watched) the models' aggressive behaviour. They *retained* (held) in memory what they had seen, as was evident from their subsequent actions. They *reproduced* (physically performed) the modelled behaviours. When aggressive behaviour was associated with *reinforcement* (a reward) or punishment, the children were more or less motivated to imitate the observed behaviour.

Attention

In order to learn through observation, we must pay attention to or closely watch the model's behaviour. If we do not attend to the model's behaviour, we will not recognise the distinctive features of the observed behaviour.

Attention may be influenced by several factors. These include the perceptual capabilities of the

Box 10.9
Types of models

Psychologists often refer to the models that people observe as being either real-life or symbolic. *Real-life models* are those we come into direct contact with, such as parents, older sisters and brothers, teachers, and friends we admire. *Symbolic models* are presented to us through media such as television, movies, magazines, books and written instructions (symbols on a page) in a manual on 'how to do' something.

Figure 10.52 The reproduction of behaviour modelled by a *real-life* model

Figure 10.53 The reproduction of behaviour observed in a *symbolic* model

Figure 10.54 An Australian opening batsman for test matches is a model to whom one could pay attention for an excellent batting technique when playing cricket.

observer, the motivation and interest level of the observer, the situation in which the behaviour is being observed, the kinds of distracters that are present and the characteristics of the model (such as attractiveness). Our level of attention is also influenced by such factors as the importance of the behaviour (for example, whether we consider it to be a necessary behaviour, such as keyboarding skills required to obtain a particular job), its distinctiveness (such as whether it is unique, different, unusual) and the effect it might have on us (such as satisfaction, convenience, security).

According to Bandura (1977), we pay closer attention and are more likely to imitate models who have the following characteristics:

- the model is perceived positively, is liked, and has a high status
- there are perceived similarities between features and traits of the model and the observer, such as age and sex
- the model is familiar to the observer and is known through previous observation
- the model's behaviour is visible and stands out clearly against other 'competing' models
- the model is demonstrating behaviour that the observer perceives themselves as being able to imitate.

In general, the greater the similarity between model and learner, and the more attractive or successful the model, the more likely we are to follow their example. Research studies also indicate that the higher the status of the model, the more the observer will imitate the behaviour, which is why many advertisements feature celebrities. Similarly, a cricket coach advising a batter on how to play a straight drive during a cricket match would be more likely to suggest paying attention to a professional cricketer's style than to that of a weekend cricketer at a local oval.

Retention

Having observed the model, we must be able to remember the model's behaviour. Responses learned by modelling are often not needed until some time after they have been acquired. There is a need to store in memory what we have observed, and the more meaningful we can make that mental representation, the more accurately we will be able to replicate the behaviour when necessary. Linking a visual image with a verbal description of the model's actions is an effective strategy to assist the memory processes.

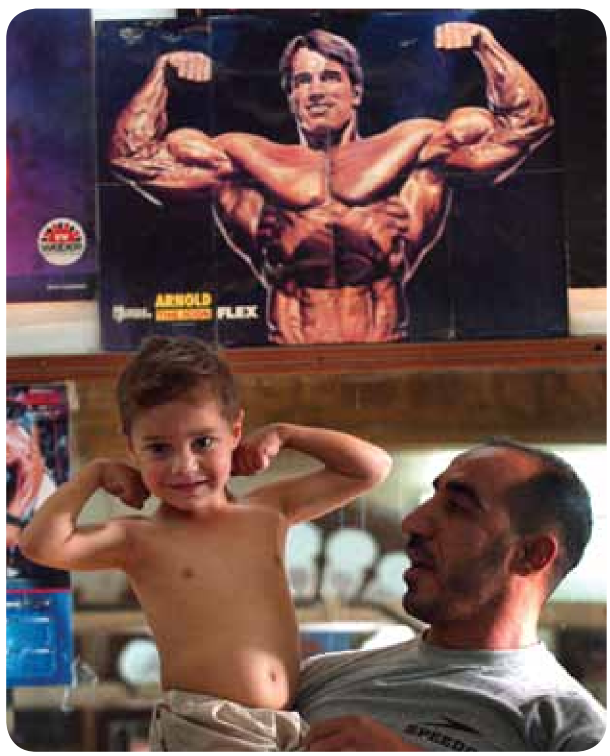


Figure 10.55 We learn much of our behaviour by imitating others, especially those who are attractive, successful or of higher status than we are.

Figure 10.56 This Guatemalan girl (left) is able to reproduce the weaving skills she has observed from her mother (right).

Therefore the cricketer in the previous example might try to visualise the style of the model cricketer when batting, while describing the action as something like: 'He leans in towards the ball with his front shoulder while his eyes are fixed on the ball. His front foot steps towards the pitch of the ball and he has a high back swing. At the moment of contact his bat is kept straight with wrists relaxed, and his head is over the ball. He also ensures he has a high follow-through after striking the ball'.

Reproduction

When the model's behaviour has been closely attended to and retained in memory, we can attempt to reproduce, or imitate, what has been observed. We must, however, have the ability to put into practice what was observed. For example, we wouldn't be able to imitate someone riding a surfboard if we were paralysed. Similarly, we must have the potential to be competent enough to develop the necessary skills to imitate the behaviour. For example, no matter how well the cricket stroke-making style of a professional cricket player is lodged in an observer's memory, it is unlikely that this behaviour will be reproduced with the same skill. The professional cricketer may well possess attributes that cannot be learned: his reflexes and agility, his balance and poise, his perceptual judgments of the trajectory and distance of an incoming ball, and his superior motor coordination.

Motivation–reinforcement

The learner must also be motivated to perform the behaviour. Unless the behavioural response is useful or provides an incentive or reward for the learner, it is unlikely that they will want to learn it in the first place, let alone perform it or continue to perform it. Bandura distinguished between different types of reinforcement that influence motivation, in addition to the standard types described by Skinner.

External reinforcement is comparable to learning by consequences. Thus, if the girl in figure 10.56 receives a reinforcer (such as praise or money) for her work, then her motivation to become more highly skilled at her craft will be influenced in a positive way.

Vicarious reinforcement, as discussed previously, is observing the modelled behaviour being reinforced for other people. For example, a young child observing the positive reinforcement received by an older sibling who works hard at school to get into the tertiary course of her choice, may well model the same studious behaviour as a result of vicariously experiencing the reinforcement.

Self-reinforcement occurs when we are reinforced by meeting certain standards of performance we set for ourselves; for example, the sense of pride, achievement or fulfilment you may experience if you achieve the end-of-year VCE results you would like to achieve and believe you are capable

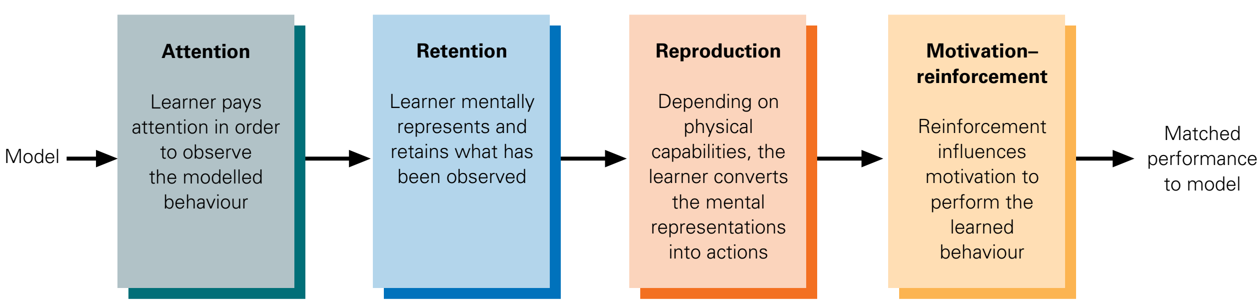


Figure 10.57 Elements in the process of observational learning

of achieving. Although this sense of pride, achievement and fulfilment typifies positive reinforcement, self-reinforcement can also include negative reinforcement. For example, avoiding a future of being bored in a mindless job may also be the self-reinforcement for achieving academic success.

In sum, if the modelled behaviour is reinforced, this will motivate the person to repeat those actions; the next time, the person will expect the behaviour to be reinforced. If the behaviour is not reinforced, it is less likely to be repeated. In this case, it could be said that the person lacks the motivation to behave in that particular way. In other words, behaviour that is acquired by observational learning may need to be maintained by operant conditioning principles of reinforcement.

Box 10.10

Neuroimaging studies of observational learning

Researchers using neuroimaging techniques have discovered specialised neurons in the brain that may be the neural basis of observational learning. These neurons are called *mirror neurons* and are found near the motor cortex in the frontal lobe and in the parietal lobe. They have been identified in birds, monkeys and humans. The choice of name for these neurons reflects their function.

Mirror neurons are active when we perform a behaviour, such as reaching for, grasping, holding or manipulating an object. However, mirror neurons are also activated whenever we observe someone else performing the same task. That is, circuits of mirror neurons are active both in performing a task and when simply observing the same task being performed. Thus, every time you observe another person engaging in an action, similar circuits of mirror neurons are firing in both your brain and the other person's. For example, mirror neurons are at work in the 'mirror game' during which one person moves slowly and the other person tries to imitate the person as closely as possible.

One neuroimaging study on mirror neurons used *f*MRI to monitor the human brain as participants watched each of three visual presentations. In one experimental condition, participants saw a hand making grasping motions in midair but without a context, such as having a coffee cup or scrubbing sponge to 'go with' the hand. In another condition, participants saw only the context; that is, a coffee cup or scrubbing sponge but no hand to go with them. In other conditions, the participants saw a hand moving in two different contexts, either grasping and moving a coffee cup to drink or cleaning dishes with a sponge. The results showed that when observed actions occurred in a context, such as in the last two conditions, the participants' mirror neurons were more active than in either of the first two conditions. This suggests that mirror neurons may be involved in recognising the intention or purpose of observed behaviour, such as the grasping of a coffee cup for the purpose of taking a drink (Iacoboni & others, 2005).

On the basis of these findings and those of other neuroimaging studies on mirror neuron activity, some psychologists have theorised that mirror neurons may help us explain and predict behaviour when observing the behaviour of others. For example, they may allow us to step into the shoes of people we observe so that we can better understand their actions. Furthermore, mirror neurons may also enable us to make inferences about another person's mental state and therefore enable empathy. For example, when observing a loved one's pain, this is mirrored in our brain. The pain 'empathised' by an individual's romantic partner and the person actually experiencing the pain activated some of the same brain areas (Singer & others, 2004).

Learning Activity 10.34

Review questions

1 Distinguish between learning and performance. Explain with reference to an example that is not used in the text.
2 What is the role of the learner in observational learning?
3 Explain why observational learning is referred to as a form of cognitive learning.
4 Describe and explain each of the four elements of the observational learning process, with reference to an example not used in the text.
5 Many people believe that violent behaviour is learnt by observing violence in television programs, movies and other media, and/or through playing violent computer games.
 a What does research evidence suggest about such learning?
 b What other variables may impact on observational learning of violence?

Learning Activity 10.35

Media response

View the 1.5-minute video *Children See. Children Do* at www.youtube.com/watch?v=eEBUboAbhHY. The video shows a television advertisement produced by the Australian National Association for the Prevention of Child Abuse and Neglect.

Do children learn to be bad parents through observational learning of bad parenting and vice versa? Write a 150–200 word commentary with reference to examples in the video and Bandura's observational learning theory.

Insight learning

Most of us, at some time in our lives, have experienced the relief of being rescued from agonising over a problem by suddenly seeing the problem in a different way and almost at the same time thinking 'Aha! I know the answer'. This is an example of what is referred to as insight learning. **Insight learning** is a type of learning involving a period of mental manipulation of information associated with a problem, prior to the realisation of a solution to the problem. The learning is said to have occurred when the relationships relevant to the solution are grasped. The learning appears to occur in a 'flash', and what has been learned is usually performed smoothly and without error from then on.

The original studies of insight learning were reported by German psychologist Wolfgang Köhler. During World War I, Köhler was working at the University of Berlin's primate colony in the Canary Islands off the coast of Africa. Because chimpanzees were available, he used them in his experiments on learning and problem-solving.

Köhler (1925) believed that learning, especially in primates and people, involved cognitive processes and not just stimulus–response relationships. For example, in Köhler's view, learning to solve a complex problem involves more than a series of responses to stimuli made in a trial and error fashion, as Thorndike observed in his experiments with cats in the puzzle box.

In his experiments, Köhler presented several problems to chimpanzees, each with different solutions. In one of the problems, called the stick problem, Köhler (1925) placed a banana or other fruit outside the cage of a chimp called Sultan, but the fruit was out of his reach. On the floor inside the cage were a box and two sticks (hollow bamboo rods). One of the sticks was shorter and slightly thinner than the other. Each stick was too short to enable Sultan to reach the banana. However, the end of the shorter stick could be placed inside the other to form a 'double stick' long enough to reach the banana.

When presented with this problem, Sultan first tried to reach between the cage bars in a futile attempt to grab the banana. When this failed, he flew into a temper tantrum. When he calmed down, he tried other solutions which included using each stick independently to reach the banana and even one of the boxes. After about

Figure 10.58 Köhler's stick problem: the solution requires the chimpanzee to insert the end of a small stick into a hollow larger one to make an implement long enough to reach the desired object.

an hour of unsuccessful attempts, Sultan squatted indifferently on the box as if he had given up. Then, as described by Köhler:

> *Sultan gets up, picks up the two sticks, sits down again on the box and plays carelessly with them. While doing this, it happens that he finds himself holding one rod in either hand in such a way that they lie in a straight line; he pushes the thinner one a little way into the opening of the thicker, jumps up and is already on the run towards the railings (bars), to which he has up to now turned his back, and begins to draw a banana towards him with the double stick.*

Köhler concluded that Sultan's discovery of the solution to the problem of retrieving the banana was an example of insight learning. Although Köhler could not be certain about what was going on 'inside' Sultan's head, Köhler believed Sultan behaved as if he was sitting around thinking about the problem for a while, as people do. It seemed to Köhler that Sultan had mentally organised the sticks into a suitable relationship, which he instantly recognised as the solution to the problem. Then, as soon as he put the sticks together, he ran over and got the banana. According to Köhler, there appeared to be different stages in the process of insight

Figure 10.59 Wolfgang Köhler (1887–1967)

learning, which occurred as follows:

- an initial helplessness or inability to deal with the problem
- a pause in activity
- a sudden and smooth performance of the solution.

Numerous researchers and theorists who have studied insight learning since Köhler's early studies with primates have built upon Köhler's initial description of the stages. The stages have been named and additional terms have been devised to describe processes leading up to and following an insightful experience.

Stages of insight learning

Preparation

Preparation is the first stage of insight learning and is a 'getting ready' period in which the person or animal gathers as much information as possible about what needs to be done. They may even 'look for leads' by using the information available in attempting possible solutions. For example, Köhler's chimpanzee, Sultan, picked up the sticks, looked at them, looked at the banana, then tried to reach the banana with a stick.

Incubation

Incubation is a period of mental 'time out' during which the information gained in the preparation stage appears to be put aside. However, the information continues to be processed or reflected upon and 'weighed up' in the background (or at an unconscious level).

Sultan demonstrated this when he squatted on a box and appeared uninterested in solving the problem.

Figure 10.60 Another of Köhler's chimpanzees demonstrated insight learning when it suddenly realised that stacking the boxes on top of each other and using a pole enabled it to knock down the fruit dangling above.

Insightful experience

The insightful experience is sometimes referred to as the 'ah-ha experience' because it occurs so suddenly that people often exclaim 'ah-ha!' This experience seems to occur because of some mental event that unexpectedly bridges the gap between the problem and its solution in a 'flash'. It's like a sudden period of illumination after feeling for some time as though you're in the dark. For this reason, the insightful experience is often represented in cartoons as a light globe going on above someone's head. For Köhler's chimpanzee, Sultan, this brief moment was indicated by him behaving as though he had suddenly been given a proper understanding of the relationship between one stick and the other—the realisation that one stick would fit into the other to make a longer implement. It was like mentally *seeing* 'what led to what' before actually doing it.

Verification

Verification represents the final stage of insight learning, when the visual image that flashed into the mind during the insightful experience (the 'solution') is acted upon with overt behaviour and is tested. Sultan the chimpanzee quickly verified, or confirmed, his insightful representation by getting the two sticks and placing the thinner one inside the thicker one to make a stick that was twice as long. He was then able to retrieve the piece of fruit that had been elusive for so long. Subsequent studies with people have found that if the solution is faulty or inappropriate, the learner (or problem solver) will return to the stage of incubation.

Köhler observed that the same kind of insightful learning and problem-solving process occurred with other problems he presented to chimpanzees. For example, in another problem called the box problem, the banana was suspended from the cage ceiling, out of reach, and some boxes were scattered about the cage floor. The chimps, after apparently wrestling with the problem, would suddenly get up, stack the boxes on top of each other, scamper up and grab the banana.

Köhler (1927) believed that the insight that led to the problems' solutions was not the result of random trial and error responses, although some of this type of behaviour may be displayed in the preparation stage. Instead, the chimps had suddenly perceived relationships among different elements of a problem and had organised them so as to form a meaningful whole, a process that is mostly unconscious.

Learning Activity 10.36

Demonstration of insight

The following problem tends to rely on a flash of insight for its solution:

Add a single line to the figure below to make it equal 6:

IX

When you get the solution, explain how you worked it out with reference to the stages of insight learning. If any stage was missed, explain why.

Box 10.11

Is insight the result of learning or a way of learning?

Figure 10.61

Consider a pigeon that solves a problem like the Köhler box problem. It uses the box to get a banana that is out of reach. The pigeon had been previously taught not to fly or jump at the banana. It was also conditioned to perform two actions separately: (1) to push a box to a location, and (2) to climb on a box and peck at a banana. When placed in the situation shown in the photo, the pigeon integrated these two behaviours. The researchers suggested that the pigeon's spontaneous behaviour when placed in this problem-solving situation demonstrates the role of prior experience in what appears to be a genuine insight. They also viewed the pigeon's accomplishment, which resembles that of Köhler's chimps, as evidence against the cognitive view of insight. Like other conditioning theorists, they believe that insight is the result of learning, not a way of learning (Epstein & others, 1984).

Features of insight learning

Studies on insight learning since Köhler's experiments have led psychologists to describe insight learning as having the following characteristics:

- the learning appears to be sudden and complete
- the first time the solution is performed, it is usually done with no errors
- the solution is less likely to be forgotten than if it is learned by rote (repetitive drill)
- the principle underlying the solution is easily applied to other relevant problem-solving situations.

It is also proposed that insight depends on three key factors: (1) whether the problem has elements that can be manipulated in such a way as to enable discovery of their relationship, (2) whether the organism trying to solve the problem has the cognitive ability to manipulate the elements of the problem in such a way as to identify their relationship, and (3) whether all the tools, processes and other information necessary for the solution are available to the problem-solver (within vision or 'mentally' through prior experience).

Insight learning, like observational learning, is described as a form of *cognitive learning*. It is difficult to account for by using only the principles of classical or operant conditioning. For example, animals in problem-solving situations such as those posed by Köhler do not show many successive approximations of the solution that can be reinforced. In insight learning, the organism seems to know a correct solution to a problem, apparently without having ever been reinforced for it, or any response that approximates it. However, although trial and error was not observed by Köhler during his experiments, this does not necessarily mean that Sultan the chimp could not have learned a rule or method for solving the problem at some prior time through trial and error or by observation.

It has been suggested that the chimpanzees with which Köhler worked had lived free in the wild before Köhler used them in his experiments. Thus, it is possible that they had previous experience with using various kinds of sticks and climbing different structures. Consequently, the insightful solutions of the stick and box problems may not have 'come out of the blue'. The chimpanzees' accumulation of past experiences probably played some role in the appearance of an insightful solution to the problem. Similarly, someone who is not enrolled in VCE Psychology would be unlikely to get a good grade for the end-of-year psychology exam if they went to it unprepared, expecting to solve the questions by insight. To have insight, you need previous experience with material covered in the course.

Learning Activity 10.37

Review questions

1. Define the term insight learning.
2. Briefly describe the stages of insight learning.
3. Briefly describe four characteristics that distinguish insight learning.
4. What are three key factors upon which insight learning depends?
5. What insight did Köhler's chimpanzee appear to have that led to the solution of the 'stick problem'?
6. How might a conditioning theorist such as Skinner account for insight?
7. a. Would Köhler have been likely to observe insight in Sultan's solution to the 'stick problem' if he controlled for the influence of prior experience?
   b. How could the influence of this potential confounding variable be minimised or controlled?

Latent learning

In the 1930s, American psychologist Edward Tolman conducted maze learning studies with rats that highlighted two aspects of learning that challenged the traditional conditioning theories. The studies indicated that learning can occur *without* reinforcement of observable actions, and learning can occur without revealing itself in observable behaviour.

In a well-known study, Tolman and Charles Honzik (1930) conducted an experiment in which rats were allowed to run individually through a maze once a day over several weeks. The kind of maze used in this study is shown in figure 10.63. The hungry rat must find its way from the start box to the goal box, in which a food reward can be given. There are many possible blind alleys on the way. When a rat is first put in the maze it will enter blind alleys (make errors) as it tries to get from the start box to the goal box. With more trials, learning is observed as the amount of time taken (or number of errors made) to get to the goal box decreases.

Tolman and Honzik (1930) used three groups of rats. The rats in group 1 were *always* reinforced with food when they got to the goal box on each trial. The rats in group 2 were *never* reinforced when they reached the goal box. The rats in group 3 were also not reinforced for reaching the goal box during the first ten days. Then, on the *11th day*, food was given in the goal box.

Figure 10.62 Edward Chace Tolman (1886–1959)

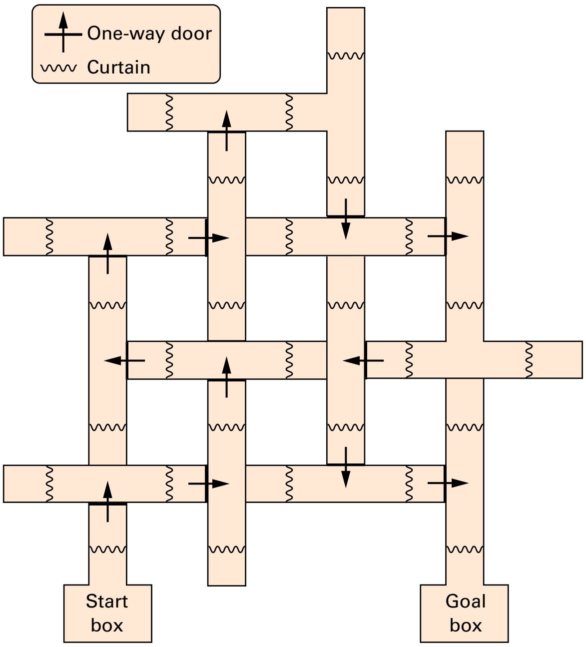
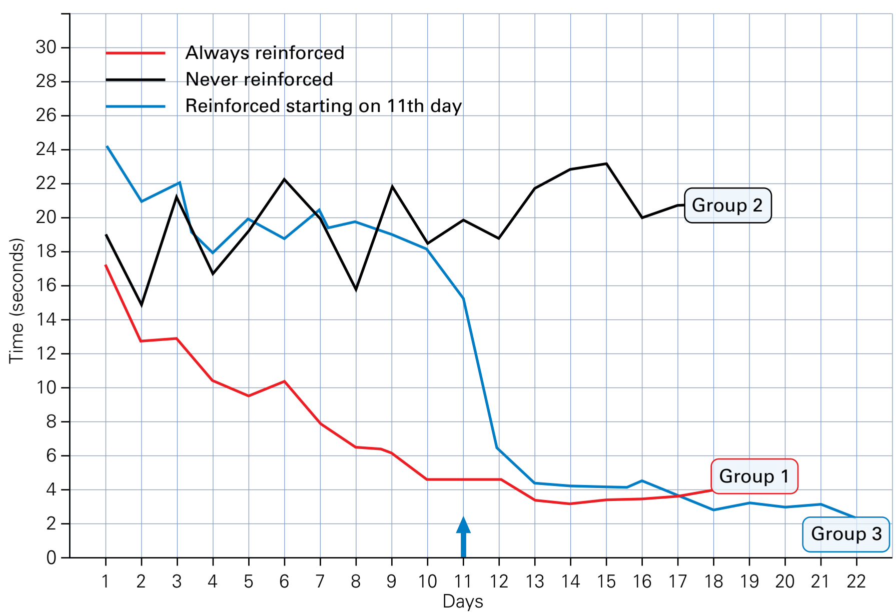


Figure 10.63 Floor plan of the maze used in the Tolman and Honzik (1930) experiment

The results of the experiment are shown in the graph in figure 10.64. Over the course of the experiment, all groups showed some improvement in the time taken to reach the goal box. However, there were some marked differences in the performance of each group. The rats in group 1 (always reinforced) quickly learned to run the maze with few errors. They gradually reduced their errors to near zero. Group 2 (never reinforced) showed little improvement in the amount of time taken to reach the goal box. The rats continued to make many more errors throughout the experiment than did those in group 1. The most interesting result is that for group 3, which received no reinforcement during the first ten days. On the 11th day, for the first time, food was given in the goal box. The next day (12th), this group ran the maze almost as efficiently as group 1, which had always been reinforced. After just two days (two trials), the rats in group 3 were achieving almost the same times for running the maze as the group 1 rats that had been reinforced on all the earlier days. This was evidence that learning had actually taken place *before* the reinforcer was available and therefore the reinforcement was not really necessary for learning to occur.

Tolman concluded that the rats in group 3 had learned the route to the food box during the first ten trials, but only revealed this learning when a reward provided the incentive for doing so. In other words, the rats *learned* the layout of the maze, but the did not *perform* in the maze until food motivated them to use the information. He used the term 'latent learning' to describe this type of learning. **Latent learning** is learning that occurs without any direct reinforcement but remains unexpressed, or hidden, until is needed. That learning can take place without any direct reinforcement challenged Skinner's operant conditioning theory in which reinforcement has an important role in explaining learning of all types of behaviour.

Figure 10.64 The results of the Tolman and Honzik (1930) experiment. Group 1 was rewarded on each day; group 2 was never rewarded. Group 3 was rewarded for the first time on day 11. Note the change in the performance of group 3 rats on day 12.



Latent learning is not a phenomenon that applies only to rats running through a maze. Bandura demonstrated this in his studies of observational learning. You can probably list many things 'you know you know' but will not use until there is reason to do so. For example, you might know the way to the fish-and-chip shop closest to your home but will not translate this into performance by going there until the need arises. Similarly, there are many non-smokers who have never smoked a cigarette. This doesn't mean they don't know how to light a cigarette or smoke it. There are many things that organisms know but don't demonstrate. This is why most psychologists now find it useful, like Tolman did some 80 years ago, to distinguish between learning and performance. Just because something is not demonstrated through performance, it cannot be assumed that it hasn't been learned. It may have been learned, but simply has not yet been performed.

The idea that learning may not be directly observed in behaviour is an important one. It reminds us to not assume that performance is a complete representation of what a person knows. Much of what is learned during childhood may never affect performance until adulthood. For example, many of the things we learn about how to treat infants and young children are acquired while we observe our parents' behaviour towards us and our brothers and sisters. However, this learning may not become apparent through our behaviour until we become parents ourselves (Newman & Newman, 1983).

Learning cognitive maps

Tolman also concluded from his experiment that in maze learning, rats learned the location of places. This was different from the view held by conditioning theorists who assumed that maze learning resulted from a series of stimulus–response associations for a sequence of turns. For example, a rat might learn to associate a left turn with the first corner in the maze, a right turn with the first door, another right turn with the second corner, and so on until it reaches the goal box where it will receive a reward for this chain of responses.

Tolman believed that in the early days of wandering through the maze without reinforcement, the rats in group 3 built up a mental picture of the maze as they learned the location of places such as corners, curtains, one-way doors and the goal box. Then, when they were shown on the 11th day that the goal box now contained reinforcement, they demonstrated their latent cognitive learning by running through the maze efficiently. (The rats that were never reinforced probably developed a comparable mental picture, but never had a reason to use it.) Tolman devised the term 'cognitive map' to describe the mental picture used by the rats to navigate in the maze. A cognitive map is a mental representation of the relationship between locations. It is like a real map, which provides a visual representation of these relationships on paper, and is used to guide movement from one place to another.

In subsequent research, Tolman found that once rats had developed a cognitive map, they could use alternative routes to reach the goal box when one or more routes were blocked. Tolman suggested that the rats, on the basis of cognitive maps, typically chose the shortest route or the one requiring the least effort. He called this tendency the *principle of least effort*.

People also form cognitive maps of their physical environments through latent learning in much the same way as did Tolman's group 3 rats in their maze environment. For example, when children ride their bikes around the neighbourhood for no particular purpose, they learn the names of streets, locations of vacant lots and postal boxes, where courts are and so on. In doing so, they form a map of their neighbourhood in their heads.

This learning is not undertaken with the intention of ever having to retrieve the information for a reward, but the learning still occurs. Similarly, if you were travelling to school by car and you encountered a roadblock, you would probably be able to find an alternative route even if you had never travelled along it before. Although useful, cognitive maps are not always perfect replicas of reality. They are often distorted by our own perception and even the age at which they were established. The cognitive map held of a holiday resort visited regularly in early childhood may be quite different from the reality that unfolds during a return visit in adult years.

Learning Activity 10.38

Review questions

1. Define latent learning with reference to an example not used in the text.
2. In what key way does Tolman's 'cognitive' theory of learning differ from Pavlov's and Skinner's conditioning theories of learning?
3. **a** Give an example of a principle of latent learning that suggests that Bandura was influenced by Tolman in developing his observational learning theory.
   b In what way can Bandura's theory be considered a cognitive theory of learning?
4. Briefly compare the role of the learner in latent learning with the role of the learner in all the other learning theories.
5. **a** What is a cognitive map? How are cognitive maps learned?
   b In what way does the learning of a cognitive map in a maze suggest that learning in a maze involves more than S → R or S → R → C association?
6. Of all the theories of learning, which theory, or combination of theories, do you believe best accounts for human learning? Explain your answer.

Learning Activity 10.39

Evaluation of research by Tolman and Honzik (1930)

Evaluate the experiment by Tolman and Honzik (1930) on latent learning. Your evaluation should include responses to the following:

1. Construct an operational hypothesis that could be used for the experiment.
2. Identify the IV(s) and DV(s) in the experiment.
3. Explain whether the hypothesis is supported, with reference to the results in figure 10.66.
4. Briefly state the conclusion made on the basis of the results obtained.
5. Suggest a possible limitation of the experiment, such as a variable that may not have been adequately controlled.

Learning Activity 10.40

Essay on theories of learning

Write an essay of about 600–700 words in which you compare and contrast three different theories of learning and their applications. References may be used in obtaining information for your essay.

In your essay, ensure that you:

- define learning and explain its conceptual components
- discuss similarities and differences between the three theories, both of a general nature (for example, a description of learning) and a specific nature (for example, key learning principles and processes)
- refer to at least one application of each theory
- discuss a strength and limitation of each theory when compared with the others
- refer to relevant research evidence and/or types of research on which each theory is based
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms, principles and processes
- structure the information in a logical way
- explain your information in a clear and concise way
- accurately cite and reference all information using appropriate conventions.

Learning Activity 10.41

Visual presentation on theories of learning

Prepare a poster with a graphic organiser such as a table or chart that compares and contrasts the different theories of learning and their applications. References may be used in obtaining information for your presentation.

In your poster, ensure that you:

- define learning and explain its conceptual components
- compare and contrast the theories in terms of eight criteria, six of which must be a description of learning, an example of learning process, the role of the learner, the role of environmental factors (for example, consequences), research evidence and applications
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms, principles and processes
- explain your information in a clear and concise way (dot points may be used)
- attach a list of references using appropriate conventions.

Chapter 10 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Learning may be described as any change in behaviour.

2 ______ Classical conditioning is the simplest form of learning.

3 ______ Latent learning involves the sudden realisation of a solution to a problem.

4 ______ The S → R → C model of learning excludes cognitive processes.

5 ______ Reflexes can be conditioned.

6 ______ Thorndike developed the law of effect through studies of one-trial learning by cats in puzzle boxes.

7 ______ Taste aversion is an example of insight learning.

8 ______ Reinforcement is a vital element of classical conditioning.

9 ______ Bandura proposed that learning may be latent unless a person is motivated to reproduce observed behaviour.

10 ______ Trial and error learning is a type of learning by S → R → C.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 10 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 A young child who has a white guinea pig at home sees a white rabbit in a pet shop and calls the rabbit a 'guinea pig'. This illustrates the process known as

A stimulus generalisation.
B stimulus discrimination.
C conditioning.
D a conditioned response.

Q2 In classical conditioning, an unlearned involuntary response to an unconditioned stimulus is called a/an

A neutral stimulus.
B conditioned stimulus.
C unconditioned response.
D conditioned response.

Q3 In one of Pavlov's classic experiments, the sound of the bell was the ______________ stimulus and the presentation of the meat powder was the ______________ stimulus.

A unconditioned; conditioned
B conditioned; unconditioned
C neutral; conditioned
D conditioned; neutral

Q4 Spontaneous recovery is said to occur when a previously conditioned response that no longer occurs

A is extinguished.
B affects the environment.
C returns.
D is punished.

Q5 A mother asks her daughter to switch off the television. The daughter refuses because her favourite TV show is on. The mother reacts to her daughter's disobedience by sending her to the laundry, where she is required to sit and do nothing for 10 minutes.

In this example, sending the daughter to the laundry is an example of

A positive reinforcement.
B negative reinforcement.
C positive punishment.
D negative punishment.

Q6 Thorndike's law of effect referred to

A behaviours followed by positive consequences being strengthened, and those followed by negative consequences being weakened.
B the rewarding of behaviours that were successively closer to the target behaviour.
C the rate at which acquisition occurs being dependent on the motivation of the learner.
D the difference between the effects of partial and continuous reinforcement.

Q7 In classical conditioning, the learner is relatively ____________ when either the CS or UCS is presented; whereas in operant conditioning the learner must be ____________ to obtain a reinforcer.

A active; neutral
B passive; neutral
C passive; active
D active; passive

Q8 In classical conditioning there is always a specific _____________ that elicits the correct response, whereas in operant conditioning the _____________ must first produce the desired response.

A operant; stimulus
B reflex; learner
C stimulus; learner
D reflex; reinforcer

Q9 Trial and error learning always involves an organism

A trying to escape from a puzzle box.
B behaving randomly because it is not motivated.
C trying different responses until a correct solution or desired outcome is achieved.
D trying so many behaviours and making so many errors that the organism is discouraged from ever repeating the learned behaviour.

Q10 A factory worker decides that timing a trip to the toilet to coincide with weekly team meetings with his supervisor and other factory workers allows him to avoid being reprimanded for not working hard enough. In this situation, going to the toilet to avoid being told off is an example of

A positive reinforcement.
B negative reinforcement.
C punishment.
D stimulus generalisation.

Q11 The object or event that increases the probability of a response recurring is referred to as a

A reinforcer.
B discriminator.
C shaper.
D motivator.

Q12 The conditioning of fear in Little Albert is an example of

A aversive therapy.
B stimulus discrimination.
C a conditioned emotional response.
D one-trial learning.

Q13 A major difference between one-trial learning and classical conditioning is that

A in one-trial learning, the strength of the conditioned response is weaker when spontaneous recovery occurs, whereas in classical conditioning the strength of the conditioned response is stronger when spontaneous recovery occurs.
B in one-trial learning, the conditioned response is relatively simple to extinguish, whereas in classical conditioning extinction takes a considerable amount of time and effort.
C in one-trial learning, the learner takes a more active role in the learning process than in classical conditioning.
D in one-trial learning, the stimulus and the response may be separated by many hours, whereas in classical conditioning the response occurs immediately after the stimulus.

Q14 As a child you were playing in the backyard one day when a big black crow landed near you. Your father suddenly screamed and snatched you into his arms. His unusual behaviour caused you to cry. You now have a fear of big black birds. Your reaction of crying when your father grabbed you is the ___________, and the fear of big black birds you now have is the _____________.

A unconditioned response; conditioned response
B conditioned response; unconditioned response
C neutral stimulus; unconditioned response
D unconditioned stimulus; neutral stimulus

Q15 Classical conditioning involves the pairing of

A the conditioned stimulus and the conditioned response.
B the conditioned stimulus and the unconditioned stimulus.
C the unconditioned stimulus and the unconditioned response.
D the conditioned stimulus and the neutral stimulus.

Q16 Which one of the following statements is **not** true of the acquisition phase in classical conditioning?

A Each pairing of the two stimuli should be in the same sequence and very close together.
B The length of the acquisition phase is often measured by the number of trials.
C The acquisition phase is shortest when the conditioned stimulus is unpleasant.
D The acquisition phase usually produces a strengthening of the response being conditioned over the duration of the trials.

Q17 When spontaneous recovery occurs in a classical conditioning experiment,

A the organism demonstrates the conditioned response without the presentation of any stimulus.
B the conditioned stimulus elicits a conditioned response even though it had previously been extinguished.
C the organism demonstrates a much stronger conditioned response than it had during acquisition.
D the conditioned response is elicited by a stimulus that is different from the conditioned stimulus.

Q18 Jason remembers seeing his brother James sustain a serious injury as a result of sticking his arm out of a car window. Since the incident, Jason has never attempted to put his arm, or any other part of his body, out the window of a moving vehicle.

In this example, Jason has observed _______________ , and has been vicariously ______________ not to repeat his brother's behaviour.

A reinforcement; punished
B modelling; conditioned
C punishment; conditioned
D reinforcement; conditioned

Q19 According to Albert Bandura, there are four elements involved in observational learning. These four elements, in their correct sequence, are

A attention, reproduction, motivation–reinforcement, retention.
B attention, modelling, motivation–reinforcement, retention.
C attention, retention, reproduction, motivation–reinforcement.
D motivation–reinforcement, reproduction, retention, attention.

Q20 Which of the following is **not** an example of observational learning?

A A new student learns vicariously that Mr Brown puts poorly behaved students on detention.
B A piano student watches the technique of her instructor so as to be able to play a difficult piece of music.
C A teacher works alongside a school principal for a week to learn about the role.
D A student whose VCE results are very disappointing learns how much work was required to achieve the university entrance score she needed.

Q21 Which of the following accurately states the sequence in which the stages of insight learning occur?

A incubation, verification, preparation, insightful experience
B preparation, verification, incubation, insightful experience
C preparation, insightful experience, incubation, verification
D preparation, incubation, insightful experience, verification

Q22 Which of the following is **not** a feature of insight learning?

A The solution is less likely to be forgotten than if it is learned by rote.
B The principle underlying the solution cannot be applied easily to other problem-solving situations.
C The learning appears to be sudden and complete.
D The solution usually appears to be error-free the first time it is performed.

Q23 If a rat in a Skinner box presses a lever for reinforcement when a buzzer is sounded but never when a bell is sounded, then ____________ is apparent.

A shaping
B stimulus discrimination
C stimulus generalisation
D extinction

Q24 Bianca teaches her pet rabbit to come to her when she makes a short, high-pitched whistling sound. At first, she gently approaches the rabbit, whistling and holding a carrot, but stops within half a metre or so of the rabbit. The rabbit approaches and nibbles the carrot. Gradually, Bianca expands the distance between herself and the rabbit. Every time Bianca whistles, she presents the carrot. Eventually, the rabbit learns that approaching Bianca after hearing a whistle generally results in a reward.

This example illustrates the use of

A spontaneous recovery.
B negative reinforcement.
C stimulus generalisation.
D positive reinforcement.

Q25 When conducting research on conditioning human behaviour, which of the following is **not** an ethical principle that should be taken into account by the researcher?

A respect for the participant
B confidentiality
C expediency
D integrity

Q26 An operant is any behaviour that

A is triggered by a stimulus from the environment.
B is reflexive or involuntary.
C elicits a response.
D affects the environment.

Q27 An important difference between negative reinforcement and punishment is that negative reinforcement ____________ a response, whereas punishment ___________ a response.

A strengthens; weakens
B always involves an unpleasant consequence for; does not necessarily elicit
C weakens; strengthens
D always involves a pleasant consequence for; always elicits

Q28 One factor that is thought to have influenced the insightful learning displayed by Köhler's chimpanzees is that

A Köhler had established a good relationship with the chimpanzees and they performed better for him than they would for other people.
B the chimpanzees may have had previous experience with sticks and climbing tasks, thereby predisposing them to solve such problems more readily than other problems.
C Köhler's experimenter expectations may have influenced the chimpanzees when solving the problem.
D the chimpanzees were more capable than was originally thought, and this enabled a quicker solution to the problem, but only because they were reinforced.

Q29 A rat in a Skinner box receives a reinforcer on the average of every seven lever-pressing responses, but actually getting a reinforcer may require fewer or more than seven lever responses. The rat is on a ______________ schedule of reinforcement.

A variable-ratio
B variable-interval
C fixed-ratio
D fixed-interval

Q30 A house cleaner gets paid for each house he cleans. The more houses he cleans, the more he gets paid.

The house cleaner is on a _______________ schedule of reinforcement.

A fixed-ratio
B fixed-interval
C variable-ratio
D variable-interval

The answers to the Chapter 10 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

A primary school teacher gives a sticker to each student who gets eight or more words correct in a daily spelling test consisting of ten words. At the end of the week, students can trade stickers for time-out from the usual lesson to do a favourite activity. Name this application of conditioning theory.

____

1 mark

Question 2

Learning following which type of reinforcement schedule tends to be most resistant to extinction?

____

1 mark

Question 3

Explain the difference between positive and negative punishment.

____

____

____

2 marks

Question 4

List three key findings of the series of experiments on observational learning (modelling) conducted by Bandura, Ross and Ross (1961, 1963a, 1963b).

3 marks

Question 5

Explain what shaping of a response involves.

2 marks

Question 6

Explain the difference between flooding and graduated exposure with reference to a relevant example.

3 marks

Question 7

With reference to research on latent learning conducted by Tolman and Honzik (1930), explain why classical and operant conditioning may involve cognitive processes.

3 marks

The following information relates to questions 8, 9 and 10.

A psychologist wanted to demonstrate that children of three and four years of age could be affected by behaviour they observed around them.

The psychologist selected two groups of ten children, matching them (as far as possible) for age, intelligence and personality. Each group watched a different Punch and Judy puppet show. Group A, which consisted of seven girls and three boys, saw Punch behaving very badly. He laughed when he saw Judy fall over and wouldn't help her to stand up. Group B, which consisted of six girls and four boys, saw Punch become upset when Judy fell over and went to help her straight away. The children were then observed in their playgroups for the next week and the number of times each child ignored another who was upset or went to help was counted.

The results are shown in the following table.

Group	Offers to help	Times ignored
Group A	7	18
Group B	21	5

Question 8

Construct an operational hypothesis for the experiment.

1 mark

Question 9

What are the independent and dependent variables in the experiment?

2 marks

Question 10

Identify the experimental and control groups, if any.

2 marks

The answers to the Chapter 10 short-answer questions are available at www.OneStopScience.com.au.

11 Normality, mental health and mental illness

You would probably agree that the behaviour of a man at a shopping centre insisting to all passers-by that he is the bushranger Ned Kelly is not normal. You would probably also agree that the woman who avoids television sets because she believes they are used by aliens to read her thoughts is not normal. It seems easy enough to identify behaviour that is not normal. Agreeing on what is normal behaviour also seems relatively straightforward. For example, you would probably agree that thanking a friend for a birthday present is normal behaviour. And that it is normal to smile when feeling happy and to feel saddened by the loss of a loved one. In some cases, however, it is much more difficult to reach agreement on what is normal and what is not normal, or is abnormal (*ab* specifically means 'away from'). For example, consider the list of characteristics and behaviours in Learning Activity 11.1.

Figure 11.1 Is it normal or abnormal (a) for a young girl to be in love with someone she has never met or (b) for a man to wear black make-up and clothing everywhere each day?

Learning Activity 11.1

Normal versus abnormal behaviour

In a small group, discuss the following list of characteristics and behaviours. For each item in the list, try to reach agreement as to whether it would be considered normal or abnormal. Compare your group's decisions with those of another group (or groups).

- being scared of hairy spiders
- enjoying skydiving
- wearing black make-up and clothing everywhere each day
- changing your plans because of a horoscope prediction
- walking arm in arm down the street with a friend of the same sex
- having a belly button that sticks out (an 'outie')
- being in love with someone you have never met
- achieving an extremely high IQ score on an intelligence test
- preferring to live alone and isolated from others
- being able to provide help to someone in need of it, but choosing not to do so

You probably found that you experienced difficulty in reaching agreement on what is normal and abnormal for some of the items in Learning Activity 11.1. For some items, you may have even thought 'It depends …', and this was a stumbling block. This is not surprising because even in psychology the meanings of normality and abnormality in relation to thoughts, feelings and behaviour can vary.

Normality and abnormality

Throughout the history of psychology, many different approaches to defining or describing normality and abnormality in relation to mental processes and behaviour have been proposed. Six approaches that have been influential are the *socio-cultural*, *functional*, *historical*, *situational*, *medical* and *statistical* approaches. Each of these approaches views normality and abnormality from a different perspective and has a different emphasis on how normality and abnormality are best considered.

Approaches to defining normality and abnormality

Socio-cultural approach

Thoughts, feelings and behaviour that are appropriate or acceptable in a particular society or culture are viewed as normal and those that are inappropriate or unacceptable are considered abnormal. For example, in some cultures, loud crying and wailing at the funeral of a stranger is expected and considered normal, whereas in other cultures it would be considered abnormal as it is inappropriate in that culture to wail at the funeral of a stranger.

Functional approach

Thoughts, feelings and behaviour are viewed as normal if the individual is able to cope with living independently ('function') in society, but considered abnormal if the individual is unable to function effectively in society. From this perspective, being able to feed and clothe yourself, find a job, make friends and so on is normal, but being so unhappy and lethargic that you cannot get out of bed each morning, do not eat properly, cannot hold a job and avoid relationships with others is abnormal.

Historical approach

What is considered normal and abnormal in a particular society or culture depends on the era, or period of time, when the judgment is made. For example, in many western societies prior to the 20th century, if a parent severely smacked their child for misbehaving, few people would have considered this to be abnormal behaviour, but in western societies and cultures today, such behaviour by a parent could be considered abnormal and may even be illegal.

Situational approach

Within a society or culture, thoughts, feelings and behaviour that may be considered normal in one situation may be considered abnormal in another. For example, if you were to come to school wearing pyjamas, most of your classmates would think that your behaviour was abnormal, yet it is considered normal to wear pyjamas to bed.

Medical approach

Abnormal thoughts, feelings or behaviour are viewed as having an underlying biological cause and can usually be diagnosed and treated. For example, if someone commonly thinks in a disorganised way, sees or hears things that are not really there, and always showers in their swimming costume because they believe they are constantly under surveillance by ASIO, then this pattern of thoughts, feelings and behaviour could be diagnosed as schizophrenia primarily attributable to neurochemical factors, requiring treatment with prescribed medications.

Statistical approach

The statistical approach is based on the idea that any behaviour or characteristic in a large group of individuals is distributed in a particular way; that is, in a normal distribution. Generally, if a large majority of people, called the 'statistical average', thinks, feels or behaves in a certain way, it is considered normal. For example, by this definition, it is normal to laugh when tickled, because most people do. If the thought, feeling or behaviour is shared by a small minority of people, called the 'statistical extremity', then it is considered abnormal. For example, to laugh when a loved one dies might be considered abnormal because very few people do this.

Contemporary psychologists recognise that none of these approaches to describing normality or abnormality is entirely satisfactory on its own. However, each approach has contributed to the understanding of normality or abnormality—in particular, of the various factors that need to be considered when using the terms in relation to someone's thoughts, feelings or behaviour. This is important as the way normality and abnormality are viewed and described provides the basis of diagnosing and treating mental disorders.

Although **normality** is often defined as a pattern of thoughts, feelings or behaviour that conforms to a usual, typical or expected standard, it is recognised that what is a 'usual, typical or expected standard' depends upon many different factors. For example, as emphasised by the socio-cultural approach, all thoughts, feelings and behaviour originate from a cultural context, and culture can therefore shape or determine how normality and abnormality are defined.

Figure 11.2 What is accepted as normal in one situation may be considered abnormal in another. If a man violently threw himself at another man and pushed him to the ground in a public space, this would be considered abnormal. However, if the man were on a football field, this behaviour would be considered normal.

Figure 11.3 A Buddhist monk is performing an exorcism, a supernaturally based cure that is common in Thailand and many other cultures and subcultures in which exorcism may be a religious or spiritual cure. In Australia, similar behaviour would break norms, or standards, for acceptable behaviour and would be considered abnormal.

Figure 11.4 These American university students are taking a break during a nude protest on campus about sweatshops. Public nudity is considered 'abnormal' in such places, yet if these students lived in a nudist colony, they would be considered 'overdressed'.

Similarly, the specific situation or context in which a thought, feeling or behaviour is expressed is an equally important consideration, as is the quality of an individual's functioning in different situations in everyday life. In one form or another, *each* of the six approaches has influenced the way normal (and abnormal) thoughts, feelings and behaviour are viewed and studied in psychology. In sum, there is no universally accepted single definition of normality in psychology and psychologists tend to avoid defining it. The unique combination of individual characteristics occurring among humans has created such diversity that many psychologists tend to focus on understanding and explaining our individual differences.

Pinpointing the meaning of abnormality in relation to mental processes and behaviour is of greater concern to psychologists because of its implications for the diagnosis and treatment of mental health problems. As with normality, there is no single definition of abnormality that is universally accepted. The definitions are also subject to the same types of factors that influence definitions of normality.

Some definitions of abnormality focus exclusively on the *concept* of abnormal, describing it as a pattern of thoughts, feelings or behaviour that is a deviation from, or 'away from', what is considered normal or most prevalent in a cultural context. Conceptual definitions are particularly useful for providing a basis from which theoretical models and principles can be developed or applied in describing and explaining abnormality. Other definitions of abnormality have a *practical* emphasis that takes account of the effects that thoughts, feelings and behaviour have on the individual demonstrating them, as well as on others. These definitions are more useful than conceptual definitions for diagnosing and treating mental health problems as they tend to be based on criteria used for diagnostic and treatment purposes. For example, in practical terms, **abnormality** may be defined as a pattern of thoughts, feelings or behaviour that is deviant, distressing and dysfunctional.

According to this definition, thoughts, feelings or behaviour are considered *deviant* when they differ or vary so markedly from social or cultural norms 'governing' behaviour that they can reasonably (or legally) be considered inappropriate or unacceptable.

Generally, a barely noticeable difference would not be considered deviant but thinking, feeling or behaving in a way that is extreme, unusual, or perhaps even bizarre, would be. Thoughts, feelings or behaviour are considered *distressing* when they are unpleasant and upsetting to the person experiencing them and/or others around them. Finally, thoughts, feelings or behaviour are considered *dysfunctional* if they interfere with the person's ability to carry out their usual daily activities in an effective way. That is, thinking, feeling or behaving in a particular way distracts or confuses the person so much that it affects their ability to care for themselves, go to school or work and participate in their relationships with others. For example, an individual with a fear of contamination may repeatedly wash their hands. Washing hands is in itself not an abnormal behaviour. However, it can be considered dysfunctional (and therefore abnormal) when spending as many as five hours each day handwashing interferes with one's ability to function effectively in everyday life.

Figure 11.5 Handwashing would only be considered dysfunctional if it is done so many times each day that it interferes with the person's ability to effectively carry out their usual daily activities.

Learning Activity 11.2

Review questions

1 Explain the meaning of the term normality with reference to an example.

2 Name and outline the main approaches psychologists have used to describe normality and to differentiate normality and abnormality.

3 a Describe two examples of normal behaviour in Australian society that may be considered abnormal in another society.

b Describe two examples of normal behaviour in a cultural group within Australian society that may be considered abnormal by another cultural group in Australia.

4 a Explain the meaning of the term abnormality with reference to an example.

b Consider the following description of Alessio and explain whether his thoughts, feelings and behaviour are normal or abnormal, with reference to deviance, distress and dysfunction.

Before leaving his house, Alessio checks that all the electrical appliances are unplugged (because he thinks they might start a fire while he's out), all the taps are completely turned off (because he thinks they might flood his house while he's out) and that all the doors and windows are properly secured (because he thinks someone might break in while he's out). On a couple of occasions, Alessio has made several journeys back and forth to his home to check that things are as they should be, because he had a 'niggling doubt' that his first check was not done properly. Alessio's 'checking' behaviour consumes several hours of his day and it has got to the point where he has been late for work so often that he's just been dismissed. The situation between Alessio and his girlfriend is also strained. Alessio's girlfriend reports that 'he has no time for me anymore'. Alessio wants to stop having to 'check' things all the time, but if he doesn't do it, he experiences so much anxiety that he is nearly physically sick.

5 Under what circumstances is 'feeling stressed' normal or abnormal?

Learning Activity 11.3

Practical activity on appearance and normality

Cut out about eight to ten photos of people from magazines and paste them on a sheet of A3-sized paper. At least two of the pictures must be of people with messy hair and/or untidy clothing (or general appearance).

Ask males and females of different ages who are not members of your psychology class to indicate which of the people in the pictures have a mental illness.

1. How many selected the people with a messy appearance?
2. Were age or sex differences evident in the responses?
3. What tentative conclusion(s) about views of normality (or abnormality) in your community can be drawn from this research activity?

Health and illness

According to the World Health Organization (WHO), **health** is a state of complete physical, mental and social wellbeing and not merely the absence of illness or disease. This definition was first proposed by the WHO in 1948 and still remains a widely used definition of health or reference for describing health. It is also commonly used by all types of health professionals, including mental health professionals such as psychologists.

The WHO definition describes physical, mental and social wellbeing as all being equally important to the overall health of any individual. As shown in figure 11.6, these three aspects of health can be represented as a 'health triangle'. *Physical wellbeing* primarily involves the body and such activities as exercising regularly, eating a well-balanced diet, getting rest when required, and maintaining the body weight that is biologically most appropriate for the individual. *Mental wellbeing* primarily involves the mind and such activities as expressing feelings calmly even when angry or sad, rationally thinking about personal problems and issues that arise in everyday life, and approaching life with a view that there is much to be learnt through experience and that learning continues throughout the lifespan. *Social wellbeing* primarily involves personal relationships and interactions with others and such

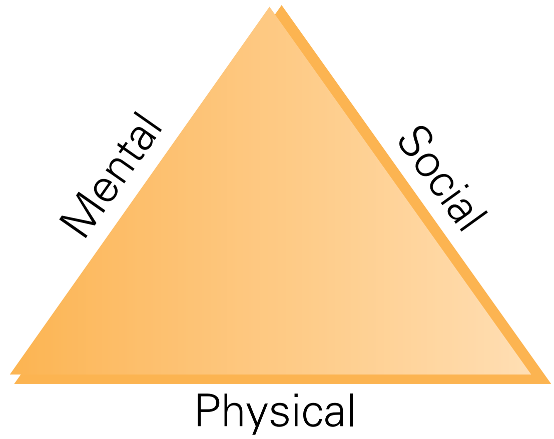


Figure 11.6 The health triangle represents the three aspects of health as equally important in overall health.

activities as getting along with family, friends and acquaintances, giving and receiving social support when needed, and making and keeping friends. The health triangle has three sides of equal length to show that no single aspect of health is more or less important to overall health than the others. Devoting more attention to one aspect of health, while neglecting another, can lead to 'illness or disease'.

The WHO definition of health also emphasises the relationship of health to illness and disease, but distinguishes between illness and disease. **Illness** refers to a person's subjective experience of feeling unwell in relation to one or more aspects of their health. This means that illness involves how an individual thinks and feels about their physical, mental and/or social wellbeing. More specifically, it relates to an individual's personal interpretation of some aspect of their health or overall health, their description of their symptoms, reactions to their symptoms, and what they can or cannot do as a consequence of their condition. The symptoms associated with illness and their onset may be *acute* (that is, sudden in onset and lasting for a short duration) or they may be *chronic* (that is, have a gradual onset and be frequently recurring or longlasting). The symptoms may also vary in intensity and their effects may be more or less serious in terms of their consequences for the individual. Often, when a person reports illness, there is evidence of disease. The term 'disease' is used primarily in relation to physical wellbeing rather than mental or social wellbeing.

Disease refers to identifiable physiological changes associated with an abnormal bodily condition. It is a medical doctor's objective findings of physiological changes that are common to all people with a particular disease and have been documented by the medical profession. Although disease often accompanies illness, this is not always the case. For example, it is possible to have a disease (such as a brain tumour) without feeling ill, and for someone to feel ill or not well even though a doctor cannot find evidence of any known disease. Furthermore, people with the same disease may experience illness associated with that disease in different ways, given the subjective nature of illness (Campling & Sharpe, 2006).

Learning Activity 11.4

Review questions

1 Explain the meaning of the term health with reference to an example.

2 a Distinguish between the three aspects of health considered by the WHO to be equally important.
  b Give an example of an activity that you believe would maintain each aspect of health.

3 a Distinguish between illness and disease with reference to an example.
  b Describe the relationship between illness and disease with reference to an example.
  c In what way might subjectivity influence a doctor's diagnosis of a disease?
  d Suggest a reason to explain why the term disease is primarily used in relation to physical wellbeing rather than psychological wellbeing.

Learning Activity 11.5

Visual presentation using the health triangle

Draw a health triangle such as that shown in figure 11.7 and label each side. On each side of the triangle, include at least three diagrams or images that show activities in which you often engage and that you believe maintain that aspect of your health. Ensure each diagram or image clearly identifies the specific activity it represents.

After you have prepared your presentation, evaluate your current lifestyle with reference to activities relating to each aspect of health. Write a short report referring to what you do or could do more often in order to achieve or maintain a healthy lifestyle that ensures all three aspects are 'balanced'.

Differentiating physical health from physical illness

For most people, the distinction between physical health and physical illness is quite clear. **Physical health** refers to the body's ability to function efficiently and effectively in work and leisure activities, to be in good condition, to resist disease and to cope in threatening or emergency situations. When we are physically healthy, or experience physical wellbeing, our bodies are functioning as we know they should and we have no aches, pains or problems that cause us concern or prevent us from doing the things we normally do or want to do. The symptoms or signs of good physical health can be objectively assessed by a medical practitioner. These signs include having a normal temperature, heart rate, blood pressure, cholesterol level, breathing rate, eyesight and hearing; feeling bright and alert (no fatigue); having regular and normal stools (no blood) and normal urine; and having healthy gums.

The term **physical illness** refers to our subjective experience of a disease or physical health problem that interferes with the normal functioning of our body and adversely impacts on our ability to function effectively in everyday life. The term tends to be used when physical problems experienced by a person are more serious than a temporary ache or pain, are likely to persist for a relatively long time and are also likely to require a longer-term treatment plan. For example, diseases underlying physical illness could include diabetes, kidney or heart disorder, multiple sclerosis, HIV, cancer and other serious tumours. Often diseases are distinguished from *physical health problems* that are experienced when our body doesn't function as well as it could and therefore often also underlie physical illness. Such problems are generally less serious in nature than a disease and likely to pass, often without medical intervention. However, they may also be symptoms of a disease that is developing or already exists. Examples of physical health problems include ear infection, sore throat, headaches and dizziness, aches and pains, chronic tiredness, fever, diarrhoea or constipation, shortness of breath, and itchy red eyes or blurred vision.

Differentiating mental health from mental illness

Mental health and mental illness are similar to physical health and physical illness in several ways; however, mental health and illness primarily involve the mind, whereas physical health and illness primarily involve the body. When we are mentally healthy, our mind functions as it is supposed to. **Mental health** is the capacity of an individual to interact with others and the environment in ways that promote subjective wellbeing, optimal development throughout the lifespan and effective use of the person's cognitive, emotional and social abilities (Australian Institute of Health and Welfare, 2010).

As shown in table 11.1, characteristics of good mental health include being able to establish and maintain positive social relationships and to cope effectively with problems and issues that arise in everyday life. Unlike the WHO definition of health, psychologists tend not to describe mental wellbeing and social wellbeing as separate aspects of health. Instead, mental wellbeing is viewed as including social wellbeing and is therefore an aspect of mental health. Mental health may also be referred to as *psychological health* and the two terms are often used interchangeably. However, like the WHO, psychologists view good mental health as a vital part of overall health and wellbeing. It is also recognised in psychology that our state of physical health can affect our mental health and vice versa. As you are aware, each often affects the other, so it is just as important to maintain good physical health as it is to maintain good mental health.

Mental health is not something we either have or do not have. Instead, we may be more or less mentally healthy (or not healthy). Therefore, mental health is often represented as being on a continuum, ranging from mentally healthy, when we are functioning well and coping with the normal stressors of everyday life, through to a mental health problem (usually mild and temporary) or to a mental illness that may be serious and/or prolonged (see figure 11.8). The term 'mental illness' is more likely to be used when difficulties experienced by a person are more serious, likely to persist for a relatively long time

Table 11.1 Characteristics of mental health, mental health problems and mental illness

Mental health	Mental health problem	Mental illness (disorder)
People who are mentally healthy can: • form positive relationships with others • cope with the normal stressors arising in everyday life • think logically and clearly • manage feelings and emotions (no extreme highs or lows) • experience pleasure and enjoyment • use their abilities to reach their potential.	The mind of people with mental health problems doesn't function as well as it could. People may: • feel tense, low, irritable, quiet, confused, angry • experience increased or decreased sleep and appetite • experience a loss of energy and motivation • feel that things are somehow 'different' • have difficulties concentrating • become withdrawn.	People are diagnosed with a specific mental illness, such as: • anxiety disorder; e.g., specific phobia • mood disorder; e.g., major depression • psychotic disorder; e.g., schizophrenia • impulse control disorder; e.g., pathological gambling.

Figure 11.7 Mental illness primarily involves the mind and physical illness primarily involves the body. However, mental health can affect our physical health and vice versa.

and likely to require a longer-term treatment plan. In such cases, the individual is likely to have a diagnosable mental illness or disorder.

Mental illness describes a psychological dysfunction that usually involves impairment in the ability to cope with everyday life, distress, and thoughts, feelings and/or behaviour that are atypical of the person and may also be inappropriate within their culture. As with the experience of physical illness, mental illness involves variable amounts of impairment, suffering and distress to the person involved. It is also possible for a person to feel mentally ill even though a doctor or mental health professional cannot find evidence of any known disease. Although the WHO defines illness as a person's subjective experience of feeling unwell, in terms of 'mental' functioning, the term 'illness' is used in psychology and psychiatry to describe a diagnosable 'disorder', rather than a subjective experience alone. Consequently, mental illness is also referred to as *mental disorder*. The two terms are often used interchangeably and a person can be described as having or suffering from a specific mental illness (or mental disorder). However, this does not mean that a person with a mental illness does not have a subjective experience of illness or that their subjective experience is not important or relevant to its diagnosis and treatment.

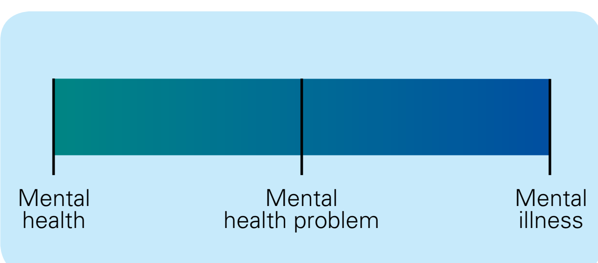


Figure 11.8 Mental health is often represented as being on a continuum from mental health through to a mental health problem and to a mental illness.

Psychological dysfunction refers to a breakdown in cognitive, emotional and/or behavioural 'functioning', thereby interfering with the person's ability to adjust to the challenges of everyday life and carry out some or all of their usual daily activities in an effective way. In simple terms, this means that the person does not think, feel and/or behave as they normally do and it affects their ability to cope effectively with everyday life experiences. For example, a person may be so fearful of crowds that they cannot go shopping in a supermarket or catch a bus to work, or a person may be so afraid of contamination that they cannot hug or kiss their own children. Similarly, suppose you agreed to go to a party on a blind date with someone. Imagine feeling so anxious and distressed during the entire evening that you were unable to talk to people and felt sick, and that all you wanted to do was go home. In this situation, it could be said that your thoughts and feelings are dysfunctional, as they are preventing you from having a good time and thereby leading you to behave in a way that is different from how you would normally behave at a party. However, if your friends met your date at the party and agreed with you that he or she seemed secretive, untrustworthy and suspicious, it would not be considered dysfunctional for you to be anxious and want to return to the safety of your home.

Distress often accompanies dysfunction. When a person experiences *distress* they are very upset, anxious and/or unhappy. People experience distress for many different reasons in everyday life. For example, if someone close to you dies, it would be normal for you to be extremely upset. Therefore, defining mental illness by the presence of distress alone is misleading. However, distress is often present when someone has a mental illness and distress is not only caused by loss or grief.

Impairment in the ability to cope with everyday life is another characteristic of mental illness. If a person is unable to do the things they normally do on a daily basis because of their mental state, they are considered to have impaired functioning. However, as with other characteristics, impaired functioning on its own does not necessarily indicate a mental illness. For example, some people might be shy or lazy. While being shy or lazy might impair their functioning to the extent that it may prevent them from doing some things, this does not mean they have a mental illness. A shy person would be considered to have impaired functioning if they were so shy that they found it impossible to mix with others, were unable to attend school or work and avoided situations where other people were present.

Another characteristic of a mental illness is that a person's thoughts, feelings and behaviour are atypical. *Atypical* means that the person responds in a way(s) that is not normal, or 'typical' for them. For example, if a usually friendly, outgoing person becomes withdrawn, does not talk or interact with others and stays in their bedroom alone for extended periods of time, they would be considered to be behaving in a way that is atypical for them. However, someone who behaves in an unconventional or extremely different way would not necessarily be considered to be showing symptoms of a mental illness. For example, a rock star who is normally well-spoken and polite when out of the public eye may dress, speak and behave outrageously as a part of their performance and the public image they wish to portray. Their performance is atypical of their normal everyday behaviour but not of their behaviour when on stage. However, this does not mean that their atypical behaviour when performing is a symptom of a mental illness.

Finally, even if a person's thoughts, feelings and behaviour appear to be abnormal, if the ways that they think, feel and act are culturally appropriate and/or common in their society, then they would probably not be considered to have a mental illness. Each culture or society has its own set of standards, or 'norms', for what is considered normal and abnormal within that culture or society. For example, in many western cultures a person in a 'trance-like' state who believed they were possessed by the devil would probably be considered to have a mental illness. However, in some cultures, this behaviour would not be considered unusual or abnormal. In these cultures, individuals who experience this state may even be highly regarded, as it may be believed that they have direct contact with God. Therefore, it is important to take account of a person's cultural background and experiences before judging whether their behaviour is a symptom of mental illness.

Box 11.1

Incidence of mental illness in Australia

Mental illness, like physical illness, is common in Australia and its incidence has steadily increased over the past 20 years. This does not mean there is a mental illness 'epidemic' in Australia. Rather, greater community awareness of mental illness, and media campaigns that encourage people to recognise and seek support for mental health issues, may explain the recent increase in self-reports for having experienced mental illness.

The second *National Survey of Mental Health and Wellbeing* (NSMHW2) was conducted in 2007 by the Australian Bureau of Statistics (ABS) to provide updated evidence on the prevalence of mental illness in the Australian population, its impact and the use of services and medication by people with mental illnesses. The NSMHW2 focuses on types of mental illnesses that are more commonly experienced, specifically non-psychotic mental illness such as affective disorders (including major depression), anxiety disorders and substance abuse disorders. Someone experiencing a *non-psychotic* illness maintains contact with reality despite their psychological dysfunction, whereas a *psychotic* mental illness (for example, schizophrenia) involves loss of contact with reality.

The NSMHW2 sampled 16–85-year-olds from 8841 households throughout Australia. It was found that one in five (20%) of Australian adults experience mental illness in any year. Based on this result, approximately 3.2 million Australians had experienced a mental illness in the previous 12 months. It was also found that close to half of the Australian population (45.5%) has experienced mental illness at some point in their lifetime.

The survey findings also indicate that males and females experience mental illness in similar numbers. However there is a gender difference in the type of mental illness experienced. For example, as shown in table 11.2, males experience substance abuse disorders, such as alcohol and drug dependence, much more than females, whereas females report experiencing anxiety-related disorders more than males. Furthermore, more females experience an affective disorder such as depression than do males.

As shown in figure 11.9, mental illness can be experienced in any stage of the lifespan. However, more people aged between 16 and 24 years reported having experienced a mental illness in the previous 12 months than was reported by people in any other age group. One explanation of this finding is that young people experience many psychological changes throughout their adolescent years at the same time as they are trying to establish their identity—a time of considerable upheaval.

Table 11.2 Gender differences in reported experiences of mental illnesses

Mental illness	% in population		
	Female	Male	Total
Any non-psychotic illness	43	48	45
Anxiety disorder (e.g. phobia)	32	20	26
Substance abuse disorder (e.g. alcohol or drug dependence)	14	35	25
Affective disorder (e.g. depression)	18	12	15

Source: Australian Bureau of Statistics (2007). *National Survey of Mental Health and Wellbeing.* ABS Cat. No. 4326.0. Canberra: ABS.

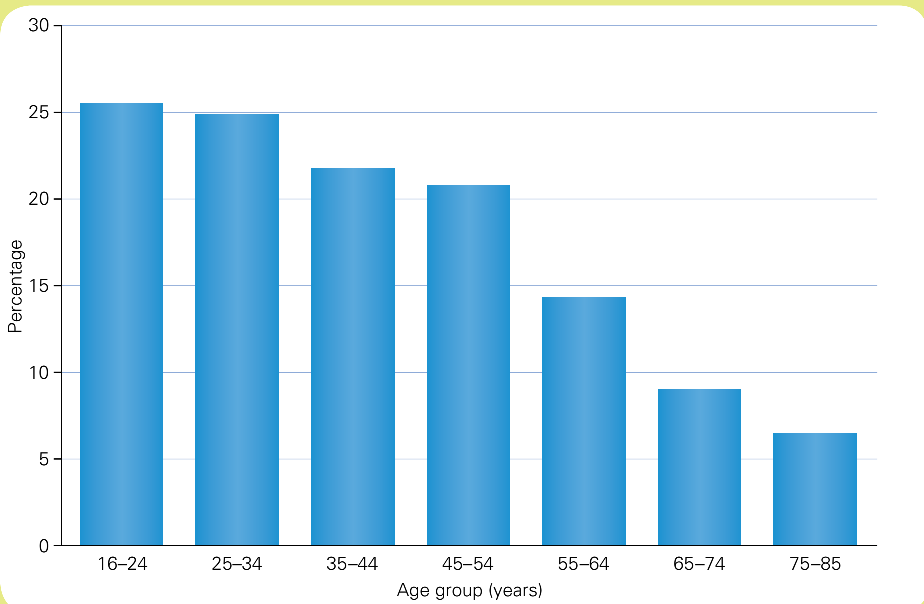


Figure 11.9 Comparison by age group of the percentage of people who reported having experienced mental illness in the previous 12-month period

Source: Australian Bureau of Statistics (2007). *National Survey of Mental Health and Wellbeing.* ABS Cat. No. 4326.0. Canberra: ABS.

Box 11.2

Maintaining good mental health

If you asked, most people would be able to tell you how they could look after their physical health. For example, they are likely to make such statements as: 'Make sure I get enough rest', 'Eat healthy foods and exercise regularly' and 'Take any medication prescribed by a doctor'. But fewer people are likely to be able to tell you how they could look after their mental health.

Good mental health helps us to more fully enjoy life and appreciate the people and environment around us. We respond better to the stressors and challenges of daily life, use our abilities to the fullest and make the most of opportunities when our mental health is strong.

The Mental Health Council of Australia advises that there are three categories of activities we can do to build and maintain good mental health. These involve practising ABCs.

- **A**ct by keeping yourself as active as possible, physically, socially and mentally. For example:
  - exercise—regular physical activity improves psychological wellbeing and can reduce depression and anxiety
  - enjoy hobbies—taking up a hobby brings balance to your life by allowing you do something you enjoy, and it also keeps your brain active
  - treat yourself well—cook yourself a good meal, have a bubble bath, see a movie, call a friend or relative you haven't called for ages, sit on a park bench and take in your surroundings.
- **B**elong by connecting to your community. For example:
  - invite—join a group, chat to a neighbour, meet a friend
  - share a laugh—life often gets too serious, so when you hear or see something that makes you smile or laugh share it with someone you know
  - do one thing at a time—for example, when you are out for a walk or spending time with friends, turn off your mobile phone and stop making that mental 'to do' list.
- **C**ommit to looking for challenges, having a go and getting involved. For example:
  - 'collect' positive emotional moments—recall times when you have experienced pleasure, comfort, tenderness, confidence or other positive emotions
  - learn ways to cope with negative thoughts—don't block negative thoughts but learn how to interrupt them and not let them take over
  - set personal goals—for example, finish that book you started three years ago, walk around the block every day, learn a new skill, call your friends instead of waiting for the phone to ring
  - keep a journal (or even talk to the wall!)—expressing yourself after a stressful day can help you gain perspective, release tension and even boost your body's resistance to illness
  - volunteer—volunteering helps others, makes us feel good about ourselves, widens social networks, provides new learning experiences, and can bring balance to people's lives.

Source: adapted from Mental Health Council of Australia (2010). *Be Active for Your Mental Health*, fact sheet, www.mhca.org.au/resources.

Figure 11.10 Exercising regularly is good for both your mental and physical health.

Box 11.3

Medical student syndrome

Have you ever read about a disease or disorder on the internet or heard about it on television and become convinced that you are suffering the same symptoms and therefore must have the disease or disorder? This is known as medical student syndrome, as it is most frequently observed in medical students.

It is thought that psychology students who study mental disorders may also suffer from the same syndrome. Although some students do suffer from a disorder, most are merely experiencing an exaggerated sense of their susceptibility to a disorder. It has been found that one in every five individuals responds 'yes' to the question 'Have you ever felt that you were going to have a nervous breakdown?' Of course, most of these people have never suffered an actual breakdown (Sue, Sue & Sue, 2005).

Research has shown that students who plan to major in psychology report more worry about their psychological health than those planning to major in another field. However, the process of learning about psychological disorders eventually decreases their anxiety about their own mental health but increases it about the health of their family members.

It is also thought that anyone who reads a lot of medical information is susceptible to medical student syndrome. More recently, the term 'cyberchondria' has been coined to describe the condition suffered by people who use the wealth of medical material on the internet to diagnose themselves with a dire health disorder. What starts as a web search about headache leads to the conclusion that they must have a brain tumour!

As you learn more about psychology you may recognise 'symptoms' in yourself—or in others. These so-called symptoms are likely to be a normal reaction to life circumstances and not a sign of a disease or disorder. For example, feeling down, anxious or overwhelmed may be an understandable response to a stressful situation such as studying VCE. However, if you are concerned, talk over your fears with a friend, family member or teacher. If you then feel you may have a problem, consider getting help from your school's student welfare service or other mental health professional.

Learning Activity 11.6

Review questions

1 Distinguish between physical health and physical illness with reference to an example.
2 Explain the meaning of mental health with reference to examples of the thinking, feeling and behaviour of a mentally healthy person.
3 Explain the meaning of mental illness with reference to an example that illustrates the key elements of the definition, but not an example used in the text.
4 Identify similarities and differences between the characteristics of abnormality and mental illness.
5 How relevant to describing mental illness are the approaches to describing abnormality? Explain your answer.
6 Does abnormal behaviour necessarily indicate the presence of mental illness? Explain your answer.
7 Distinguish between mental health and mental illness with reference to an example.
8 In what way(s) might mental health (and illness) be related to physical health (and illness)?
9 In your opinion, which is more serious: mental illness or physical illness? Explain.

Learning Activity 11.7

Visual presentation on normality, mental health and mental illness

Prepare a visual presentation in which you:

- differentiate between normality and abnormality
- differentiate between mental health and mental illness
- describe the relationship between normality and mental health
- describe the relationship between abnormality and mental illness.

You may select from a range of formats to present your information; for example, a PowerPoint presentation, a poster, a concept map, a flow chart or a combination of formats. Photographs and other visual or art media may be used.

Written information may be in dot-point form but you should ensure that all relevant information is accurately and adequately explained, using appropriate examples to clarify your understanding of key concepts.

The biopsychosocial framework

Our physical and mental health are subject to many and varied factors that can influence our overall wellbeing at different times throughout our entire lifespan. These influences have been organised into three different domains, or areas, within a framework called the biopsychosocial framework.

The **biopsychosocial framework**, also called the *biopsychosocial model* or *theory*, is an approach to describing and explaining how biological, psychological and social factors combine and interact to influence a person's physical and mental health. The framework is based on the idea that both health and illness are best understood by considering specific factors from within each domain and how these factors may combine and interact to influence our wellbeing.

Biological factors involve physiologically based or determined influences, often not under our control, such as the genes we inherit and our neurochemistry. *Psychological factors* involve all those influences associated with mental processes such as how we think; learn; make decisions; solve problems; perceive our internal and external environments; perceive, understand and experience emotions; manage stress; reconstruct memories; and so on. *Social factors* are described broadly to include such factors as our skills in interacting with others, the range and quality of our interpersonal relationships, the amount and type of support available from others when needed, as well as socio-cultural factors such as our cultural values and traditions, family upbringing, exposure to trauma and stressors, educational and employment history, income level and access to medical care (Engel, 1977).

The biopsychosocial framework reflects a *holistic* view of health; that is, the individual should be considered as a 'whole person' functioning in their unique environment. The framework focuses not just on the individual's physical or mental condition ('within the

Figure 11.11 The biopsychosocial framework reflects a holistic view of health—the individual is considered as a whole person in their unique environment.

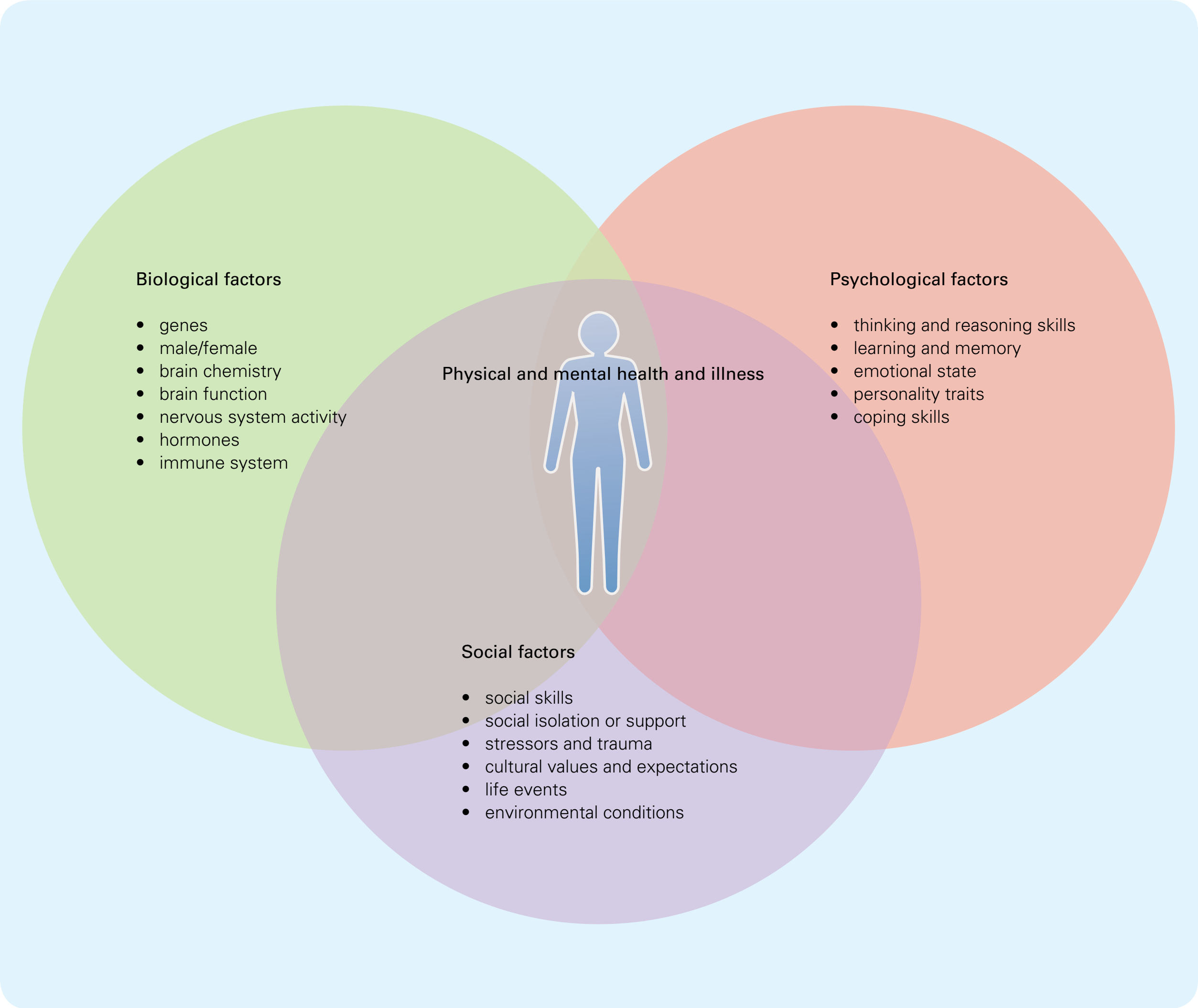


Figure 11.12 Most contemporary psychologists believe that biological, psychological and social factors interact to influence physical and mental health and, conversely, to produce physical and mental illness.

individual'), but also their wider social context or circumstances ('outside the individual'). Focusing on the influence of factors from one or two domains, rather than all three, is likely to give an incomplete and therefore inaccurate picture of a person's health. This also applies to an illness or disease an individual may have and the treatment and management plan. For example, according to the biopsychosocial framework, a personality disorder might best be explained by the combined influence of an individual's inheritance of certain genes and impaired functioning of a part of the brain that controls impulsive behaviour (*biological* factors), poor self-image and an intense fear of abandonment (*psychological* factors), and their strict upbringing and lack of skills required to develop and maintain social relationships (*social* factors).

The biopsychosocial framework therefore views each of the three domains as equally important for both physical and mental health. However, it is recognised that specific factors may have more or less influence on an individual's physical and mental health. In addition, factors often combine and interact in a complex way. For example, factors within each domain may combine with other factors in the same domain as well as with factors in the other two domains. This complex interaction of multiple factors helps account for individual differences in health and, conversely, the experience of illness or disease.

Box 11.4

Olivia Newton-John Cancer and Wellness Centre at Melbourne's Austin Hospital

Figure 11.13 Olivia Newton-John

A unique Wellness Centre

Innovations in cancer management require close integration of laboratory developments and research with patients, with scientists and doctors working side by side in a relationship that fosters special synergies.

It is within this environment of cooperation that the Olivia Newton-John Cancer and Wellness Centre will operate.

The Olivia Newton-John Cancer and Wellness Centre will offer patients a specially designed Wellness Centre. In line with Olivia's dedication to the promotion of patient-centred wellness programs, this centre will focus on the needs of the whole person.

The Wellness Centre will provide much needed space to further develop some patient-centred aspects of care, such as relaxation, massage and meditation, as well as providing education and information for patients and their families.

It will be a tranquil and inspirational space for patients to actively balance the various aspects of their treatment, including a combination of 'quiet space' for reflection and 'community space' for the sharing of ideas, experiences and support.

It will be a special place where people can reaffirm their identity as an individual, not just a cancer patient.

How does Wellness help?

As patients with a life-threatening illness face the consequences of that illness, they often express a need to balance the medical facets of their care with spiritual and emotional aspects in order to better cope with the disease. Patients involved in wellness programs learn new skills that help them to regain control of their lives, reduce feelings of isolation and restore hope, regardless of the stage of their disease.

They become active participants in the journey of their illness.

Current wellness programs

Cancer Support Group

This is a self-help group that meets on a monthly basis. It provides an opportunity to express feelings, share experiences, give mutual support and further understand cancer.

Living with Cancer

This is a program to help patients and their carers to better understand cancer. It focuses on the importance of staying positive and is an education and support program. The emphasis is on interacting and sharing experiences with each other.

Look Good … Feel Better

This is a program run by beauty therapists for women undergoing cancer treatment. The aim is to assist patients in looking at new ways of coping with issues such as hair loss, changes in skin tone, and self-esteem, and to restore appearance and self-image.

Transition Program
This is a series of information/discussion sessions for women who have recently finished breast cancer therapy. Themes addressed include living with uncertainty, sexuality and intimacy, coping with the reactions of others, and creating life after cancer.

Meditation
Meditation provides simple techniques for developing a sense of overall relaxation and calming the mind.

Relaxation
Relaxation can be very helpful for some patients to achieve a sense of control over their illness and to reduce anxiety in what is a very difficult time.

Music Therapy Program
Music Therapy is the planned and creative use of music to attain and maintain health and wellbeing.

Art Therapy Program
This program operates in the Palliative Care Unit and is conducted by students from an Art Therapy Program.

Aromatherapy
This is available on all Cancer wards and is used as a means of relaxation and calming.

Source: Austin Health (2004). The Olivia Newton-John Cancer Centre, www.oliviaappeal.com.

Learning Activity 11.8

Review questions

1 What is the biopsychosocial framework?

2 a Name and describe the three domains in the biopsychosocial framework with reference to relevant examples.
 b For each domain, give two additional examples of factors not referred to in the text.
 c Give an example of a factor that you believe does not clearly belong within a specific domain or may be relevant to more than one domain. Explain your choice.

3 Briefly describe three key characteristics of the biopsychosocial framework's explanation of physical and mental health.

4 Give a reason to explain why the framework may also be described as a model or theory.

5 Consider a recent time when you were physically ill or feeling stressed. You do not have to name the illness or the source of your stress. Make a copy of the following table and identify factors from each domain that may have contributed to:
 a the onset of the illness or stress
 b recovery from the illness or stress.

Illness or stress	Biological factors	Psychological factors	Social factors
a Onset			
b Recovery			

6 Write a series of questions a doctor or psychologist who has adopted the biopsychosocial framework may ask a patient or client presenting with symptoms of a physical or a mental health problem.

Learning Activity 11.9

Visual presentation on the biopsychosocial framework

Construct a diagram different from that in figure 11.12 to represent the biopsychosocial framework's approach to describing and explaining physical and mental health.

In your diagram:

- show the relationship between the domains
- show possible relationships between different factors within each domain
- include examples of factors in addition to those described in the text.

Beneath your diagram, write a caption that briefly describes the framework and how it explains physical and mental health.

Learning Activity 11.10

Media response

Consider the rationale and approach to treating cancer patients in the Olivia Newton-John Cancer Centre at the Austin Hospital, as described in box 11.4. In what ways are the rationale and approach of the centre consistent or inconsistent with the biopsychosocial framework? Explain with reference to key characteristics of the framework and relevant information from box 11.4.

Learning Activity 11.11

Essay on mental health and mental illness

Write an essay of about 400–500 words in which you differentiate between mental health and mental illness from the perspective of the biopsychosocial framework. References may be used in obtaining information for your essay.

In your essay:

- explain mental health and mental illness, including key issues in defining or describing them
- explain what the biopsychosocial framework is with reference to its key assumptions and characteristics
- explain how the biopsychosocial framework views mental health and mental illness and differentiates between them
- accurately define and explain all key terms and concepts
- use relevant examples to demonstrate your understanding of key terms and concepts
- express your ideas in a clear and concise way
- organise your information in a logical way
- accurately cite and reference all material using appropriate conventions.

Systems of classification of mental conditions and disorders

All sciences classify. For example, botanists classify plants according to species; astronomers classify the stars, planets and other astronomical bodies according to colour, size and temperature; and the medical profession classifies diseases according to symptoms and the organ or system affected. Likewise, clinical psychologists, psychiatrists and other mental health professionals classify mental health problems and disorders in different categories according to characteristic patterns of thoughts, feelings and behaviour. People also classify in their everyday lives to organise all kinds of information, thereby giving order to and helping make sense of the world. For example, consider the number of times each day you classify experiences on the basis of 'type' or more specific features. Imagine also trying to look for cornflakes in the supermarket if the products were not classified into groups. Because cornflakes are classified as a cereal, you know where to look.

Classification is the organisation of items into groups on the basis of their common properties. Items may be objects, ideas, physical resemblances,

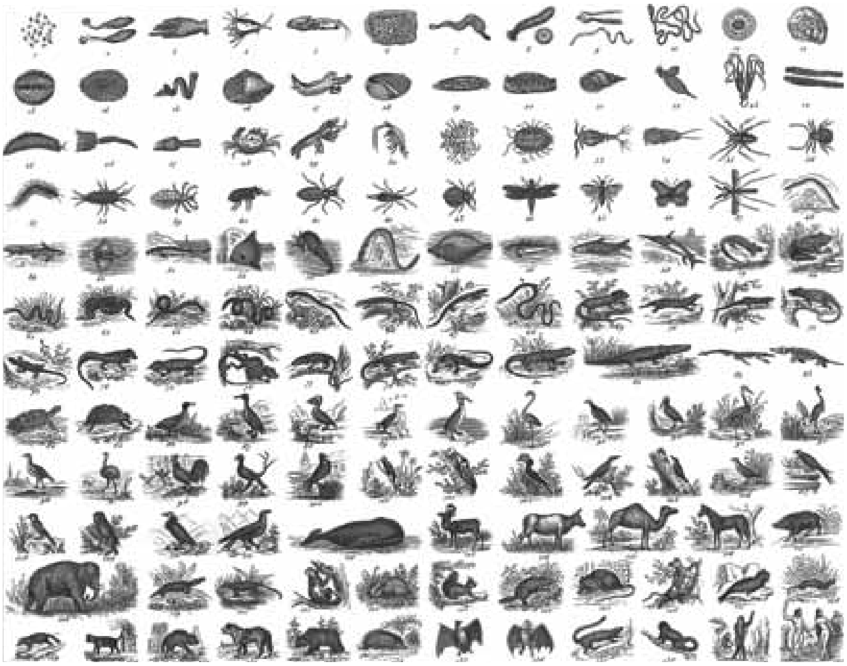


Figure 11.14 An historical classification of animal species from the 19th century. It shows simple cellular organisms (top left) through to humans (bottom right).

abilities, interests, thinking styles, emotions, behaviours, symptoms, diseases, mental disorders or anything else with distinguishable features that are alike or related in one or more ways. Often the groups into which items are organised through classification are referred to as categories or classes. A *category*, or *class*, is a group of items that shares a particular set of properties. A class may be further divided into a number of *subcategories, or subclasses*. Generally, the more subcategories that are used in a classification system, the more the items in subcategories share one or more properties that are a specialised version of the set of properties shared by the original category. Whatever the number of categories or subcategories in a classification system, they are given labels, or 'named', for identification purposes.

As well as enabling order and organisation, classification makes it easier to identify and understand relationships between different groups. Furthermore, the use of specific terms as labels for different categories assists communication between people who use them. For example, the names of the categories and subcategories within classification systems used for diagnosing mental disorders provide concise terms for describing the disorders. These descriptions standardise the uses of terms for mental disorders, thereby assisting communication among psychologists (and psychiatrists) when using the same categories to convey information about clients.

Categorical and dimensional approaches

There are currently two main approaches to classifying mental disorders or illnesses. One approach, called the *categorical approach*, is a 'yes–no' approach to classification. Categorical approaches classify a person's symptoms in terms of which specific category of mental disorder they best fit or 'belong' to. The focus is on diagnosing whether the person has or does not have a disorder.

The other approach, called the *dimensional approach*, classifies a person's symptoms or other characteristics of interest in terms of 'how much'. The focus is on ranking a person's characteristics or other symptoms of interest on one or more quantitative dimensions; for example, a 1-to-10 scale of anxiety, on which '1' represents minimal anxiety and '10' extreme anxiety. Therefore, when using a dimensional approach, classification is accomplished by assessing clients on the relevant dimensions and then quantifying, or assigning, numerical values to each dimension.

Since the Ancient Greek philosopher Hippocrates (460–377 BC) developed his dimensional model of mental disorders based on the balance of 'humors' (fluids) within the body (which he called black bile, yellow bile, phlegm and blood), and Plato (429–347 BC) countered it with a categorical model of four types of 'divine madness' (Apollo, Dionysus, Muses and Aphrodite), one of the fundamental debates about mental disorders has been the issue of dimensional versus categorical classification (Jensen & others, 2007).

The choice, however, between whether to use a categorical *or* dimensional system of classification is not as simple as it might seem. For example, as shown in figure 11.15, consider the medical condition called hypertension (high blood pressure). Blood-pressure measurements clearly fit a dimensional approach, yet it is useful to categorise certain people as having high blood pressure in order to provide them with treatment (and to conduct research on its causes and possible new treatments). Similarly, consider mental disorders involving anxiety. Even though anxiety is also a dimensional variable, it can be useful to have a diagnostic category for those people whose anxiety is extreme. One way of reconciling, or 'merging', the two approaches is for a mental health professional to start with a categorical approach to classify their clients' symptoms. They could then adopt a dimensional approach to more accurately determine the *severity* of the different symptoms, amount of impairment and how they combine to affect the individual. Consequently, many contemporary mental health professionals view the classification of mental disorders from the perspectives of *both* the categorical and dimensional approaches, rather than one or the other.

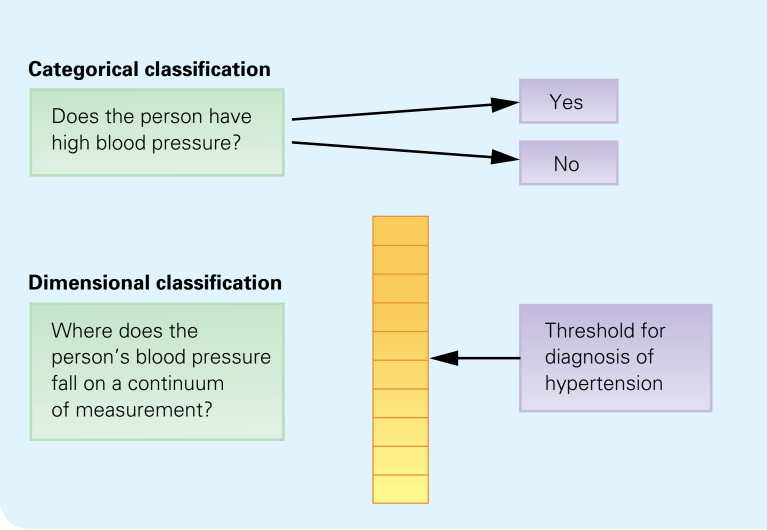


Figure 11.15 Blood pressure measurements clearly fit a dimensional approach, yet it has proved useful to categorise certain people as having high blood pressure in order to provide them with treatment and to research its causes and possible new treatments.

Categorical approaches

A system of classifying mental conditions and disorders that uses a **categorical approach** organises and describes mental conditions and disorders in terms of different categories and subcategories, each with symptoms and characteristics that are typical of specific mental conditions and disorders. When used for diagnostic purposes, an individual's symptoms are classified according to those symptoms described for the relevant disorder. In this way, a judgment is made about whether or not an individual has a particular disorder.

Categorical approaches are based on a number of underlying principles and assumptions. A key principle is that a mental disorder can be diagnosed from specific symptoms reported and/or presented ('shown') by a client during a mental health assessment conducted by a qualified mental health professional.

This is based on an assumption that thoughts, feelings and behaviour can be organised into categories representing disorders. Furthermore, within a disorder category, there exist discrete ('completely separate') and distinct ('clearly different') subcategories or types of the disorder, each with a characteristic pattern of symptoms that represent that disorder and not any other disorder. This means that there are clear boundaries around each disorder and that disorders do not overlap. Therefore, the pattern of thoughts, feelings and behaviour classified as obsessive-compulsive disorder (OCD) is clearly different from the pattern for antisocial personality disorder. It is also assumed that the disorder categories are constructed and organised in such a way as to allow for wide variation in patterns of thoughts, feelings and behaviours described for a disorder. Consequently, a mental health professional using a categorical classification system should be able to categorise OCD as such, even when the client does not show the 'perfect' or 'textbook' obsessive-compulsive pattern. This also allows for the fact that one or more symptoms can belong to more than one disorder.

Another principle of the categorical approach is the 'all or nothing' principle. According to this principle, an individual either *has* a diagnosable mental disorder or *does not have* a diagnosable disorder. More specifically, their symptoms will either belong to a specific mental disorder and can therefore be classified as relevant to that disorder, or their symptoms do not. For example, on the basis of a person's symptoms, a judgment will be made about whether they have major depression or not. Categorical approaches therefore view mental disorders in an absolute way, such as the way pregnancy is viewed. A female is either pregnant—or she is not. A female cannot be a 'little bit pregnant'.

Another underlying principle of the categorical approach is that the system used to classify and diagnose mental disorders should be both valid and reliable. In relation to the categorical approach, *validity* means that the classification system actually organises mental disorders into discrete and distinct disorders and enables diagnosis and classification of a discrete and distinctive disorder that accurately represents the symptoms that have been assessed. For example, the system used by the categorical approach should diagnose major depression if this is the disorder that the client has. If the client has major depression but the system, even when correctly used, leads to a diagnosis of a generalised anxiety disorder, then the system would have poor validity for major depression (and probably other disorders as well). In relation to the categorical approach, *reliability* means that the classification system produces the same diagnosis each time it is used in the same situation. A type of reliability called inter-rater reliability is of particular relevance. *Inter-rater reliability* indicates the degree to which different mental health professionals diagnose the same client with the same mental disorder. For example, if one mental health professional diagnoses someone as having catatonic schizophrenia, another mental health professional should also, independently, make the same diagnosis. A classification system that leads a person to be diagnosed with catatonic schizophrenia by one mental health professional but a personality disorder by another has poor reliability for both these disorders and probably other disorders as well.

The first categorical classification system for mental disorders was published by German psychiatrist Emil Kraepelin in 1883. Kraepelin's categories provided the basis for developing the two most recognised and adopted categorical classification systems for mental disorders. These are the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), developed by the American Psychiatric Association (APA), and Chapter V of the *International Classification of Diseases and Related Health Problems* (ICD), developed by the WHO. Both publications list distinctive categories of disorders but there are significant differences in the number and type of categories. In recent times, an attempt has been made to make the categories in these two systems more alike, but differences still remain. In Australia, the DSM is more widely used by mental health professionals than is the ICD. Consequently, the descriptions of mental disorders used in this text are based primarily on the DSM.

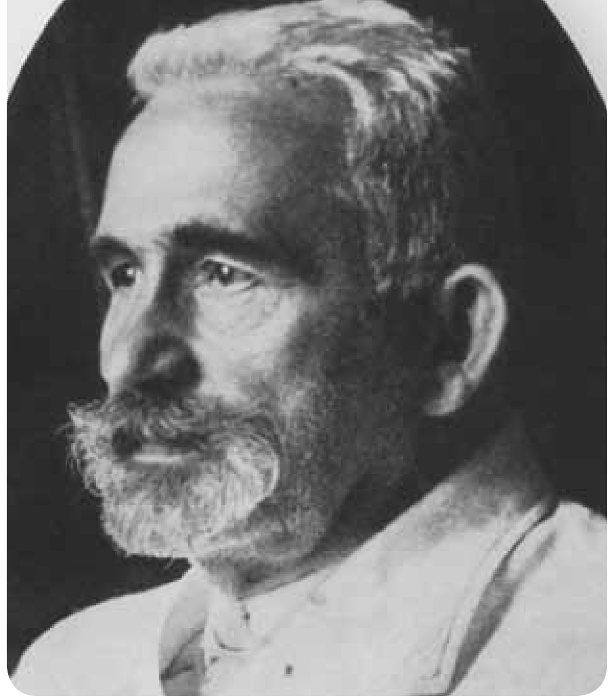


Figure 11.16 Emil Kraepelin (1856–1926)

Diagnostic and Statistical Manual of Mental Disorders

The ***Diagnostic and Statistical Manual of Mental Disorders***, or the **DSM** as it is more commonly called, is a categorical system for diagnosing and classifying mental disorders based on... recognisable symptoms that are precisely described for each disorder. As indicated in its title, DSM uses the term *mental disorder* rather than *mental illness*.

Since the DSM was first published in 1952 (DSM-I), it has been revised five times, most recently in 2000. The current DSM is called the *Diagnostic and Statistical Manual, Fourth Edition, Text Revision*, or DSM-IV-TR. The next revision of the DSM, called the DSM-V, is due to be published in 2013. Generally, each revision has expanded the list of disorders and changed the descriptions and categories to reflect both the latest in scientific research and changes in the ways mental disorders may be viewed within different socio-cultural contexts.

There are 365 mental disorders that are comprehensively described in the DSM-IV-TR. They are grouped into 16 major categories and there is one additional section, 'Other conditions that may be a focus of clinical attention' (see box 11.5). Diagnosis of a mental disorder using the DSM consists of identifying the disorder(s) that best matches or reflects the symptoms presented by an individual.

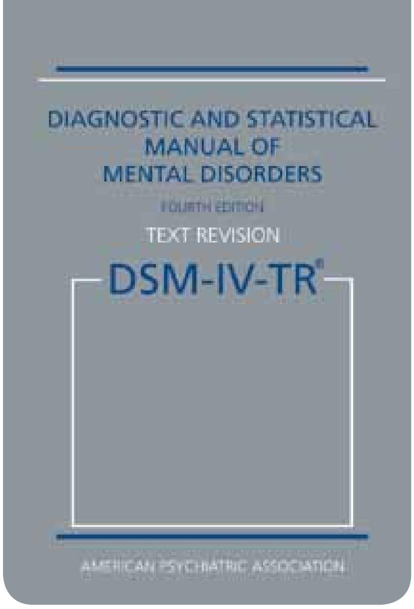


Figure 11.17 The DSM-IV-TR provides the most commonly used system for diagnosing and classifying mental disorders.

Box 11.5

Mental disorders in the DSM-IV-TR

DSM-IV-TR category	Description
Disorders usually first diagnosed in infancy, childhood or adolescence	Tend to emerge and sometimes disappear before adulthood, and include pervasive developmental disorders (such as autistic disorder), learning disorders, and attention-deficit hyperactivity disorder (ADHD)
Delirium, dementia, and amnestic and other cognitive disorders	Dominated by impairment in cognitive functioning (e.g. thinking, memory); disorders include various kinds of dementia such as dementia of the Alzheimer's type
Mental disorders due to a general medical condition not elsewhere classified	Characterised by the presence of thoughts, feelings or behaviour that are judged to be caused by an underlying medical (physiological) condition
Substance-related disorders	Brought about by the use of substances that affect the central nervous system; disorders include alcohol-related disorders, opioid-related disorders, amphetamine (or amphetamine-like)-related disorders, cocaine-related disorders and hallucinogen-related disorders
Schizophrenia and other psychotic disorders	Functioning has deteriorated to the extent that the individual has become psychotic (i.e. loses contact with reality)
Mood disorders	Characterised by severe disturbances of mood that cause the individual to feel extremely and inappropriately sad or elated for extended periods of time; disorders include major depressive disorder and bipolar disorders
Anxiety disorders	Characterised by anxiety; disorders include generalised anxiety disorder, panic disorder, phobia, obsessive-compulsive disorder, acute stress disorder and post-traumatic stress disorder
Somatoform disorders	Characterised by physical symptoms that appear to be caused primarily by psychological rather than physiological factors; disorders include conversion disorder, somatisation disorder and hypochondriasis

DSM-IV-TR category	Description
Factitious disorders	Characterised by physical or psychological symptoms that are intentionally produced or 'faked'. The individual adopts these symptoms in order to assume the 'sick role' (i.e. be cared for, sympathised with, and protected from the demands and stresses of life); disorders include factitious disorder and factitious disorder not otherwise specified
Dissociative disorders	Essential feature is a disruption in the usually integrated functions of consciousness, memory, identity or perception of the environment; disorders include dissociative identity disorder (formerly multiple personality disorder) and dissociative amnesia
Sexual and gender identity disorders	Characterised by disturbance in sexual desire and in the psychophysiological changes that characterise the sexual response cycle; disorders include premature ejaculation and sexual aversion disorder
Eating disorders	People with these disorders display abnormal patterns of eating that significantly impair their functioning; disorders include anorexia nervosa and bulimia nervosa
Sleep disorders	Characterised by chronic (persistent) sleep problems; disorders include primary insomnia, primary hypersomnia, sleep terror disorder and sleepwalking disorder
Impulse-control disorders not elsewhere classified	Chronically unable to resist impulses, drives or temptations to perform certain acts that are harmful to themselves or to others; disorders include pathological gambling, kleptomania, pyromania and intermittent explosive disorder
Adjustment disorders	Primary feature is a dysfunctional response to a stressful event, such as divorce or work-related problems, that first occurs within three months after the onset of the stressful event. Adjustment disorders are 'coded' according to the subtype that best describes the main symptoms; therefore, disorders include adjustment disorder: with depressed mood, with anxiety, or with disturbances of conduct (e.g. truancy, fighting, reckless driving)
Personality disorders	Essential feature is a longstanding, and often socially unacceptable, pattern of inflexible and maladaptive ways of thinking, feeling and behaving. There are 11 different personality disorders grouped into three clusters (A, B and C) based on descriptive similarities (e.g. people with personality disorders in 'Cluster A' often appear odd or eccentric). Disorders include borderline personality disorder and antisocial personality disorder
Other conditions that may be a focus of clinical attention	This section covers other conditions or problems about which a person sees a mental health professional; examples include a parent–child relational problem, bereavement, and acculturation problem (involving adjustment to a different culture; for example, following migration)

For each disorder in the DSM, there are diagnostic criteria to enable its identification. *Diagnostic criteria* indicate the symptoms that are characteristic of the disorder and therefore enable assessment of the presence of the disorder. The purpose of diagnostic criteria is to increase the reliability of the diagnostic process. With most disorders, the diagnostic criteria typically describe inclusion and exclusion criteria. *Inclusion criteria* are used to identify the symptoms that must be present in order for the disorder to be diagnosed, whereas *exclusion criteria* identify the symptoms, conditions or circumstances that must *not* be present in order for the disorder to be diagnosed. For example, separation anxiety disorder is generally characterised by excessive anxiety associated with separation from one's home (prolonged 'homesickness') or from someone with whom a close emotional bond has been formed. There are eight symptoms listed as diagnostic criteria. The inclusion criteria that are considered when diagnosing separation anxiety disorder are as follows: the presence of at least three out of eight of the symptoms, the symptoms must have been present for at least four weeks, the symptoms develop before age 18 years, and

Figure 11.18 Separation anxiety disorder typically occurs before 18 years of age. Among children, it often causes significant anxiety and distress when the child is separated, or fears they will be separated, from a person to whom they are attached.

the symptoms cause distress or impairment in day-to-day functioning. In addition, there is one exclusion criterion: separation anxiety disorder is *not* diagnosed if the symptoms can be explained by the presence of another mental disorder (American Psychiatric Association, 2000).

For some disorders in the DSM-IV-TR, such as separation anxiety disorder, polythetic criteria sets are used. *Polythetic criteria sets* are a list of diagnostic criteria in which only some symptoms, not all, need to be present in order for the disorder to be diagnosed.

The DSM also provides information on the typical course of each disorder (that is, a description of how the disorder will progress); the age at which a person is most likely to develop the disorder; the degree of impairment; the prevalence of the disorder (that is, how commonly it occurs); whether the disorder is likely to affect others in the family; and the relationship of the disorder to gender, age and culture. For example, the DSM includes information on nightmare disorder such as that nightmares often begin between ages 3 and 6 and that most children outgrow the disorder (the *course*); between 11% and 50% of children aged 3 to 5 have nightmares of sufficient intensity to disturb their parents (the *prevalence*); and that females report having nightmares more often than do men (the *relationship to gender*). An important feature of the DSM is that it is not, and does not claim to be, a textbook. No mention is made of theories about the specific cause(s) (*aetiology*) of any disorder unless a cause can be definitely established. It simply names the 365 disorders and describes each one in detail.

When making a diagnosis using the DSM, information in relation to five different 'axes' must be considered in order to completely evaluate an individual's mental condition. This is why diagnosis using the DSM is called the 'multiaxial system'. As shown in table 11.3, each *axis* refers to different information about a person and their mental condition. Axes I, II and III address the individual's present condition. Axes IV and V provide additional information about the person's situation and functioning in everyday life. Together, the five axes are intended to provide comprehensive and useful information, such as factors to take into account when planning treatment.

Table 11.3 The five axes in the DSM-IV-TR multiaxial system

Axis number	Name of axis
I	Clinical disorders and other conditions that may be a focus of clinical attention
II	Personality disorders and mental retardation
III	General medical conditions
IV	Psychosocial and environmental problems
V	Global assessment of functioning

Axis I describes all the mental disorders in the DSM (except for those in Axis II). When making a diagnosis, the disorders in Axis I are first checked to identify the individual's current mental condition and the relevant disorder (unless it is believed that the person has an Axis II disorder). Sometimes a person may have symptoms resulting in the identification of more than one disorder.

In such cases, all the relevant disorders are listed by the mental health professional, with the primary disorder listed first.

Axis II describes only two categories of mental disorders: personality disorders and mental retardation (called intellectual disability in Australia). A *personality disorder* involves a pattern of inflexible and maladaptive ways of thinking, feeling and behaving that are often socially unacceptable and have been evident over a long period of time. There are a number of different kinds of personality disorders. For example, people with an *antisocial personality disorder* frequently ignore and abuse the rights of others, whereas people with a *dependent personality disorder* are constantly 'clingy' and very afraid of being alone. Someone with an *intellectual disability* has a significantly below-average level of intellectual functioning and usually has difficulty in coping independently with everyday life activities.

The mental disorders described in Axis II usually continue throughout a person's life and are part of 'who the person is'. In contrast, mental disorders described on Axis I tend to be experienced during a period in a person's life, but they usually have not been present for all of the person's life. Although most people are diagnosed with a disorder from either Axis I or Axis II, some people have a disorder this is described in both axes. For example, a child diagnosed with separation anxiety disorder (Axis I) may also be diagnosed as having an intellectual disability (Axis II).

Axis III provides information about medical conditions that may be related to each of the mental disorders in Axes I and II. These conditions may give information that is potentially relevant to understanding and planning treatment for the individual. For example, if a person has major depression but did not experience any symptoms before learning that they had breast cancer, the major depression would be listed by the mental health professional on Axis I, and the breast cancer would be listed on Axis III. Note that psychologists are not medical doctors so they do not diagnose the medical conditions themselves—the person and/or medically qualified personnel provide the medical information and Axis III is used to consider its potential relevance to a mental disorder.

Axis IV provides information about potential stressors in an individual's life that may be relevant to their disorder, and is used to identify current and recent stressors impacting on their thoughts, feelings and behaviour and which need to be considered when devising a treatment program. For example, if a person has recently lost their job, separated from their partner and has a housing problem, these stressors would be listed in Axis IV when making a diagnosis. Information relevant to Axis IV is usually obtained from the individual as part of the clinical assessment. Psychosocial and environmental problems considered in Axis IV include:

- problems with primary support groups, such as separation from one's family
- problems related to the social environment, such as isolation from friends
- educational problems, such as learning difficulties
- occupational problems, such as job loss
- housing problems, such as inability to find ongoing accommodation
- problems with access to health care services
- legal problems, such as having committed a criminal offence
- other psychosocial and environmental problems.

Axis V is used to assess an individual's overall level of psychological, social and occupational functioning. This is achieved using the descriptions in the Global Assessment of Functioning (GAF) scale provided in the DSM (see table 11.4). The information used to assess the individual is obtained during a 'clinical interview' and sometimes from results of psychological testing. The GAF provides an overall numerical rating on a 100-point scale on which '1' indicates severe impairment in psychological, social and occupational functioning (for example, the person is in persistent danger of severely hurting themselves or others or is unable to maintain minimal personal hygiene), and '100' refers to superior functioning with no symptoms. The higher the score on the GAF, the more effectively the person is considered to be functioning in everyday life. A common goal of psychological therapy is to increase a client's GAF score.

Table 11.4 Global Assessment of Functioning (GAF) scale

Score	
91–100	Superior functioning in a wide range of activities; life's problems never seem to get out of hand; is sought out by others because of his or her many positive qualities No symptoms
81–90	Absent or minimal symptoms (such as mild anxiety before an exam); good functioning in all areas; interested and involved in a wide range of activities; socially effective; generally satisfied with life; no more than everyday problems or concerns (such as an occasional argument with family members)
51–60	Moderate symptoms (for example, flat affect and occasional panic attacks) or moderate difficulty in social, occupational or school functioning (for example, few friends, conflicts with peers or co-workers)
21–30	Behaviour is considerably influenced by delusions or hallucinations or serious impairment in communication or judgment (for example, sometimes incoherent, behaviour is grossly inappropriate, suicidal preoccupation) or inability to function in almost all areas (for example, stays in bed all day, no job, home or friends)
11–20	Some danger of hurting self or others (for example, suicide attempts without clear expectation of death, frequently violent, manic excitement) or occasionally fails to maintain minimal personal hygiene (for example, smears faeces) or gross impairment in communication (for example, largely incoherent or mute)
1–10	Persistent danger of severely hurting self or others (for example, recurrent violence) or persistent inability to maintain minimal personal hygiene or serious suicidal act with clear expectation of death

Source: adapted from American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.* Arlington, Virginia: American Psychiatric Publishing, p. 34.

Box 11.6

An example of classification using DSM-IV-TR

A mental health professional considers all five axes of the DSM to evaluate an individual. The following case study is an example of how a client, Barry, was assessed according to the DSM.

Barry's story

Barry had been referred to a mental health service by his supervisor at work. Barry was a 49-year-old building contractor who worked on mine sites. He had recently tested positive for marijuana in a compulsory drug test, and he had been cautioned by police after picking a fight in the local pub. His performance and attitude at work had deteriorated, and he sometimes failed to turn up for work or came late, smelling of alcohol. When Barry's supervisor tried to talk to him about his performance, he always came up with an excuse. His workmates found Barry difficult to talk to and generally avoided him, but when they did manage to engage him in conversation, Barry mostly complained about the bosses or his ex-wife who had divorced him a year ago. He constantly seemed angry and to have a 'big chip on his shoulder'.

Barry had always been a big drinker and every day, after he left work, he would go straight to the pub in town and drink solidly for four hours before heading home, often with a bottle of Scotch. He was a heavy smoker and was known to frequently smoke marijuana.

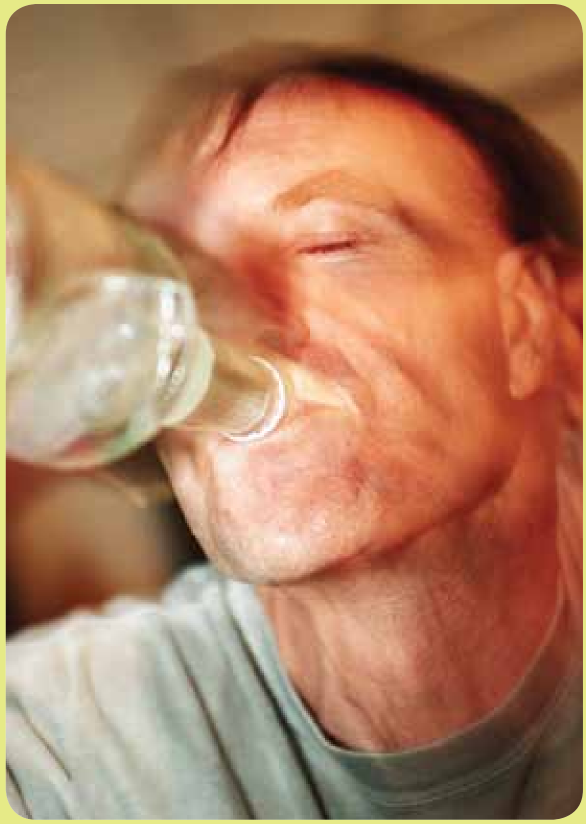
The clinical psychologist who interviewed Barry managed to piece together the basic facts of Barry's story after a few sessions, but he did not feel that Barry had developed any trust towards him. Any questions or suggestions were heard by Barry as criticisms, and Barry would react angrily and blame everyone else for his problems. A medical examination showed that Barry's lungs were damaged by the years of smoking and that he was developing cirrhosis of the liver.

The evaluation

Barry's heavy use of alcohol and marijuana, which was interfering with his functioning, resulted in a drug and alcohol abuse diagnosis (Axis I). The psychologist also felt that Barry was exhibiting an antisocial personality disorder (Axis II). Barry's physical health issues were noted for Axis III and his recent divorce and difficulties in his job were recorded for Axis IV. For Axis V, Barry was given '51' on the Global Assessment of Functioning (GAF) scale, recognising that he was experiencing moderate difficulty at work and in social relationships.

Barry's diagnosis was summarised as:

- Axis I—Clinical syndrome: drug and alcohol abuse
- Axis II—Antisocial personality disorder
- Axis III—Physical disorder: lung damage and cirrhosis
- Axis IV—Psychosocial and environmental problems: (1) problems with primary support group (divorce) and (2) workplace problems
- Axis V—Current GAF = 51.



Learning Activity 11.12

Review questions

1. Explain the meaning of the phrase 'categorical approach to the classification of mental disorders'.
2. What are the underlying assumptions and principles of the categorical approach? Explain with reference to examples.
3. Why is it important that categorical approaches are valid and reliable?
4. **a** What is the DSM, who is it created for and what is it used for?
   b How many major categories of mental disorders does the current DSM have?
   c What is the common purpose of diagnostic, inclusion, exclusion and polythetic criteria?
   d Explain the meaning of the terms course and prevalence in relation to a mental disorder.
   e Name each of the five axes in the DSM and briefly describe the type of information provided in each axis for classification and/or diagnostic purposes.
   f What significant information about mental disorders is *not* provided in the DSM?
   g In what ways is the DSM's multiaxial system consistent with the biopsychosocial framework? Explain your answer with reference to key characteristics of the DSM and biopsychosocial framework.

Learning Activity 11.13

Visual presentation on the DSM

Prepare a flow chart that summarises the procedure for diagnosing and classifying a mental disorder when using the DSM.

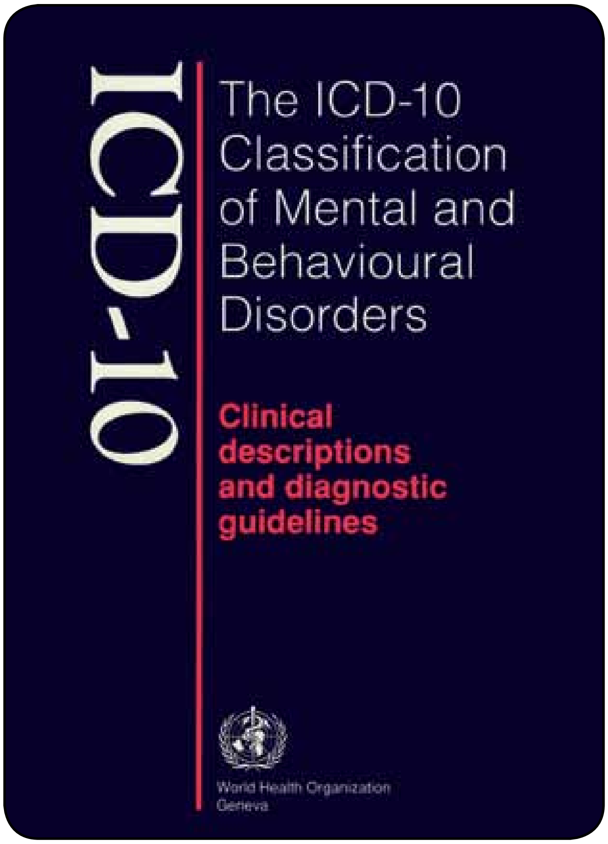


Figure 11.19 The ICD-10

International Classification of Diseases and Related Health Problems

The ***International Classification of Diseases and Related Health Problems*** **(ICD)** is a categorical system for diagnosing and classifying diseases and mental disorders based on recognisable symptoms that are precisely described for each disease and disorder. The ICD, as it is commonly referred to, is published by the World Health Organization (WHO) and is primarily used in Europe. The current ICD, called the *International Classification of Diseases, Tenth Revision*, or ICD-10, was published in 1992. The ICD-10 consists of 21 chapters covering the whole of medical practice; that is, all physical and mental conditions and disorders. Mental disorders are included in chapter V(5), called *International Classification of Mental and Behavioural Disorders*. Like the DSM, this chapter of the ICD uses the term mental disorder rather than mental illness. However, the ICD also distinguishes between mental and behavioural disorders, whereas the DSM uses the term 'mental disorders' as an umbrella term for both types of disorders.

The first edition of the ICD, called the *International List of Causes of Death*, was published by the International Statistical Institute in 1893. Since the first ICD was developed, it has been revised a number of times. The WHO took over responsibility for the ICD in 1949 when the Sixth Revision (ICD-6) was published. The ICD-6 was the first to include a chapter on mental and behavioural disorders. The next revision of the ICD (the ICD-11) is due to be published in 2015.

In 1998, the National Centre for Classification in Health, located at the University of Sydney and Queensland University of Technology, published an Australian version ('modification') of the ICD-10. It was called the *International Classification of Diseases, Tenth Revision, Australian Modification*, or ICD-10-AM. The current ICD-10-AM was published in 2010. It is updated every two years and also has a chapter on mental and behavioural disorders.

Box 11.7

Versions of the ICD-10

The WHO has published four versions of the ICD-10 *International Classification of Mental and Behavioural Disorders*, each of which has been developed for a different purpose and user group. For example, one version, called *Diagnostic Criteria for Research*, has been developed for use by researchers. Another version, developed for use by mental health professionals, is called *Multiaxial Presentations of the ICD-10.* This version is similar to the DSM-IV-TR as it uses a multiaxial system for the diagnosis and classification of disorders. However, there are only three axes rather than five:

- **Axis I—**Clinical diagnoses: describes all mental and behavioural disorders. Unlike the DSM, includes personality disorders (which are in Axis II in the DSM).

- **Axis II**—Disabilities: describes disabilities due to impairments produced by the disorder(s) from which the individual suffers. Includes a rating scale like the Global Assessment of Functioning (GAF) scale in the DSM, called the WHO Short Disability Assessment Schedule (WHO DAS-S), which is designed to assess disabilities in the following areas of a person's functioning: personal care, occupation, family and household, and the broader social context; for example, leisure activities.
- **Axis III**—Contextual factors: intended for mental health professionals to report situational factors that influence the diagnosis, treatment and prognosis of disorders that are recorded on Axis I. This is similar to Axis IV in the DSM.

The disorders in chapter V of the ICD-10 are grouped into 11 *blocks* that resemble those of DSM-IV-TR (see box 11.8). Unlike the DSM-IV-TR, however, each disorder classified in a category can be converted into an alphanumeric *F* code. For example, F2 is schizophrenia, F25 is schizoaffective disorder, and F25.1 is schizoaffective disorder, depressive type. Alphanumeric codes are used to support easy storage, retrieval and analysis of data (WHO, 2004).

The version of chapter V of the ICD-10 called *Clinical Descriptions and Diagnostic Guidelines*, informally referred to as the 'blue book', is the one used by mental health professionals for diagnosing and classifying mental disorders.

Like the DSM-IV-TR, diagnosis of a mental disorder using the 'blue book' consists of identifying the disorder(s) that best matches or reflects the symptoms presented by an individual. Also like the DSM, the ICD-10 provides a detailed description of each disorder listed. For example, separation anxiety disorder in childhood (F93.0) is described as follows: 'It is normal for toddlers and preschool children to show a degree of anxiety over real or threatened separation from people to whom they are attached … Separation anxiety disorder is differentiated from normal separation anxiety when it is of such severity that it is statistically unusual (i.e. persists beyond the usual age period) and when it is associated with significant problems in social functioning' (pp. 273–274).

Diagnostic guidelines are also provided for each disorder. *Diagnostic guidelines* identify the symptoms that are characteristic of the disorder and therefore indicate the presence of the disorder. For example, all of the following symptoms must be present for a diagnosis of non-organic insomnia (F51.0) to be made: the complaint is either difficulty falling asleep or maintaining sleep, or of poor quality sleep; the sleep disturbance has occurred at least three times per week for at least one month; there is preoccupation with the sleeplessness and excessive concern over its consequences at night and during the day; and, the unsatisfactory quantity and/or quality of sleep either causes marked distress or interferes with ordinary activities in daily living. If any one of these symptoms is not present, a 'definite' diagnosis of non-organic insomnia cannot be made.

Although the ICD is used in the same way as the DSM and helps a mental health professional decide whether or not a person can be diagnosed with a mental disorder, the ICD is a less-detailed categorical system than the DSM. For example, the ICD provides a detailed description and diagnostic guidelines for each disorder, but it typically does not provide information about the course, prognosis and prevalence of each disorder as the DSM does.

Figure 11.20 People with non-organic insomnia have significant difficulty falling asleep or staying asleep that causes them distress or interferes with their day-to-day functioning.

Box 11.8

Mental and behavioural disorders in chapter V of the ICD-10

ICD-10 F code	Blocks of mental and behavioural disorders
F00–F09	Organic, including symptomatic, mental disorders
F11–F19	Mental and behavioural disorders due to use of psychoactive substances
F20–F29	Schizophrenia, schizotypal and delusional disorders
F30–F39	Mood (affective) disorders
F40–F49	Neurotic, stress-related and somatoform disorders
F50–F59	Behavioural syndromes associated with physiological disturbances and physical factors
F60–F69	Disorders of personality and behaviour in adults
F70–F79	Mental retardation
F80–F89	Disorders of psychological development
F90–F98	Behavioural and emotional disorders with onset usually occurring in childhood and adolescence
F99	Unspecified mental disorders

Learning Activity 11.14

Review questions

1 **a** What is the ICD-10, who is it prepared for and what is it used for?

b Name the ICD chapter that specifically relates to mental disorders.

c Name the Australian version of the ICD.

d How many major categories of mental and behavioural disorders does the ICD-10 have?

e What are diagnostic guidelines and what are they used for?

2 In what ways is the ICD-10 approach to diagnosing mental and behavioural disorders consistent with the biopsychosocial framework? Explain your answer with reference to key characteristics of the ICD-10 and biopsychosocial framework.

3 Construct a table in which you compare key similarities and differences of the DSM and ICD-10.

Learning Activity 11.15

Visual presentation on the ICD-10

Prepare a flow chart that summarises the procedure for diagnosing and classifying a mental and/or behavioural disorder when using the ICD-10.

Strengths and limitations of categorical approaches

Categorical approaches to the classification of mental disorders, such as the DSM and ICD, are based on ongoing scientific research and regularly revised on the basis of the research findings. They are very comprehensive in terms of the number of disorders they include and the amount of information presented on each disorder. They are also regarded as useful in facilitating the growth of a body of expert knowledge about mental disorders among mental health professionals and the community in general; for example, in the identification of the factors that contribute to the development, persistence and course of the particular disorder and possible treatment and management plans for disorders.

The main purpose of categorical systems is to assist mental health professionals in diagnosing the mental conditions of their clients so they can subsequently devise a treatment and management plan for those who require it. The many mental health professionals throughout the world who rely on categorical systems for such purposes find them useful. They are also considered to be 'user-friendly'. This is because they are consistent with the types of clinical decisions that mental health professionals have to make about their clients every day. For every client who consults a mental health professional,

Figure 11.21 (a) Classifying an animal as 'mammal' says a great deal about it—it is warm-blooded, has lungs and breathes air, gives birth to living young and produces milk; (b) similarly, classifying a person's characteristic thoughts, feelings and behaviour as 'schizophrenia' suggests that the person has hallucinations or delusions and disorganised behaviour. The classification is a handy shorthand way of describing a very complex disorder.

a number of 'yes or no' decisions have to be made; for example, Does the client have a mental condition or disorder? If so, does the client need treatment? Does the client need admission to a hospital? These types of decisions are more easily made on the basis of categorical information. Categorical classification is therefore useful and consistent with the way most mental health professionals work.

Categorical approaches also enhance communication among mental health professionals by providing a common language. Having diagnostic labels and precise definitions of mental disorders is helpful when mental health professionals communicate with one another about a client's mental health, as they ensure a common 'shorthand' understanding of what is being discussed. For example, in referrals from one mental health professional to another, simply stating the diagnostic label(s) assigned to a client facilitates communication and there is a shared understanding of what the client's difficulties are without having to 'spell out' each individual symptom. Diagnostic labels therefore convey a large amount of information quickly and conveniently. This does not mean, however, that categorical approaches are perfect.

In the past, one of the major problems with categorical approaches to classification of mental disorders was their low inter-rater reliability. Mental health professionals who interviewed the same clients often reached different conclusions about the most appropriate diagnosis. Key terms such as 'schizophrenia' also tended to be used in different ways in different countries, even in different mental health settings within the same country. The situation has changed markedly, and both the DSM-IV-TR and ICD-10 have greater inter-rater reliability than their earlier versions. For example, studies on the inter-rater reliability of the DSM-IV-TR have found up to 70% agreement between mental health professionals on the classification of mental disorders such as anxiety disorders, major depression and antisocial personality disorder. However, these studies also indicate as much as 30% disagreement in the classification of people with these disorders. Furthermore, inter-rater reliability has been found to be much lower with other disorders such as personality disorders (Maddux & Winstead, 2008; DiNardo & others, 1993).

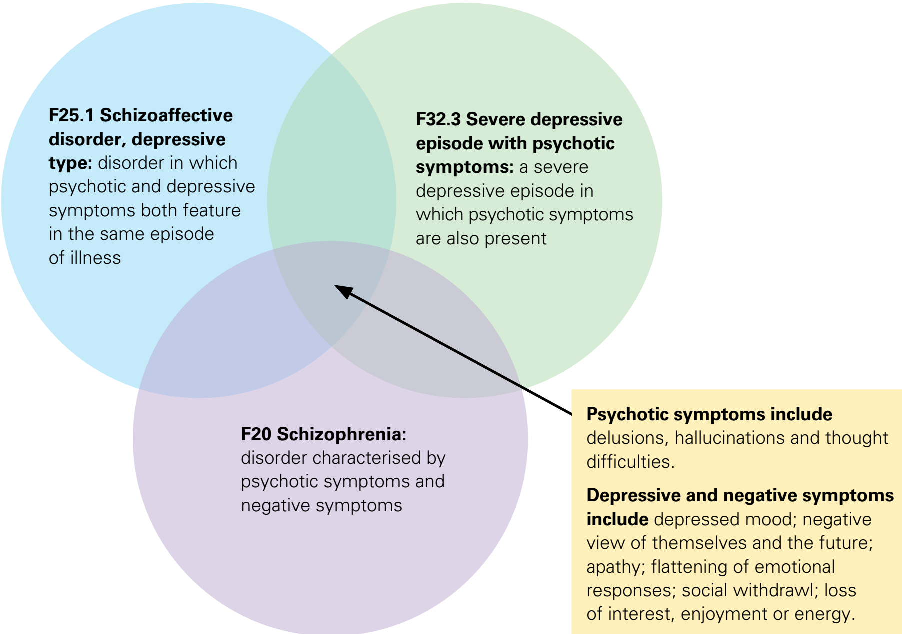


Figure 11.22 The overlap between the symptoms of the ICD-10 diagnosis of F20 (schizophrenia), F32.3 (severe depression with psychotic symptoms) and F25.1 (schizoaffective disorder, depressive type)

One of the underlying principles of the categorical approach to classification is that it should clearly be able to distinguish between symptoms and other characteristics described for a category or subcategory from those that are not described for the category or subcategory. Each category must be discrete and separate from all the others. This means that a classification system for mental disorders should not result in 'fuzzy' categories and uncertainty over whether a person suffers from disorder A or disorder B. However, the amount of overlap between the symptoms of some disorders in the DSM and ICD does not adequately reflect this principle. For example, many symptoms such as 'attention or concentration difficulties' and 'sleep difficulties' are not specific to a single type of disorder. The degree of overlap between the symptoms of some disorders listed in the DSM and ICD sometimes makes it difficult for mental health professionals to decide which disorder (category) their client's symptoms belong to, possibly even leading to a misdiagnosis. For example, as shown in figure 11.22, the three disorders in the ICD identified as F20 schizophrenia, F32.3 severe depression with psychotic symptoms and F25.1 schizoaffective disorder, depressive type all have a number of overlapping symptoms.

Another limitation of categorical approaches is the substantial loss of valuable clinical information. That is, whenever human thoughts, feelings and behaviour are classified into categories, the uniqueness of the person is overlooked. American psychologists Gerald Davison and John Neale (1996) highlight how this may happen using the example of throwing dice. Any of the numbers one through six may come up on a given toss of a single die. However, we can classify each outcome as odd or even—whenever a one, three or five comes up on a roll we would call out 'odd' and whenever a two, four or six appears, we call out 'even'. A person listening to our calls will not know whether the call 'odd' refers to one, three or five or whether 'even' refers to two, four or six. Therefore, when using categorical classification, some information must inevitably be lost.

Finally, a common criticism of categorical approaches to the classification of mental disorders involves their use of diagnostic 'labels' to describe the various disorders in specific ways. While labelling is useful for communication purposes, labelling a pattern of thoughts, feelings and behaviour as a mental disorder can also have a negative effect on the individual being labelled and result in their experiencing social stigma. *Stigma* is a sign of social unacceptability or undesirability, often involving shame or disgrace. This can influence how people think and feel about themselves and the way they are viewed by others in the community. Labelling can create misunderstandings that may bias our perceptions of a person in terms of the way they do behave or may behave. Once a label has been given to a person, it may be there for life and consequently can affect the way that individual is treated by others. For example, consider how you might be affected by being told you have 'paranoid schizophrenia' and admitted to a psychiatric unit or hospital for treatment. You may become chronically uneasy about when your 'psychotic' symptoms might return. Furthermore, after you are discharged and go home, the fact that you are now a 'former mental patient' could have a great impact on your life. Friends or loved ones may now treat you differently and employment could be difficult to obtain if you mention that you have previously experienced or presently have 'paranoid schizophrenia'. There is little doubt that labelling can have these and many other negative consequences. It is clear from existing research that the general public holds very negative views and misunderstandings of mental illness and that people with a mental illness and their families often experience social stigma (Davison & Neale, 1996). In an attempt to deal with this problem, it has recently become standard practice to use language that describes the psychological construct rather than the person; for example, using the phrase 'a person with schizophrenia' rather than the term 'a schizophrenic'.

Dimensional approaches

A dimensional approach, also called a *spectrum* or *continuum approach*, is an alternative to the categorical approach. Dimensional approaches assume that normality and abnormality are end points on the same continuum with no clear dividing line between them. This also applies to all symptoms and characteristics that may be associated with various mental disorders. A **dimensional approach** quantifies a person's symptoms or other characteristics of interest and represents them with numerical values on one or more scales or continuums, rather than assigning them to a mental disorder category. Classification is therefore accomplished by assessing a person on relevant dimensions and giving them a score on each of the dimensions. This can be done using standardised inventories, or questionnaires. An *inventory*, often referred to as a 'test', typically comprises closed-ended questions requiring a 'yes' or 'no' answer, or statements requiring a rating about the extent of agreement or disagreement. This format enables responses to be scored and summarised, and then the summaries of scores on different dimensions to be graphically represented.

A **dimension** is most commonly viewed as a cluster of related psychological and/or behavioural characteristics that tend to occur together and can be measured. For example, the *Eysenck Personality Questionnaire–Revised* (EPQ-R) is an inventory that adopts a dimensional approach. Because it adopts a dimensional approach, the EPQ-R does not aim to decide whether a person 'has' or 'doesn't have' a personality disorder. It is designed to measure three dimensions called *extraversion–introversion*, *neuroticism–emotional stability* and *psychoticism.* Each of these dimensions is made up of a number of personality traits (or 'characteristics'). Collectively, the three dimensions are believed to form the personality of any individual aged over 18 years. It is assumed that each individual possesses each of these dimensions in varying amounts. Scores on the inventory show 'how much' (or 'little') a person 'has' of each dimension but can also indicate degrees of psychological dysfunction. For example, the psychoticism dimension encompasses traits such as 'aggressive', 'egocentric', 'impulsive', 'impersonal', 'antisocial' and 'unempathetic', which are present in some degree in all individuals. Individuals who score high on most of these traits will also achieve a high score on the psychoticism dimension, which has a close association with psychological dysfunction. Therefore, according to dimensional approaches, lower scores on a particular dimension are usually associated with lower impairment, and higher scores are usually associated with more impairment.

The dimensional approach may also be applied at a more specific level. For example, an individual's 'functioning' or 'impairment' could be a dimension and a 100-point scale may be used to assign a *grade* ('score') to overall impact on functioning or level of impairment (as does the GAF in table 11.4). Similarly, a symptom may be a dimension and one or more scales linked to questions about 'how much' or 'how often' could be used to grade the severity, frequency or duration of the symptom. For example, the severity of a symptom could be graded using a three-point scale such as '1' is absent, '2' is mild and '3' is severe. Thus, a key feature of the dimensional approach is that a mental disorder is not considered in terms of whether it is present or absent. Rather, the focus

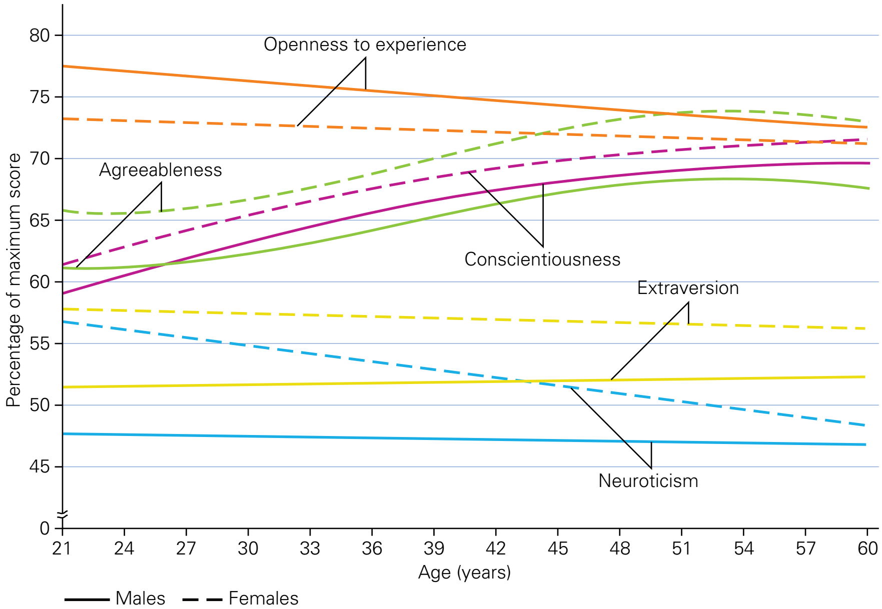


Figure 11.23 Results from a study using the Big Five Personality Inventory. Participants were aged 21 to 60 years and the graph shows the mean scores for men and women for each of the big five traits (openness to experience, agreeableness, conscientiousness, extraversion and neuroticism) in relation to age.

is on grading a person in terms of the magnitude, degree or severity on particular dimensions rather than assigning them to a diagnostic category (Haslam, 2010). By conducting assessments at different intervals and comparing scores on one or more scales, mental health professionals may also monitor the *transition*, or 'changes' over time, in an individual's symptoms, clusters of symptoms or mental condition in general in response to various treatments provided.

Another feature of the dimensional approach is that standardised inventories can be used to produce a *profile*, or graphical representation, of an individual's scores on the dimensions that are measured. Typically, each individual will have a different profile of low or high scores on the various dimensions, thereby reflecting the uniqueness of each individual's pattern of thoughts, feelings and behaviours associated with their mental condition.

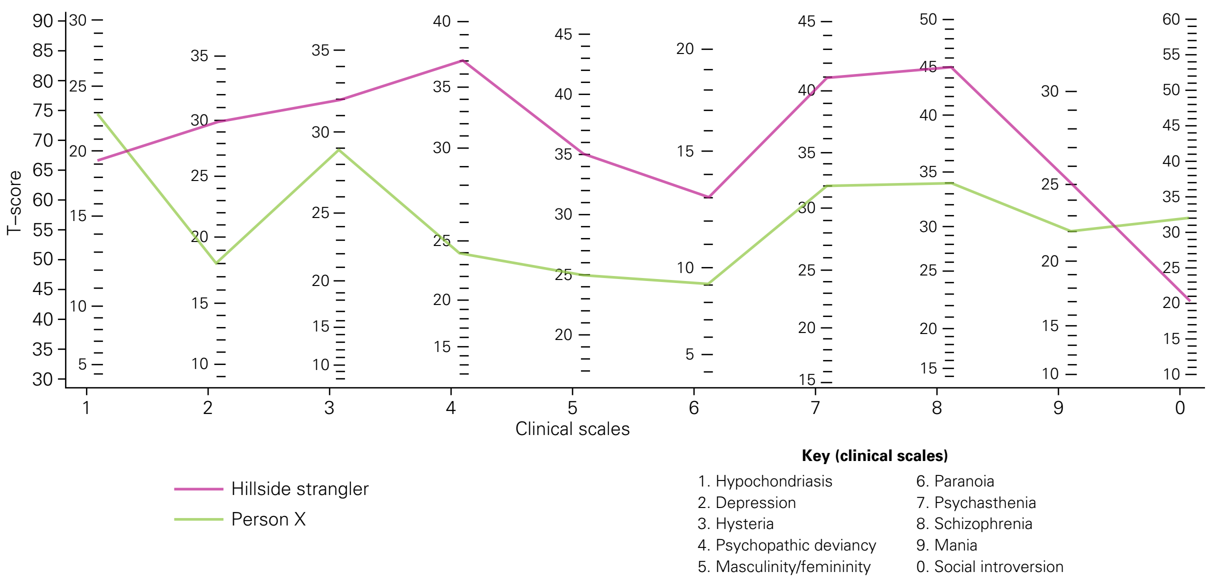


Figure 11.24 Excerpted from the MMPI-2 Handscoring Profile. Profiles of two individuals derived from the Minnesota Multiphasic Personality Inventory-2 (MMPI-2). The key shows the ten different dimensions, or clinical scales, assessed by the MMPI. Note that each individual is assessed as possessing the same dimensions, but in varying amounts. The green line is the profile of an adult male who is non-aggressive and has never committed a crime. The red line is the profile of a serial killer called the 'Hillside strangler', who murdered 13 women in the late 1970s.

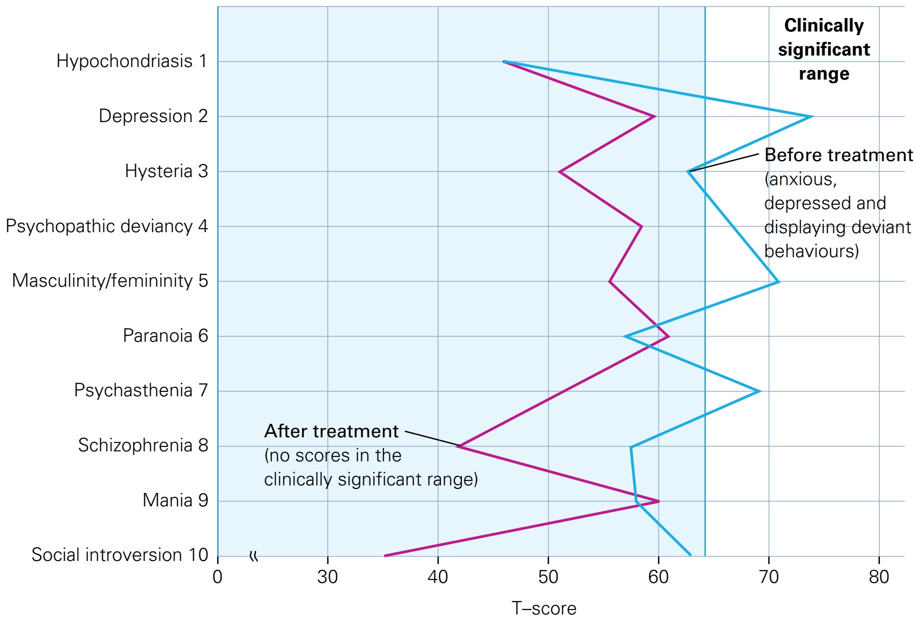


Figure 11.25 A test profile from the Minnesota Multiphasic Personality Inventory (MMPI) showing scores for before and after treatment for a depressed and anxious young man. The key shows ten different dimensions and gives a T-score rating. The average T-score is 50. High T-scores are usually associated with greater impairment on that particular dimension.

Strengths and limitations of dimensional approaches

Mental health professionals who prefer dimensional approaches to classification believe that they address many, if not all, of the limitations of the existing categorical approaches to classification. For example, it has been suggested that categorical approaches are preferable to dimensional approaches to classification because they allow for the communication of a considerable amount of information through a single diagnostic label. However, mental health professionals who favour dimensional approaches argue that single diagnostic labels actually result in a *loss* of information. Unlike categorical approaches, dimensional approaches usually take into account a wider range of a person's symptoms and characteristics. Multidimensional profiles avoid 'slotting' people into single diagnostic categories that fail to recognise the unique combination of symptoms, features and traits of an individual person. The emphasis on quantifying dimensions on scales can also provide a richer and more detailed description of an individual's mental condition in the form of a profile, as compared with the briefer summary of the categorical approach in terms of whether the person 'has' or 'does not have' a mental disorder of some kind (Widiger & Trull, 2007).

It is also believed that using dimensional approaches would help reduce the stigma usually associated with the diagnosis of a specific mental disorder because a person is not 'labelled' following an assessment based on the dimensional approach. Instead, the person obtains a 'profile of scores' for a set of

Figure 11.26 Dimensional approaches do not use diagnostic labels and therefore may reduce the incidence of social stigma, which is an undesirable consequence of being labelled with a mental disorder.

dimensions. Consider, for example, dimensions (or traits) commonly assessed by personality inventories, such as neuroticism, agreeableness, conscientiousness, impulsivity and dependability. All people vary in the extent of their neuroticism, the extent to which they are agreeable or antagonistic, and the extent to which they are conscientious, impulsive, and dependable or undependable. Therefore, individuals who would be diagnosed with a 'personality disorder' using a categorical approach would no longer be said to have a 'disorder' that is qualitatively different from normal psychological functioning. Using a dimensional approach, they would instead simply be described as people who have relatively extreme and maladaptive variants of the personality traits that are evident within all people (Widiger & Trull, 2007).

Dimensional approaches also have limitations. For most disorders in the DSM and ICD, there is no standardised inventory or system to support a mental health professional in using a dimensional approach to classification. Consequently, it would be difficult and time-consuming for a mental health professional to create the questions and scales required to suitably rate a client on a large number of different dimensions. For example, a mental health professional may have to rate a client on as many as 40 dimensions, as compared with the relatively simpler categorical approach to classification. There is also disagreement among mental health professionals and researchers on the number of dimensions that would suitably represent the wide range of mental disorder symptoms people can experience. For example, consider how many different symptoms there are for all the mental disorders in the DSM and therefore how many possible dimensions there could be. If there are too many dimensions to assess, then a mental health assessment could become an overcomplicated process (Simonsen, 2010).

Box 11.9

The CRS-III—a dimensional clinical instrument for attention-deficit hyperactivity disorder (ADHD)

The *Conners' Rating Scales, Third Edition* (CRS-III), developed by C. Keith Conners (2008), are paper-and-pencil questionnaires (inventories) designed to be completed by parents and teachers to assist mental health professionals in evaluating children and adolescents aged six to 18 years for attention-deficit hyperactivity disorder (ADHD). ADHD is a disorder characterised by inattention, hyperactivity and impulsive behaviour that is more severe than in other children of the same age. There is also a self-report form available for children and adolescents aged between eight and 18 years. Each parent, teacher and self-report form is available in full-length and short versions.

The parent and teacher (and child or young person if aged eight +) are asked to answer

Figure 11.27 A dimensional approach has been devised to assess symptoms associated with ADHD.

either 'Not true at all' (0), 'Just a little true' (1), 'Pretty much true' (2) or 'Very much true' (3) to a number of different statements; for example, 'Is one of the last to be picked for teams or games'. Each question relates to a different dimension, such as hyperactivity, learning problems, peer relations, family relations, inattention and anxiety. For example, the statement 'Is one of the last to be picked for teams or games' relates to the 'peer relations' dimension.

Raw scores for each of the dimensions are obtained and converted into 'T' scores. 'T' scores can range from 0 to 90, with a 'T' score of 50 considered average. Two-thirds of the 'normal' population score between 40 and 60. When children receive a T-score above 65 on a particular dimension, their functioning may be considered 'clinically significant' in that area.

Following completion of the CRS-III, the scores on each dimension are graphed and a line is drawn to show a pattern called a *profile*. For example, an eight-year-old child might have been rated by his teacher as extremely inattentive (T = 90), experiencing moderate peer relationship problems (T = 67) and learning problems (T = 70), but not at all anxious (T = 52).

The CRS-III therefore provides detailed information about the child in a number of different areas of functioning, but it does *not* tell the mental health professional whether the child has ADHD or not.

Box 11.10

Distiguishing between the categorical and dimensional approaches

Imagine that a person with a mental health problem went to see a mental health professional. If a categorical approach is used, the mental health professional would seek to make a 'yes/no' decision about whether the client's symptoms fit into or 'belong' to one of the mental disorders listed in either the DSM or ICD (depending upon which one is used). They would find out about their client's symptoms and then decide, based on their symptoms, whether they fit one or more of the DSM or ICD disorders. Consequently, the person would walk out of the mental health professional's office with either a diagnosis ('label') of some type of mental disorder if their symptoms met the diagnostic criteria for one (or more) of the disorders in the DSM or ICD, or no diagnosis if their symptoms did not.

Alternatively, if a dimensional approach were used, the mental health professional would seek to obtain a profile of their client's symptoms on a number of different dimensions. The mental health professional will have no interest in classifying the client's symptoms into a mental disorder category or giving them a diagnosis (or label) of any kind, because they believe that all of the client's symptoms are merely extreme variations of characteristics that we all possess to some degree. Instead, the aim is to 'grade' the magnitude, degree or severity of the person's symptoms. For example, using ten-point scales, the mental health professional might rate their client as severely depressed (10), mildly anxious (3) and mildly manic (2) in order to create a dimensional profile of emotional functioning (10, 3, 2). Therefore, rather than concluding that the client has 'major depression', the mental health professional would conclude that the client is 'significantly above average' (or 'clinically significant') on the depression dimension. Consequently, the person would walk out of the mental health professional's clinic with a profile of scores on a number of different dimensions, but no diagnosis (or label).

Learning Activity 11.16

Review questions

1 Explain the meaning of the phrase 'dimensional approach to classification of mental disorders'.
2 What are the underlying assumptions and principles of the dimensional approach? Explain with reference to examples.
3 What is a profile and what does it indicate about dimensions?
4 Explain the meaning of the phrase 'dimensions can be graded'.
5 Give an example of a dimensional approach and explain why it is dimensional rather than categorical.
6 Give an example of how a dimensional and categorical approach could be used together.
7 Describe two strengths and two limitations of dimensional approaches to classification of mental disorders.

Learning Activity 11.17

Summarising categorical and dimensional approaches

Complete the following table to summarise the categorical and dimensional approaches to classification of mental disorders.

	Categorical	Dimensional
Definition		
Principles and assumptions		
Examples		
Strengths		
Limitations		

Chapter 11 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Culture can determine how normality and abnormality are defined.

2 ______ Any mental illness is also a disease.

3 ______ A dimensional approach to classification may be used to diagnose a specific mental disorder.

4 ______ Physical health can be influenced by mental health and vice versa.

5 ______ Health is best defined as the absence of disease.

6 ______ Illness refers to identifiable physiological changes in a person's body.

7 ______ People with a mental illness usually experience distress.

8 ______ According to the biopsychosocial framework, poverty is a social factor that can contribute to the development and persistence of physical and mental illness.

9 ______ One of the strengths of categorical approaches to classification is that they may eliminate the use of labels such as 'phobic' and 'psychotic'.

10 ______ According to the biopsychosocial framework, physical and mental illnesses are caused by biological changes within the person.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 11 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the following is a psychological factor that could contribute to the development and persistence of physical or mental illness?

A cultural traditions
B how we perceive our internal and external environments
C an overcrowded environment
D the inheritance of particular genes

Q2 In relation to mental illness, 'atypical' means that an individual

A is distressed and extremely upset.
B behaves in a way that is not normal for them.
C is unable to do the kinds of things they normally do on a daily basis.
D has experienced a breakdown in cognitive, emotional and/or behavioural functioning.

Q3 Someone consults with a mental health professional and is diagnosed as having a specific type of anxiety disorder. In this case, the mental health professional has used a __________ approach to classification of mental health conditions and disorders.

A categorical
B dimensional
C cultural
D biopsychosocial framework

Q4 Physical or mental illness is best described as

A a personal interpretation that something is wrong with the body or mind.
B a diagnosable impairment to physiological or psychological functioning.
C a breakdown of physiological or psychological functioning.
D a disorder listed in the DSM or ICD.

Q5 Thoughts, feelings or behaviour are considered __________ if they interfere with a person's ability to carry out their usual activities in an effective way.

A distressing
B deviant
C dysfunctional
D different

Q6 Which of the following is an advantage of the categorical approach to classification of mental disorders?
- **A** avoids labelling
- **B** enables dimensional gradings
- **C** produces profiles
- **D** assists diagnosis

Q7 Which of the following is **not** a biological factor that could contribute to the development and/or persistence of physical or mental illness?
- **A** genetic inheritance
- **B** a neurochemical imbalance
- **C** immune system response
- **D** health education

Q8 Both the DSM-IV-TR and ICD-10 are
- **A** primarily used in Europe.
- **B** primarily used to produce a profile of a mental disorder.
- **C** categorical systems.
- **D** dimensional systems.

Q9 Which of the following is an advantage of the dimensional approach to classification of mental conditions and disorders?
- **A** uses discrete categories
- **B** is based on clear diagnostic guidelines
- **C** avoids labelling
- **D** can be used by any mental health professional

Q10 If a categorical or dimensional classification system enables different mental health professionals to independently give the same diagnosis to the same individual when used, then the system is said to have high ___________ reliability.
- **A** construct
- **B** internal
- **C** classificatory
- **D** inter-rater

The answers to the Chapter 11 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

______________________________ is a pattern of thoughts, feelings or behaviour that conforms to a usual, typical or expected standard in a culture, whereas ______________________________ is a pattern of thoughts, feelings or behaviour that is deviant, distressing and dysfunctional.

1 mark

Question 2

Explain the difference between mental health and mental illness.

____

____

____

____

2 marks

Question 3

a What is the meaning of the term biopsychosocial framework in relation to physical and mental health?

1 mark

b Describe a key assumption underlying the biopsychosocial framework when considering physical and mental health.

1 mark

Question 4

Distinguish between categorical and dimensional approaches to classification of mental disorders with reference to two key underlying principles or assumptions of each approach.

4 marks

Question 5

Describe a major limitation of categorical approaches to classification of mental disorders.

1 mark

The answers to the Chapter 11 short-answer questions are available at www.OneStopScience.com.au

12 Stress and health

Exposure to stressful situations and events is a common human experience. Such events or situations can range from daily hassles that are annoying, such as losing a locker key or missing the bus, through to ones that are much more challenging or even life-changing, such as the breakdown of a relationship, the loss of a job or being diagnosed with a serious illness. These situations and events can produce stress; however, they do not describe or explain stress. They are examples of stressors.

A **stressor** is any person, situation or event that produces stress. Virtually anything can be a stressor and therefore a cause of stress to an individual. Stressors can also be organised and described in different ways for the purpose of constructing theories or research. For example, a stressor may be described as a *physical* stimulus (for example, extreme temperatures, intense light, loud noise, a heavy object) or *psychological* in nature (for example, an argument with a friend, running late for a class, failing an exam, changing schools, losing a job, living in poverty). A stressor may also be described as having an internal or external source. An *internal stressor* originates within the individual; for example, a personal problem that causes concern about the potential consequences or the experience of physical pain that may be perceived as signalling an untimely illness. An *external stressor* originates outside the individual from situations and events in the environment; for example, having too much homework, being nagged by parents, being in an overcrowded situation or being a victim of bullying.

Stress is a state of physiological and psychological arousal produced by internal or external stressors that are perceived by the individual as challenging or exceeding their ability or resources to cope. It is a subjective experience, and depends on our personal interpretation of a situation or event. Internally and externally sourced events are usually interpreted in a way that produces stress when we believe that we may not or do not have the ability or resources to cope with their demands or consequences. If we believe we can cope, these events may be perceived as difficult or 'unsettling' experiences, but not necessarily as stressors. For example, some people find speaking to a large group of people highly stressful, whereas others find it challenging but enjoyable rather than stressful. Similarly, some people experience a high level of stress when they are forced to make a significant change in their lives, whereas others may simply view change as an opportunity for a new experience.

In this chapter we will examine how biological, psychological and social factors (the *biopsychosocial framework*) contribute to stress and affect the stress response. We begin with biological influences on the stress response, focusing on physiological changes associated with stress, most of which are involuntary. We then consider psychological factors influencing stress, focusing on a model

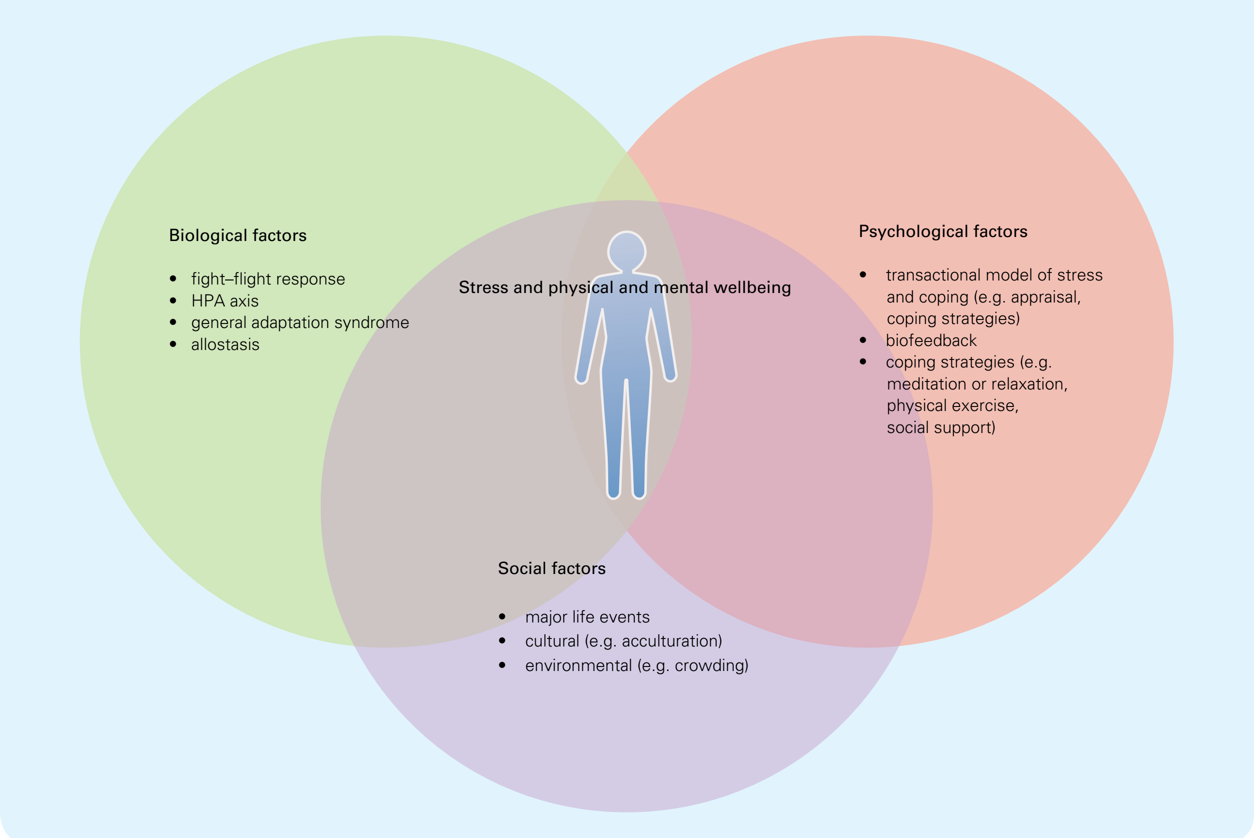


Figure 12.1 Applying the biopsychosocial framework to understanding the relationship between stress and physical and mental wellbeing

that helps to explain individual differences in the stress response and the role of the individual in determining their experience of the stress response. We then consider social factors that can influence stress, including cultural and environmental influences. Biological, psychological and social factors are then considered in an integrated way by examining allostasis, a change brought about by the brain's regulation of the body's response to stress. Finally, we consider strategies for coping with stress, examining the use of biofeedback, meditation or relaxation, physical exercise and social support (see figure 12.1).

The hassles, or 'concerns', listed in table 12.1 are relatively minor ones arising out of day-to-day living and have been identified through research as common causes of stress for people in each of the three lifespan stages. Often, daily hassles are not readily identified as stressors because they are such a part of everyday life that they may be taken for granted. Which six daily hassles cause you the most stress in your daily life?

Table 12.1 Common daily hassles

Children and early adolescents
• Having to clean up your room • Being bored and having nothing to do • Seeing that another child can do something better • Being punished for doing something wrong • Having to go to bed when you don't want to • Being teased at school
Middle–late adolescents
• Conflicts with a boyfriend or girlfriend • Dissatisfaction with your athletic skills • Having your trust betrayed by a friend • Struggling to meet your own academic standards • Not having enough leisure time • Gossip concerning someone you care about • Dissatisfaction with your physical appearance
Adults
• Concerns about weight • Health of a family member • Social obligations • Concerns about money • Misplacing or losing things • Home maintenance • Job security

Source: Kanner & others, (1991); Kohn & others, (1990)

Figure 12.2 Any event can cause stress if you believe you do not have the resources or ability to cope with it.

Physiological and psychological responses to stress

Stress can affect different people in different ways, depending on the severity or intensity of the stress response, its duration and the individual involved. A **stress response**, or 'reaction', involves the physiological ('bodily') and psychological ('mental') changes that people experience when they are confronted by a stressor. Any stress response is often classified in one of three categories, commonly called mild, acute and chronic. The experience of *mild stress* can be stimulating, exhilarating, motivating, challenging and sometimes even desirable. For example, the elevated level of arousal that usually accompanies mild stress can enhance performance in both simple and complex tasks. However, an *acute stress response* that suddenly produces a very high arousal level, or a *chronic stress response*, which produces a high arousal level that persists over a long period of time, can result in a variety of physiological and/or psychological responses, some of which are short-term and others that are long-lasting.

Physiological responses to stress

Two of the most widely used models for describing and explaining physiological responses to stress are called the *fight–flight response* and the *general adaptation syndrome*. The general adaptation syndrome includes the fight–flight response in a longer sequence of reactions when stressors are longer lasting. Both models describe a pattern of involuntary minor and major bodily changes that occur when we first become aware of a stressor. These changes initially involve the sympathetic nervous system and occur in much the same way in all individuals.

Fight–flight response

Any kind of immediate threat to your wellbeing is usually a stress-producing experience that triggers a rapidly occurring chain of bodily changes. Without our awareness or conscious control, our body responds to a perceived threat by automatically activating the fight–flight response. The **fight–flight response** is an involuntary reaction resulting in a state of physiological readiness to deal with a sudden and immediate threat by either confronting it ('fight') or running away to safety ('flight'). This reaction was first identified by American doctor Walter Cannon (1871–1945), one of the earliest researchers on the effects of stress. Cannon (1932) found that the fight–flight response involves both the sympathetic nervous system and the endocrine (hormone) system. He described the fight–flight response as including changes such as increased heart rate, redistribution of blood supply from the skin and intestines to the muscles, increased respiration, increased glucose secretion by the liver, dilation of the pupils and suppression of functions that are not immediately essential in order to conserve energy, such as digestion and sexual drive. Changes associated with the fight–flight response can occur within seconds, thereby allowing the organism to react very quickly to the threat at hand. Once the threat has passed, our parasympathetic system calms and restores normal functioning.

More recent research has clarified what happens in the brain and body during the fight–flight response (and when we face chronic stressors).

"The fight or flight response is perfectly normal. Though, traditionally, the bride takes flight."

Figure 12.3

When a threat is perceived, the hypothalamus is activated. This lower brain structure stimulates the nearby pituitary gland, which in turn secretes (releases) the hormone called ACTH (andrenocorticotropic). ACTH travels through the bloodstream and stimulates the adrenal glands, which are located just above the kidneys. This chain of reactions in the physiological response to stress involving the *h*ypothalamus, *p*ituitary gland and the *a*drenal glands is called the **HPA axis**. When the adrenal glands are stimulated, they secrete 'stress hormones', which include adrenaline (also called epinephrine) and noradrenaline (also called norepinephrine). These hormones boost the activity of the sympathetic nervous system, and therefore increase heart rate, blood pressure and respiration rate. The increased respiration and blood pressure make more oxygen available to the muscles to help meet immediate energy needs for the fight–flight response. The adrenal glands also release cortisol, a hormone that increases metabolism and the concentration of glucose in the blood to make fuel available to the muscles. In this way, the body is mobilised to defensively attack or flee an immediate threat. A 'racing heart' during the fight–flight response is explained by the surge of 'stress hormones' in the body. Once the threat is removed,

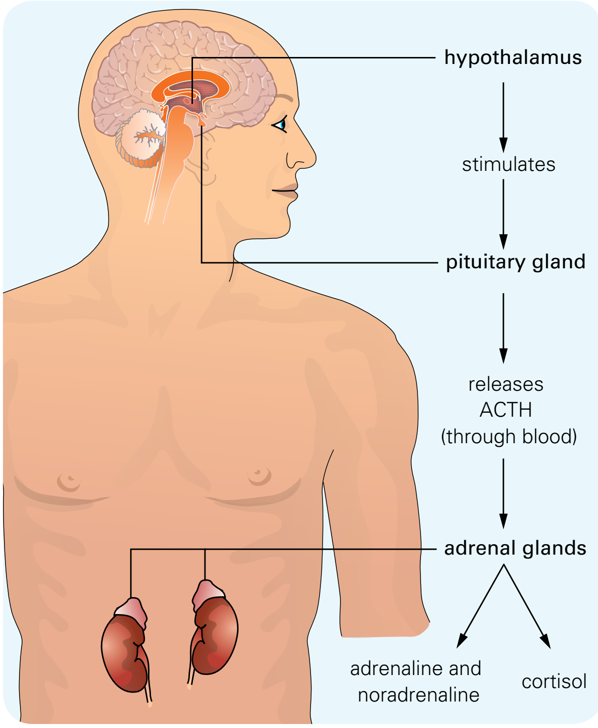


Figure 12.4 The HPA axis—a few seconds after a threatening stimulus is perceived, the hypothalamus activates the pituitary gland to release ACTH, which then travels through the bloodstream to activate the adrenal glands to release adrenaline, noradrenaline and cortisol, which energise the fight–flight response.

the high level of bodily arousal subsides gradually, usually within about 20 to 60 minutes (Schacter, Gilbert & Wegner, 2009).

The fight–flight response is viewed as adaptive in that it can help ensure our survival when we are suddenly faced with a life-threatening situation, such as someone coming towards us with a knife on a deserted street late at night. However, when exposure to a threat is unavoidably prolonged, the intense physiological arousal of the fight–flight response will also be prolonged. Under these conditions, Cannon believed that the fight–flight response could be harmful to physical health. When physiological arousal is extremely high or continues for a prolonged period of time, the body must use more resources in an effort to deal with the threat (or any other stressor). Physiological wear and tear on the body, especially in those organs that are already weak, becomes apparent. For example, if the stress hormones such as adrenaline, noradrenaline and cortisol remain at high levels and stay in the bloodstream for a prolonged time, then the body's overall level of functioning begins to decline and the immune system becomes less effective, resulting in a range of physical symptoms and increased vulnerability to disease.

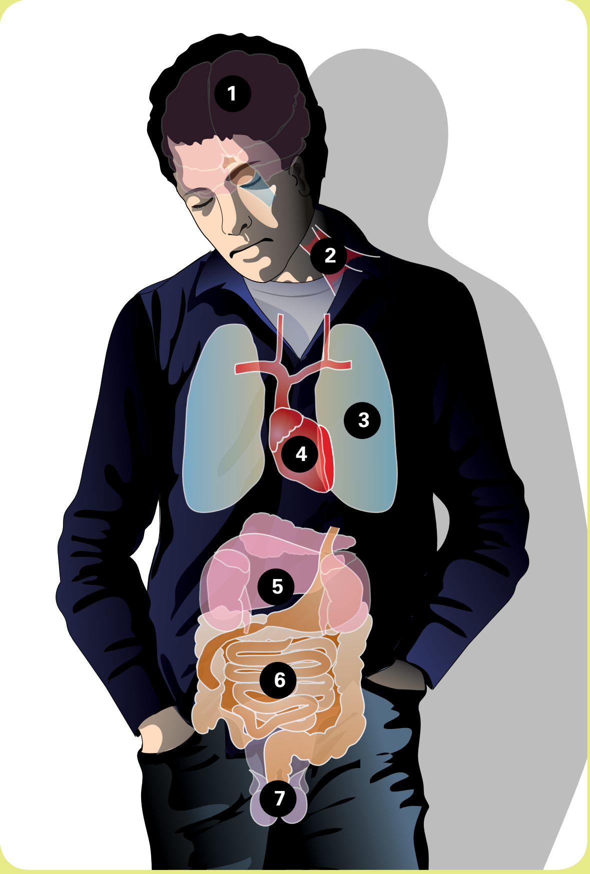
Because physiological stress responses vary among individuals, different people may experience additional bodily reactions from intense or prolonged arousal. Some of the commonly experienced responses include dizziness, aches and pains associated with muscle tension, heart palpitations, skin rashes, fatigue and a general feeling of being unwell. For many people, stress causes muscles in the neck and head to contract and tighten, resulting in stress-induced headaches. Colds or influenza and digestive disorders such as indigestion and stomach ulcers may also result from intense and prolonged arousal. These digestive disorders may occur as a result of the sympathetic nervous system slowing down the body's digestive functioning for too long (Breedlove, Rosenzweig & Watson, 2007).

Box 12.1

Body systems involved in a physiological stress response

Many body systems may be involved in a physiological stress response. Some of the systems and ways they react to a physical or psychological stressor include the following.

1 **Nervous system**
The body automatically activates the flight–fight response so that its resources are in a physiological state of readiness to deal with



the perceived threat. The so-called 'stress hormones'—e.g. adrenaline, noradrenaline and cortisol—are released by the adrenal glands after receiving a signal from the sympathetic nervous system. These hormones increase the heart rate, raise blood pressure, increase respiration and increase glucose secretion from the liver. Other functions that are not immediately essential are suppressed. Once the threat passes, body systems usually return to normal functioning.

2 Musculoskeletal system
Stress causes muscles, particularly in the neck and head, to contract and tighten and, over extended periods, can cause stress-induced headaches and migraines, and aches and pains in other muscles.

3 Respiratory system
Increased respiration and blood pressure makes more oxygen available to the muscles to help meet immediate energy needs for the fight–flight response. However, rapid breathing (or hyperventilation) in response to stress can bring on dizziness or even panic attacks in some people.

4 Cardiovascular system
A sudden surge of the stress hormones in response to an acute stressor results in the feeling of a 'racing heart', as the heart rate increases and the heart muscle contractions strengthen. It is now thought that the body's response to chronic stress can contribute to hypertension, stroke and coronary heart disease.

5 Endocrine system
When the body is stressed, it sets off the chain of reactions involving the HPA axis (hypothalamus, pituitary gland and the adrenal glands). Once cortisol and adrenaline have been released, the liver produces more glucose to fuel the body's response to the stressor.

6 Gastrointestinal system
Stress affects the nerves of the digestive system and can upset digestion, causing people to feel a sense of 'unease' or 'butterflies' in their abdomen, or even nausea or pain. Stress can slow the digestive system, resulting in either bloating and constipation or diarrhoea, and can affect which nutrients your intestines absorb. Over time, chronic stress can lead to damage to the digestive system. Stress can also bring about changes to diet, both in terms of what people eat and how and when they eat it, or it can cause people to increase their use of alcohol or caffeine.

7 Reproductive system
Excess production of cortisol is thought to affect the reproductive system of men by suppressing sperm count and production of testosterone, and women by inhibiting the reproductive system and impacting on the menstrual cycle.

Source: adapted from Stress and your body (*The Washington Post*, 2007, January 23) www.washingtonpost.com/wp-dyn/content/graphic/2007/01/22/GR2007012200620.html.

Learning Activity 12.1

Review questions

1 **a** Distinguish between stress, stressors and the stress response with reference to one or more examples not used in the text.
b Explain the relationship between stress, stressors and the stress response with reference to one or more examples not used in the text.

2 Consider the different classifications of stressors. Explain both of your answers.
a Give an example of an internally sourced stressor that is not psychological.
b Give an example of a how a physical stimulus may be a stressor.

3 Consider the stressors in table 12.1 derived from research conducted over 20 years ago.
a Which stressors for middle–late adolescents do you believe are still relevant or no longer relevant?
b Which stressors do you believe might be included in the list if the studies were to be replicated by contemporary researchers?

4 **a** What is the fight–flight response and when is it likely to occur?
b Describe a fight–flight response you have experienced and physiological changes occurring of which you were aware and those of which you were unlikely to be aware.
c Explain why the fight–flight response cannot be consciously controlled.
d Explain the meaning of arousal and the relationship between the fight–flight response and arousal.

5 **a** What is the HPA axis?
b Name key physiological changes involved in the HPA axis.
c Describe the role of the HPA axis in the fight–flight response.

Learning Activity 12.2

Visual presentation on the fight–flight response

Prepare a flow chart in which you describe and explain the fight–flight response and its physiological characteristics. Your flow chart summary should be based on an example of a stressor that could trigger the response.

Relevant graphics should be used and written information may be presented in point form.

Learning Activity 12.3

Research investigation on stressors

Working in a small group, plan and conduct a survey to test the contemporary relevance of the stressors in one of the lifespan stages in table 12.1.

Your survey may use rating scales for each of the stressors but should also enable participants to identify one or more additional stressors. Sex differences may also be tested.

You should construct a hypothesis (or hypotheses) before conducting the research. Write a report on the investigation.

Selye's general adaptation syndrome

Cannon's belief that prolonged stress could be potentially harmful was confirmed by Canadian endocrinologist Hans Selye (1907–1982), who was also conducting research on the effects of stress in the 1930s. Most of Selye's pioneering research was done with rats that were exposed to a variety of stressors such as painful tail-pulling, lengthy exposure to extreme heat or cold, mild electric shocks, bacterial infections, excessive exercise and forced restraint (for example, tying their legs together for 24 hours). He observed that the physiological arousal pattern in response to each of these different kinds of stressors was generally the same: adrenal glands were enlarged, stomach ulcers developed, weight loss occurred and there was a shrinking of vital glands of the immune system (for example, lymph glands). On the basis

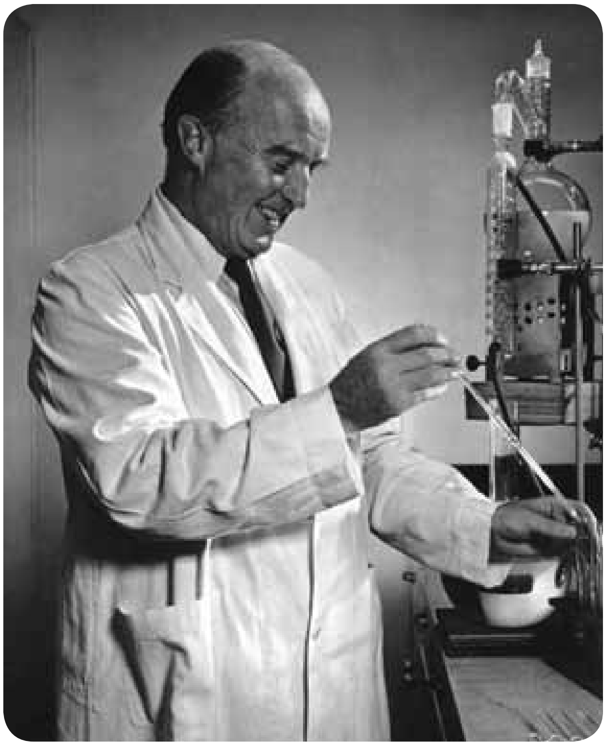


Figure 12.5 Based on extensive research with rats, Hans Selye developed the three-stage general adaptation syndrome (GAS), which describes how organisms react to stress. His popular book, *The Stress of Life* (1956), helped make stress a household word. Selye spent a lifetime researching the GAS and wrote 30 books and more than 1500 articles on stress and related problems.

of these observations, Selye concluded that stress is a condition that is non-specific, and that it can be brought on by either internal or external stressors. He also concluded that the condition of stress is the body's physiological response to both physical and psychological demands (Selye, 1936).

Selye also drew the same conclusions when he studied responses by people to stressors. He observed a small number of hospital patients who had experienced stressors such as the death of someone close to them, retrenchment from a job and arrest for embezzlement. Although the stressors were different, the patients developed similar symptoms as a result of the stressors. For instance, they all had poor appetites, muscular deterioration and a general lack of interest in the world.

According to Selye, any threat, emergency, illness, injury or demand arising through school, work and other events in everyday life causes physiological responses. These sympathetic nervous system responses include increased blood pressure, heart rate and respiration rate; secretion of adrenal gland hormones; an increase in muscle tension; and a slowing down of digestive functioning. These are *non-specific* responses to stress that occur regardless of the type of stressor. In addition to non-specific reactions, a number of *specific* responses appropriate for particular stressors can occur. These specific reactions may include running away from a vicious dog, fighting off an attacker, activation of the immune system to destroy bacteria and viruses, and becoming tense or frustrated at someone who is annoying. Specific and non-specific responses to stressors are natural reactions to the challenges of varying complexity that we encounter in everyday life.

On the basis of his observations of animals, and to a lesser extent people, Selye developed the general adaptation syndrome. The **general adaptation syndrome (GAS)** is a three-stage physiological stress response that occurs regardless of the stressor that is encountered. This means that the GAS is *non-specific* and will appear whatever the source of the stressor. As shown in figure 12.6, the GAS occurs in three stages called alarm reaction, resistance and exhaustion.

Stage 1: Alarm reaction

The first stage of the GAS is the **alarm reaction stage**, which occurs when the person (or animal) first becomes aware of the stressor. Following exposure to a stressor, the body goes into a temporary state of *shock*, and its ability to deal with the stressor falls below its normal level. Physiologically, the body reacts as if it were injured; for example, blood pressure and body temperature drop, and a temporary loss of muscle tone is experienced. The body rebounds from this level with a reaction that Selye referred to as countershock. During *countershock*, the sympathetic nervous system is activated and the body's resistance to the stressor increases. The organism's response is the same as the fight–flight response. It becomes highly aroused and alert, as it prepares to deal with the stressor. Stress hormones are released into the bloodstream and the organism's heart and respiratory system respond by accelerating. This supplies the muscles with more energy (glucose and oxygen), allowing the organism to 'fight or flee' as necessary. Overall, the alarm reaction stage of the GAS is a general defensive reaction to the stressor, and results in a state of tension and alertness, and a readiness to respond to the stressor.

Stage 2: Resistance

According to Selye, if the source of the stress is not dealt with immediately, and the state of stress continues, the organism enters a stage of resistance. During the **stage of resistance**, the body's resistance to the particular stressor rises above normal, as it tries to adapt to and cope with the stressor. The intense arousal of the alarm reaction stage diminishes, but physiological arousal remains at a level above normal. Since the body is being taxed to generate resistance, all unnecessary physiological processes are shut down. For example, digestion, growth and sex drive stall, menstruation stops, and the production of testosterone and sperm decrease. However, hormones such as adrenaline and cortisol, which support resistance, are released into the bloodstream. These hormones energise the body and help to repair any damage that may have occurred, but also weaken the immune system. Their continuing presence at abnormally high levels therefore interferes with the body's ability to fight disease and to protect itself against further damage. Thus, although resistance to the initial stressor increases during the resistance stage, resistance to other potential stressors such as an illness may decline. For example, during an exam week, a VCE student may be able to cope well enough to study for all their exams despite a decrease in sleep, exercise, recreation and healthy food (that is, their body responds to the initial stressor). However, soon after the exams, the student may experience the onset of a physical disorder such as the flu. While the body's focus has been on dealing with the original stressor, it has failed to respond effectively to the flu virus, a new stressor that has entered the body. Generally, if the effort to deal with the initial stressor during the stage of resistance is successful, the organism eventually returns to its normal state (Breedlove, Rosenzweig & Watson, 2007).

Stage 3: Exhaustion

According to Selye, if the stressor is not dealt with successfully during the resistance stage and stress continues, the organism enters a **stage of exhaustion**. Signs of the alarm reaction

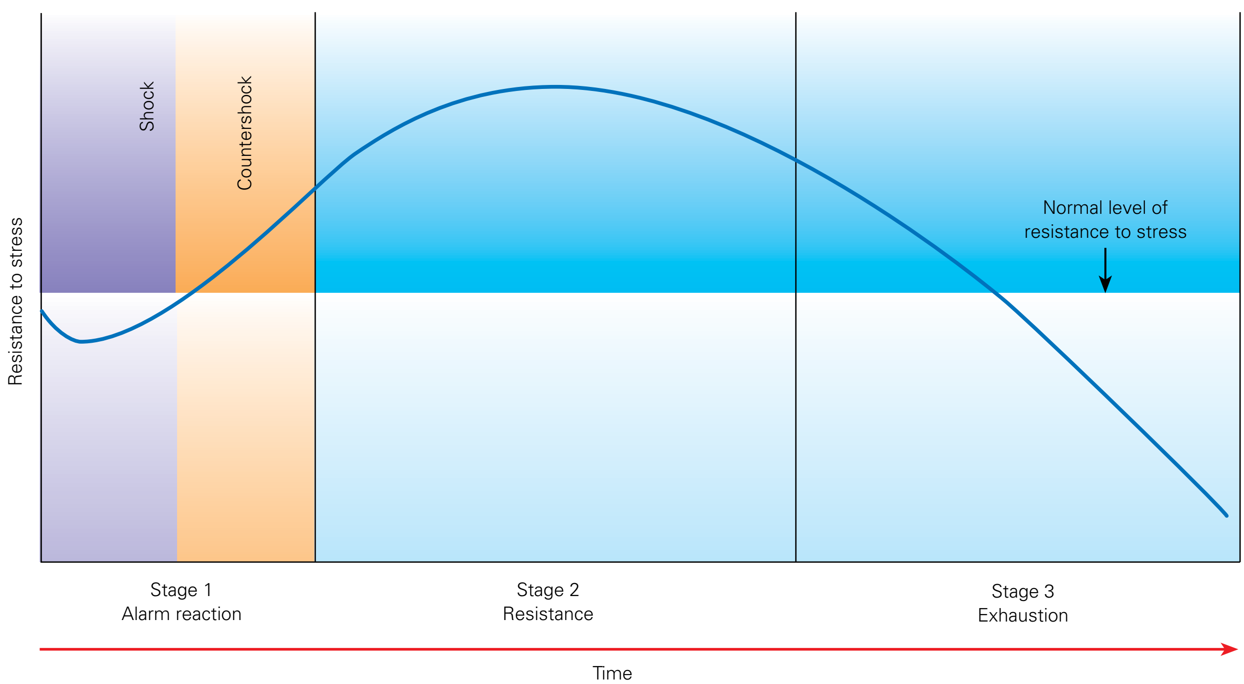


Figure 12.6 The GAS consists of three stages that occur in a sequence: alarm reaction, resistance and exhaustion.

may reappear, but the effects of the stressor can no longer be dealt with. Because the organism has been trying to deal with the stressor for some time, its resources have been depleted, its resistance to disease is very weak, and it becomes vulnerable to physical and mental disorders. The stage of exhaustion is characterised by extreme fatigue, high levels of anxiety and depression, nightmares and impaired sexual performance. Physical disorders such as hypertension (high blood pressure), allergic reactions and peptic ulcers may also occur. In extreme cases, if the stress continues further, the organism may even die. More commonly, the exhaustion stage brings about signs of physical wear and tear, especially in organs that have been consistently trying to deal with the stressor throughout the resistance stage. For example, if adrenaline and cortisol, which help fight stressors during the resistance stage, remain at high levels for a prolonged period of time, they can cause damage to the heart and suppress (restrict) the functioning of the body's disease-fighting immune system. This can result in disorders ranging from heart disease and high blood pressure to arthritis, colds and flu (Breedlove, Rosenzweig & Watson, 2007; McEwan & Stellar, 1993; Cohen & others, 1992).

Strengths and limitations of Selye's GAS

Selye's three-stage GAS model of physiological responses to stress extended Walter Cannon's findings on the fight–flight response and further developed awareness and understanding of the links between stress and disease. He was among the first researchers to suggest that stress could weaken the body's ability to resist infection and increase the likelihood of developing a physical disorder. This idea is now widely accepted within psychology (and medicine). For instance, there is extensive research evidence that stress is associated with the initiation and progression of a wide variety of diseases, from cardiac, kidney and gastrointestinal diseases to AIDS and cancer. However, in the 1930s, the proposal that stress could actually cause disease, or at least weaken the body's resistance to disease, was a radical idea. Back then, the dominant view was that most diseases could only be caused by exposure to germs, viruses and other sources of infection.

Selye's GAS model also identifies some of the physiological mechanisms and characteristics associated with the stress response. For instance, many of his findings on the role in the GAS of the endocrine system and its various hormones have been confirmed by contemporary researchers and continue to be influential. This also applies to Selye's proposals that the GAS will occur in response to any type of stressor and that our bodies have only a limited amount of resources in coping with prolonged stress. These ideas are now included in most contemporary theories on stress and stress responses. Selye's GAS has also been influential through its description and explanation of the potentially detrimental effects of the three-stage adaptation process following exposure to a persistent stressor. The idea that our bodies can eventually run out of resources and become increasingly vulnerable to disease as the stress persists had not been fully understood by previous researchers.

There are, however, a number of limitations of Selye's GAS. The GAS is a 'one size fits all' model. It assumes that *everyone* has the same general, predictable and automatic physiological responses to any kind of stressor, not unlike a sensor light that turns on outside regardless of the type of motion that is detected. Consequently, the GAS does not fully take account of or explain individual differences in physiological responses to a stressor. It also tends to overlook the roles of other bodily systems in the stress response (see box 12.1) and ignores our psychological response to different types of stressors. It does not take into account cognitive aspects of the stress response, specifically the role of the brain in interpreting a situation or event as stressful. For example, two people may appraise, or 'weigh up', the same situation and judge it differently as either stressful or not stressful. This means that what might be considered a stressful situation and cause a stress response in one person may not in another. Furthermore, if both individuals appraise the situation as stressful, they may experience qualitatively different stress responses.

Similarly, not all people respond to exposure to chronic stress in the same way. For example, some develop heart disease, some develop peptic ulcers, some develop hypertension, and so on. This suggests that, despite the same bodily arousal systems and processes being involved in the GAS in all people, the precise way that prolonged activation can lead to disease could involve other physiological and/or psychological processes. Selye's description of the GAS as a non-specific stress response may also be limited. For instance, there is research evidence that different types of stressors can trigger their own distinctive physiological reactions (Cohen & others, 1986). Finally, Selye's GAS has been criticised for being primarily based on the results of research with animals and may therefore be of limited relevance to the human stress response. His reliance on animal research studies may explain why the GAS overemphasises physiological factors and does not fully take into account individual differences and psychological factors in the stress response, particularly the role of cognitive processes.

Eustress and distress

Often, when we think about stress or a stress response, we focus on the negative effects it has on our lives. However, Selye (1974) proposed that not all stress is necessarily negative, or 'bad'. On the basis of later research, he identified different types of stress. He proposed that stress could be either negative ('bad') or positive ('good').

The excitement of a first date, an 18th birthday party, riding on a roller-coaster, meeting a celebrity, or getting an A+ for an exam can all cause what Selye called positive stress, or eustress. **Eustress** is a positive psychological response to a stressor, as indicated by the presence of positive psychological states such as feeling enthusiastic, excited, active and alert. Distress, on the other hand, is a negative psychological response to a stressor, as indicated by the presence of negative psychological states such as anger, anxiety, nervousness, irritability or tension. Distress can result from such situations as lining up before entering a room to sit a very important exam, experiencing the break-up of a relationship or ongoing difficulties in a relationship, participating in an intense athletic competition with a negative outcome (for example, losing an important match in a tennis tournament), or watching a horror movie. Generally, when stress is beneficial or desirable it can be described as eustress. When stress is objectionable or undesirable, it can be described as distress.

Whether a situation or event results in eustress or distress varies from individual to individual depending upon the cognitive interpretation they make; that is, whether they judge a stimulus as positive or negative in relation to themselves. Therefore, a stressor that may be considered positive stress by one person may be considered negative stress by another. For example, consider two friends who decide to go bungee jumping for the first time. One may experience a 'high' (eustress) while the other is extremely anxious (distress).

Box 12.2

Stress and the global disease burden

The number of people experiencing stress-related illnesses or diseases requiring psychological and/or medical intervention has increased markedly over the past 20 years or so. The World Health Organization has described stress as a 'modern day epidemic, affecting every person, in every nation, regardless of race or class'. The WHO has also identified stress as 'an underlying contributing or complicating factor' in all five of the 'diseases' predicted to cause 'the greatest global disease burden by 2020'.

Table 12.2 Global disease burden, 1990 and 2020

1990	2020
pneumonia	heart disease
diarrhoeal disease	severe depression
disease of the newborn	traffic accidents
severe depression	stroke
heart disease	chronic lung disease

Figure 12.7 The same stressor may produce eustress in one person and distress in another.

McDonald's employee 'died of overwork'

A store manager with hamburger chain McDonald's in Japan who died of a brain haemorrhage was a victim of 'karoshi' or death by overwork, a regional labour office said.

The woman, employed at an outlet in Yokohama near Tokyo and reportedly aged 41, had done more than 80 hours of overtime per month before she collapsed in October 2007 during a training program at a different store.

She died in hospital three days later, said an official at the Kanagawa Labour Bureau on Wednesday, which oversees the Yokohama region.

'We determined her work caused the illness,' said the official in charge of work-related compensation, a decision that makes her dependent family members eligible to receive a public pension.

'She had early symptoms such as headaches some three weeks before she collapsed, and we presume she already had the illness at that point.'

McDonald's Co (Japan) Ltd declined to comment on the case, with a spokesman saying only that the company had not been contacted by authorities and had not confirmed the decision by itself.

The woman had performed more than 80 hours of overtime a month on average for the six months before she suffered early symptoms, although she had a vacation shortly before she collapsed in October, the official said.

Japan's welfare and labour ministry investigates whether deaths are caused by excessive work if the victim had performed monthly overtime of 80 hours or more for the preceding six months, or 100 hours for the previous one month.

The number of deaths, usually through strokes or heart attacks, in Japan that are classified as 'karoshi' has been hovering at around 150 annually in recent years, according to ministry data.

McDonald's suffered a blow to its image when a Tokyo court last year ordered it to pay compensation of more than $US70 000 ($A76 252) to an employee who had performed unpaid overtime for several years.

The plaintiff, who had carried the job title of store manager, had earlier said he sometimes worked more than 100 hours of unpaid overtime in a month.

Japan's labour laws do not oblige companies to pay overtime to workers in managerial posts.

McDonald's argued their store chiefs have a say in management decisions but the court rejected that argument.

Source: McDonald's employee 'died of overwork', AFP (*The Age*, 2009, 28 October).

Learning Activity 12.4

Review questions

1. What is the general adaptation syndrome (GAS)?
2. Name and describe each stage of the GAS.
3. Explain the meaning of the phrase 'the GAS is non-specific'.
4. One week remained before Alison's exams. She stayed up late every night studying, and although she was feeling tired, she seemed to be managing her workload. Two nights before her first exam, Alison witnessed her dog being hit by a car, which upset her very much. On the morning of her exam, she woke up with a headache, a sore throat, aches and pains in her joints and she kept sneezing.
   - **a** Name and describe the GAS stage Alison is most likely to be in, with reference to Alison's situation and experiences.
   - **b** According to the GAS, under what circumstances would Alison be vulnerable to a physical disease?
5. Outline the main strengths and limitations of the GAS.
6. Suggest a suitable mnemonic device for recalling the names of the GAS stages in their correct order.
7. **a** Distinguish between eustress and distress.
   - **b** Copy the following table. In the first column, briefly describe three stressors that resulted in your experiencing eustress and three stressors that resulted in distress. In the second column, classify each stressor as either predominantly eustress or distress. In the last column, explain each classification.

Stressor	Eustress = E Distress = D	Reason for classification

Learning Activity 12.5

Media response

Read the newspaper article, 'McDonald's employee "died of overwork"'. Write a report of about 200–250 words in which you discuss the possibility of 'dying of overwork' with reference to the article, relevant theories and research evidence on stress and stressors, and Selye's GAS model, as described in the text.

Psychological responses to stress

Our physiological responses to stressors initially occur automatically through a cascade of bodily changes initiated by the sympathetic nervous system and endocrine system. Most of these changes are predictable, but we usually have no control over them. However, psychological responses are not involuntary and we more or less have control over them, depending on the individual. By their very nature, psychological responses are not directly observable but can either be inferred from observable reactions to stressors or determined through the use of self-reports from individuals experiencing stress and/or who reflect on their responses to different stressors. In general, psychological responses to stress are often divided into three categories: behavioural, emotional and cognitive changes. These types of responses do not necessarily occur in isolation of each other, or in isolation of physiological responses.

Behavioural changes are apparent in how a person looks, talks, acts and so on. Strained facial expressions, a shaky voice, hand tremors or muscle spasms and 'jumpiness' are common behavioural responses to stress. Sometimes, a significant change in an individual's behaviour is evidence of a stress response. For example, a significant increase or decrease in eating may occur, or sleep patterns may change and sleep disorders or problems such as insomnia and nightmares may be experienced. Some people behave more aggressively when stressed, while others respond by withdrawing. Attempts to avoid or 'flee' from a stressor may also result in a range of different behavioural responses, depending on the specific cause of the stress. For example, people may resign from their job, leave school, or use alcohol or other drugs as a way of 'blocking out' or escaping from the stressor.

Exposure to a stressor can also produce *emotional changes*, which influence the way a person feels. When people do not have an opportunity to recover their emotional equilibrium, or 'balance', following exposure to an unavoidable stressor, they often report feeling anxious, tense, depressed, angry, irritable and short-tempered. In some situations, people may also report feeling a sense of hopelessness and helplessness, feeling trapped in a situation from which they feel there is no escape. These feelings are often accompanied by a negative attitude to themselves, to their work or school and to life in general.

Cognitive functions can also be adversely affected as a result of stress. *Cognitive changes* associated with a stress response influence a person's mental abilities, such as their perceptions of their circumstances and environment, their ability to learn and how they think. Often perceptions are distorted or exaggerated in some way. People often report that they have difficulties concentrating, maintaining focus, making decisions and thinking clearly, and are more forgetful. These difficulties seem to occur partly because of the constant intrusion of thoughts about the situation or event associated with the stressor. For example, a student experiencing stress as a result of a possible or actual relationship breakdown may continually think about the problems in the relationship and these thoughts may interfere with studying for an exam. A related phenomenon is commonly described as *catastrophising*, which is considered to occur when we dwell on and overemphasise the potential consequences of negative events. For example, during the mid-year or end-of-year exams, students experiencing stress may say to themselves 'Everyone else knows more

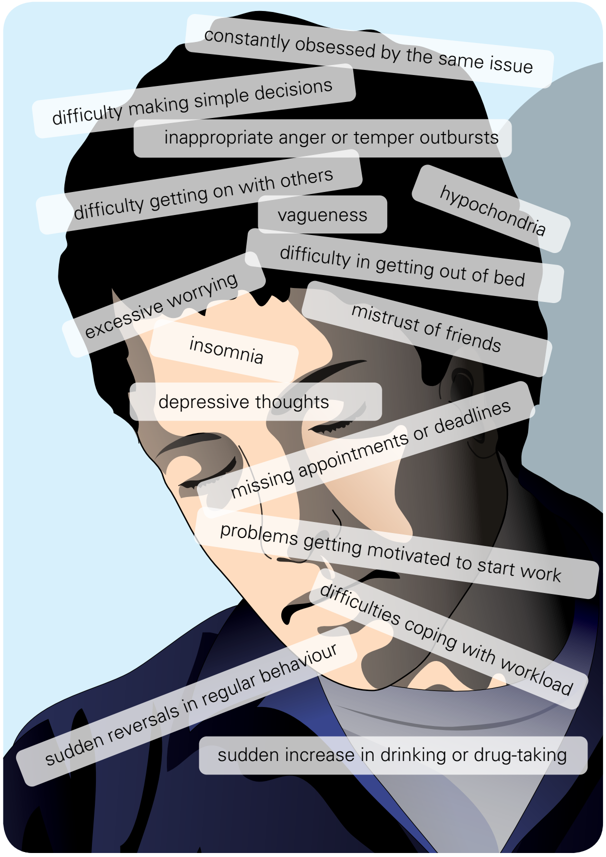


Figure 12.8 Some behavioural signs of stress

than I do' or 'If I fail this exam, my whole life is over'. Although catastrophising and intrusive thoughts occur as a consequence of stress or a stressor, they also add to an individual's stress response and further impede their performance.

Problem-solving and decision-making are other cognitive functions that can be affected by stress. People in a stressful situation are less likely to come up with efficient or effective solutions to what would normally be relatively simple problems. For example, victims of fires in large buildings sometimes die trapped in a room because in the stress of the moment, they are unable to think of using the telephone or taking a piece of furniture to break a window to escape. People who would normally consider all aspects of a decision may, while under stress, act impulsively and later regret their decision. Some high-pressure salespeople try to take advantage of this by deliberately creating a stressful situation when trying to coerce a potential customer into buying what they have to sell. For example, a car salesperson may tell a potential customer who seems to have their heart set on buying a particular car that there is someone else who is coming back at the end of the day to buy the car, thus pressuring the individual to make a quick decision.

Learning Activity 12.6

Review questions

1. Explain the meaning of the phrase 'psychological response to stress'.
2. In what three ways can psychological responses to stress be distinguished from physiological responses to stress?
3. Construct a table in which you summarise psychological responses to stress under the three categories described in the text.
4. Given an example of how prior experience may influence a psychological response to stress.
5. Suggest how an individual's personal interpretation of a stressor may impact on their stress response.

Learning Activity 12.7

Visual presentation on the stress response

Using an example of a potential stressor at school or college or in the workplace, construct a concept map in which you show potential physiological and psychological responses to the stressor and the ways they may interact.

Psychological determinants of the stress response

Researchers have identified many and varied psychological factors that cause or influence the human stress response. These include our prior experience with stressors and stress responses, attitudes, motivation, level of self-esteem, general outlook on life (for example, optimism versus pessimism), personality characteristics, coping skills and our perception of how much control we have over a stressful situation or event. Such factors are not independent of each other and combine in different ways within each individual to have more or less impact on the stress response that may be experienced. American psychologists Richard Lazarus and Susan Folkman (1984) developed the *transactional model of stress and coping* to describe and explain individual differences in the stress response from a psychological perspective. Their model focuses on two key psychological factors that determine the extent to which an event is experienced as stressful: the meaning of the event to the individual and the individual's judgment of their ability to cope with it.

Lazarus and Folkman's transactional model of stress and coping

The Lazarus and Folkman **transactional model of stress and coping** proposes that stress involves an encounter ('transaction') between an individual and their external environment, and that a stress response depends upon the individual's interpretation ('appraisal') of the stressor and their ability to cope with it.

According to Lazarus and Folkman (1984), stress is not a result of the individual alone or the environment alone. The environment can influence the individual, but the individual can also influence the environment. Furthermore, an individual's appraisal of the situation and their resources for dealing with that situation determine whether or not an individual experiences a stress response and he nature of their stress response. When there is an imbalance between a person's appraisal of the demands of the situation and their estimation of their ability to meet those demands, then a stress response will be experienced.

For example, imagine two drivers stuck in a traffic jam on Citylink that has been caused by a car accident blocking one of the exits. Both are on their way to a business meeting at work. One driver believes that the lack of movement is untimely, but that 'it's no big deal' and there's no point in getting upset because that won't make the cars ahead start moving again. So she decides to phone her assistant and explain that she will be late. She then uses the unexpected 'spare time' to catch up with her sister over the phone. The other driver reacts very differently in the traffic jam. She thumps the steering wheel and swears out loud. She then thinks about ringing her assistant but her phone battery is dead. She thumps the steering wheel again, thinking that the traffic jam is awful and will ruin her whole day. As the traffic jam continues, she sits and fumes, tapping on the steering wheel with her finger. She checks her watch regularly and becomes increasingly agitated with the passing of each minute. Her heart is pounding and, despite it being a cold day, she has to wind down the window because she feels very hot. In this example, a specific situation is a stressor for one individual and not the other. The first driver is barely affected by the situation, whereas the second driver experiences significant distress, worsened by the fact that she feels trapped and cannot do anything to improve her circumstances.

According to the transactional model, both drivers are involved in an encounter with the environment that has produced a potential stressor—they are stuck in a traffic jam that will make them late for a business meeting. However, each individual responds differently to the same situation because of how they appraise the situation. The first driver appraised the situation as 'no big deal', managed the situation as best she could, then viewed it is an opportunity to speak with her sister. The second driver was

Figure 12.9 According to the Lazarus and Folkman transactional model of stress and coping, stress is 'in the eye of the beholder' and events only become psychological stressors when individuals interpret them as unpleasant, uncomfortable or perhaps 'the worst thing that could happen to me'.

overwhelmed and appraised the situation as 'awful' and as exceeding her ability and available resources to do anything about. According to Lazarus and Folkman, stress is largely 'in the eye of the beholder'. Furthermore, the situation with which the individual has a 'transaction' will only lead to stress if they appraise that situation as unpleasant, uncomfortable or perhaps as 'the worst thing that could happen to me', as did the second driver. Appraisal is not necessarily a conscious process. However, it is always subjective and therefore a highly personal process. It also depends on our estimation of our ability to cope with it. It is for these reasons that two individuals may assess the same potential or actual stressor differently.

The transactional model of stress and coping distinguishes between two different types of appraisal of a situation. These are called primary appraisal and secondary appraisal, and they occur in a sequence in response to a potential stressor.

In a **primary appraisal**, we evaluate, or 'judge', the significance of the situation. For example, we may ask questions such as 'Is this something I have to deal with?', 'Am I in trouble?', 'Is there any benefit?' and 'Does this matter to me?' The outcome of a primary appraisal is a decision about whether the situation is *irrelevant*, *benign–positive* or *stressful*. If we decide that the situation is stressful, then we engage in additional appraisals. These are: (1) *harm/loss*, which involves an assessment of how much damage has already occurred (for example, 'I have lost my job'); (2) *threat*, which involves an assessment of harm/loss that may not have yet occurred but could occur in the future (for example, 'I mightn't be able to afford the rent'); and (3) *challenge*, which involves an assessment of the potential for personal gain or growth from the situation (for example, 'I'll get any other job I can and will learn to budget and save money').

In a **secondary appraisal**, we evaluate our coping options and resources and our options for dealing with the stressful situation. The coping options and resources available may be *internal* (for example, strength and determination) or *external* (for example, money and support from family or friends).

According to Lazarus and Folkman (1984), we may also engage in a reappraisal of an earlier stressor. In a **reappraisal**, we determine the extent to which additional resources are needed to cope with the situation. This involves a dual process: (1) reappraising the situation while taking account of the coping resources that are available, and (2) reappraising the coping resources while taking account of the reappraised threat. If the coping demands of the situation are perceived as being far greater than the resources that are available, then we are likely to experience a stress response. The discrepancy that is perceived may also trigger a search for additional or new resources that can be used to cope with the stress.

Because we can't escape a stress response, we need to learn how to effectively cope with it. The transactional model of stress and coping also describes a range of coping strategies. According to Lazarus and Folkman (1984), **coping** is the process of 'constantly changing cognitive and behavioural efforts to manage specific internal and/or external stressors that are appraised as taxing or exceeding the resources of the person'. This means that coping is an attempt to manage the demands of a stressor in some effective way. It is not one single act. Rather, it is a process that enables us to deal with various stressors. The various types of specific coping strategies are classified as either problem-focused coping or emotion-focused coping.

Problem-focused coping involves efforts to manage or change the cause or source of the problem; that is, the stressor. This may include:

- reappraising the stressor by examining it from new perspectives
- obtaining more information about the stressor by talking to someone who could help
- redefining the stressor in a way that is more manageable
- generating alternative ways of dealing with the stressor
- focusing on changing only what is changeable
- learning new skills to more effectively manage the stressor.

For example, you may become stressed when you realise that you will not be able to afford to go to a rock concert with your best friends. Some possible problem-focused solutions include taking action to get more money by offering to do jobs for family members or neighbours, seeking an advance on a weekly allowance received at home, reducing your expenses or requesting repayment from someone who owes you money. Problem-focused coping strategies tend to be used when we believe that we have some control over a situation and think that we can change the circumstances, or at least change ourselves to more capably deal with the circumstances.

Emotion-focused coping involves strategies to attend to our emotional responses to the stressor. This typically involves strategies that are directed toward decreasing the emotional component of a stress response. Emotion-focused coping strategies include such efforts as:

- denial (for example, 'I'm not stressed')
- distancing (for example, 'I don't let it get to me')
- avoiding (for example, 'I'm not entering the public-speaking competition')
- minimising (for example, 'It's not that bad')
- wishful thinking (for example, 'I wish that the situation would go away or somehow be over with')
- acceptance (for example, 'I accept that this has happened and can't be changed')
- venting emotions (for example, 'I feel angry')
- seeking emotional support from family members or friends.

Emotion-focused coping strategies tend to be used when we believe that we have little or no control over a situation and therefore can't do anything to change the circumstances. For example, emotion-focused coping would tend to be used if we become stressed on learning that a loved one has been diagnosed with a serious illness.

Many stressful situations and events are actually quite complex, so both types of coping can be combined. For example, in some situations, we may first need to use an emotion-focused strategy, which allows us to deal with the intense emotions that have been triggered by an especially overwhelming stressor. Then, later on, when we have regained emotional strength, we can reappraise our situation and use a problem-solving strategy to look for ways of managing the stressor or solutions. In other situations, however, the strategies may be used in the opposite order (see figure 12.10).

Strengths and limitations of the model

Lazarus and Folkman's transactional model of stress and coping has a number of strengths. Unlike the GAS and fight–flight models, which

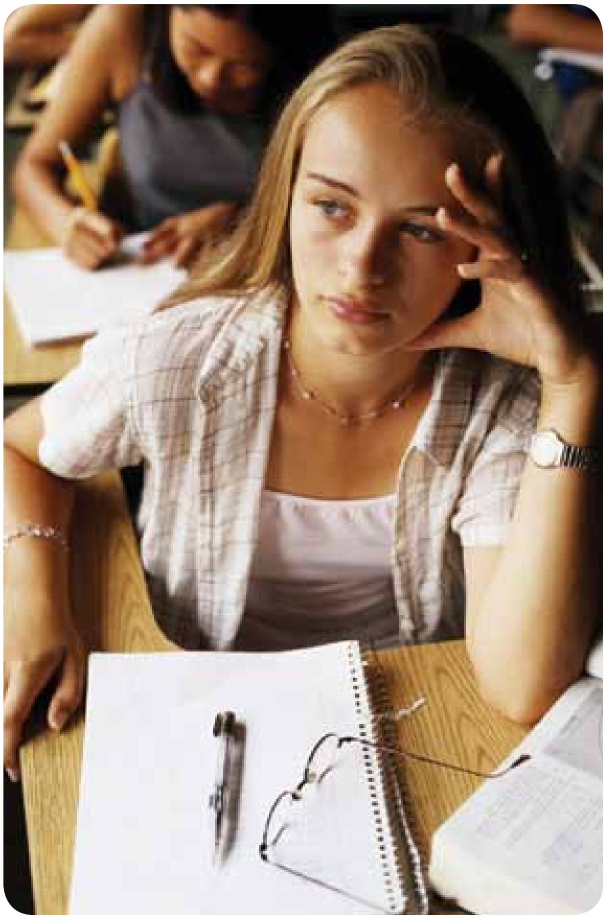


Figure 12.10 Problem-focused coping involves efforts to manage or change the cause or source of the problem. For example, when a SAC test is scheduled, you can prepare a timetable for studying, study hard, get a tutor, cheat or pretend you are sick and re-sit the test after a asking a friend what is on it. If none of these options are available, possible or desirable, and you fear that you may not pass the test, then you may use emotion-focused coping to decrease your emotional response to the stressor. For example, you can tell yourself it is not important to pass the test, remind yourself that you are quite good at sitting tests, moan to your friends, cry on someone's understanding shoulder, become very busy doing something else or use positive thinking (believe that you will cope somehow).

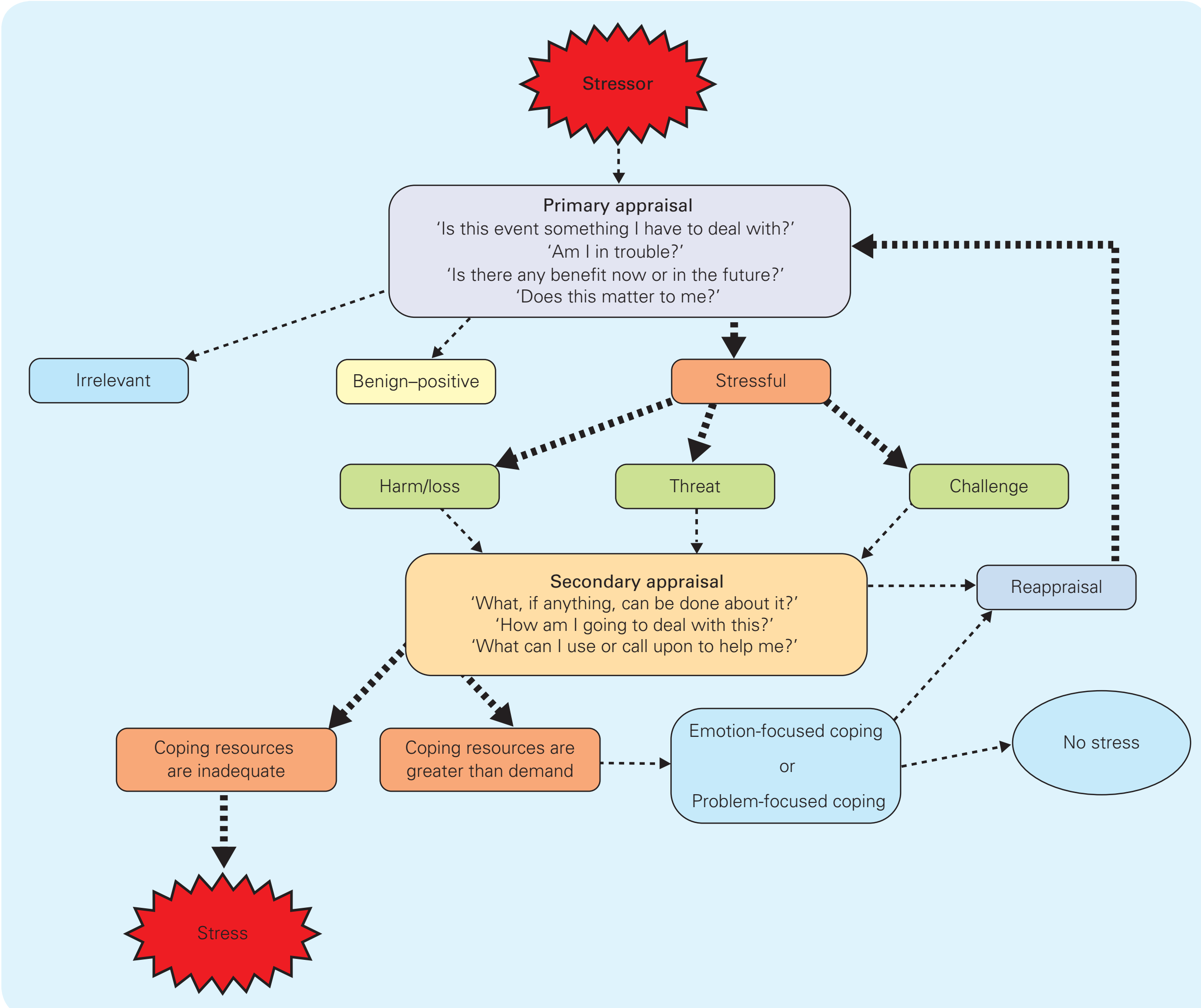


Figure 12.11 Lazarus and Folkman's (1984) transactional model of stress and coping

focus on involuntary physiological responses to stressors and mostly overlook cognitive processes and individual differences in the stress response, the transactional model of stress and coping focuses on psychological determinants of the stress response over which we have control and emphasises the personal nature and individuality of the stress response. The model views stress as involving an interaction with the environment in which the individual has an active rather than passive role. The role involves personal appraisals of a situation or an event that may be a stressor, thereby emphasising each individual's role in interpreting what that situation means to them from their perspective rather than someone else's. This allows for much more variability in the human stress response and helps explain why different individuals respond in different ways to the same types of stressors. By including a reappraisal process, the transactional model also allows for the fact that stressors and the circumstances under which they occur can change over time. This can lead us to change our thinking about a stressor and its impact on us, and even adjust our responses to it. Finally, the transactional model of stress and coping also proposes different methods for managing psychological responses to stressors and has consequently enhanced understanding of the importance of stress-management strategies and programs.

The major limitation of the transactional model of stress and coping is that it is difficult to test through experimental research. This is mainly because of the subjective nature, variability and complexity of individual responses to stressful experiences. Furthermore, primary and secondary appraisals can interact with one another and are often undertaken simultaneously. This also makes their study difficult as they are difficult to isolate for study as separate variables (Lazarus & Folkman, 1984). Some psychologists also doubt that we actually need to appraise something as causing stress in order to have a stress response. For example, we can experience a stress response without ever having thought about a situation or event, let alone made the assessments and judgments described by the transactional model. Individuals may not always be conscious of, or able to label cognitively, all the factors that are causing them to experience a stress response. For example, someone might feel a little 'on edge' and experience stomach aches and other reactions associated with stress a few weeks before an important exam, which is well before they have begun to consciously think about preparing for it.

Figure 12.12 Lazarus and Folkman's transactional model of stress and coping can explain why some learner drivers find driving stressful whereas experienced drivers don't. The learner has limited ability to meet the demands of handling a car in traffic, which means that the demands of the environment are greater than their perceived ability to cope. For experienced drivers, the perceived demands of the environment are fewer than their perceived ability to cope.

Learning Activity 12.8

Review questions

1 Explain the meaning of the phrase 'psychological determinants of the stress response' with reference to an example and explain how psychological and physiological determinants differ.

2 Briefly describe Lazarus and Folkman's transactional model of stress and coping.

3 What role does the environment play in stress? The individual?

4 **a** What does appraisal involve?
   b Name and describe the two major types of appraisal, according to Lazarus and Folkman.
   c What is the role of reappraisal and when might it occur?

5 Name and describe the three types of appraisals that follow an appraisal of a stimulus as stressful.

6 **a** Explain the meaning of coping in relation to a stress response.
   b Name and describe the two types of coping with reference to three examples of each type.
   c For each of the following statements, name the type of coping strategy that is being used to manage the effects of a stressor.
   - I talk to someone about how I feel.
   - I try to come up with a strategy about what to do.
   - I look for something good in what is happening.
   - I focus on my school work to take my mind off things.
   - I let my feelings out.
   - I learn to live with it.

   d A friend is experiencing a stress response after submitting a SAC for two VCE subjects in the morning. Shortly after, he learns that a SAC test will be held in five days for a third subject and will therefore clash with a 700-word SAC essay for a fourth subject, which must be submitted on the same day. Describe a problem-focused strategy or strategies that you believe could be effective for managing your friend's stress response.

7 Outline the main strengths and limitations of the transactional model of stress and coping.

Learning Activity 12.9

Visual presentation on the transactional model of stress and coping

Construct a flow chart or another type of diagram that shows appraisals of a stressor resulting in a stress response, as explained by the Lazarus and Folkman transactional model of stress and coping. The diagram should demonstrate a response to a stressor of your choice, and include relevant examples of appraisals of the stressor and different types of coping strategies for the stressor.

Social, cultural and environmental factors that influence the stress response

According to the biopsychosocial framework, the stress response, like most other human responses, is not only influenced by physiological and psychological factors. It is also influenced by social factors, which the framework describes broadly to include cultural and environmental factors. Although it is difficult to draw a clear line between social, cultural and environmental factors, as they overlap and typically combine in influencing the stress response, in this section we examine an example of each factor and consider how each factor can either exacerbate ('worsen') or alleviate ('lessen') affects of the stress response.

Social factors

Social factors that can influence the stress response include our relationships and social interactions with others. Such factors range from loneliness and feelings of isolation from other people or the wider community to change in one's existing social relationships; for example, adjusting to, breaking up or reconciling a relationship. Social factors also include lack of social skills in forming and maintaining relationships with others, lack of social support, being in a bad relationship, making a new friend or gaining a new family member, experiences during social and recreational activities, being a victim of discrimination or bullying, and virtually anything else that involves some kind of interaction (or lack of) with one or more people. One of the first and most widely researched social factors is called social readjustment.

Social readjustment refers to the amount of change, or 'adjustment', in lifestyle a person is forced to make following a specific event in their life. This variable was identified by American doctor Thomas Holmes and his colleague American psychologist Richard Rahe (1967), who both believed that any change that required an individual to adjust their lifestyle, and therefore their established ways of thinking, feeling and behaving, would cause stress in varying amounts, depending on the stressor and the level of social readjustment required. Furthermore, their previous research had found that some social events that required a change in lifestyle were associated with the onset of illness or disease.

In an attempt to measure the amount of stress people experienced in readjusting to lifestyle changes, Holmes and Rahe set about developing a rating scale for measuring the stress. They asked a convenience sample of 394 participants of varying ages and socio-cultural backgrounds to rate the impact of various life changes, such the break-up of a close relationship, losing a job and changing schools. From this research, they developed the social readjustment rating scale. As shown in table 12.3, the scale included 43 life events that involve change and are therefore likely to require some level of adaptation. Each life event was assigned a numerical rating that estimates its relative impact in terms of life change units. Ratings range from a score of 100 for the life event causing the most stress (death of a spouse) through to 11 for the event causing the least stress (a minor violation of the law such as 'jaywalking'). Their research found that people who score 200 life change units or more within a 12-month period are more prone to physical and psychological stress-related illnesses or diseases. The likelihood of a stress-related illness or disease diminishes with the value of the score. For example, a person who is divorced, has a friend die and remarries all in a year is more likely to develop an illness or disease than a person who gets married, falls pregnant and dramatically changes the way they dress all in the same year. An important feature of the social readjustment rating scale is that it includes both negative items (for example, death of a spouse) and positive items (for example, marriage) that can induce a stress response.

Table 12.3 The Holmes and Rahe (1967) social readjustment rating scale

Life event (mean value)	Life change unit
Death of a spouse	100
Divorce	73
Marital separation	65
Detention in jail	63
Death of close family member	63
Personal injury or illness	53
Marriage	50
Dismissal from work	47
Marital reconciliation	45
Retirement from work	45
Change in health of family member	44
Pregnancy	40
Sexual difficulties	39
Gain of new family member	39
Business readjustment (merger, reorganisation)	39
Change in financial state (much worse off or much better off than usual)	38
Death of a close friend	37
Change to a different line of work	36
Change in number of arguments with spouse (many more or many less than usual)	35
Mortgage or loan	31
Foreclosure of mortgage or loan	30
Change in responsibilities at work (promotion, demotion, lateral transfer)	29
Son or daughter leaving home	29
Trouble with in-laws	29
Outstanding personal achievement	28
Spouse begins or stops work	26
Beginning or ending school	26
Change in living conditions (building new house, renovating, deterioration of home or neighbourhood)	25
Revision of personal habits (dress, manners)	24
Trouble with boss	23
Change in working hours or conditions	20
Change in residence	20
Change in school or college	20
Change in recreational habits	19
Change in church activities	19
Change in social activities	18
Mortgage or loan for a minor purchase (car, television)	17
Change in sleeping habits (much more or much less)	16
Change in number of family get-togethers	15
Change in eating habits	15
Vacation	13
Christmas	12
Minor violations of the law (jaywalking, disturbing the peace, traffic fine)	11

Source: Holmes T.H. & Rahe, R.H. (1967). The Social Readjustment Rating Scale. *Journal of Psychosomatic Research*, *11*, 213–218.

Figure 12.13 In the social readjustment rating scale, death of a spouse is the life event that causes the greatest social readjustment and stress. However, the death of a spouse who has been abusive to their partner throughout the relationship may also alleviate the stress response of the abused person.

The social readjustment rating scale has since been revised and, along with similar scales, is still commonly used for stress research. For example, researchers have used variations of the scale to study the links between the number, types and duration of stressful life events (sometimes called *discrete stressors*) and the development of major depression. Although such scales have some value in providing rough estimates of the amount of stress a person is experiencing and possible relationships with the onset of a disease or mental disorder, they have several limitations. For instance, they do not take into account the meanings of different events for different individuals and the fact that the stress-producing potential of an event might vary widely from one person to another. Consider a person who is in a marriage that is filled with conflict, tension and unhappiness, which means that their marriage is likely to be exacerbating their stress response. For this individual, getting divorced (73 life change units) might be significantly less stressful than remaining married, so divorce might actually have the effect of alleviating their stress response. Consequently, some researchers have tended to study specific life changing events in more depth and measure an individual's perceived stress; that is, the extent to which an individual considers the experience they have undergone as either exacerbating or alleviating stress in their lives. These studies have provided considerable evidence that significant life-changing events, both positive and negative, can produce, exacerbate or alleviate the stress response, depending on the individual and their personal circumstances.

Cultural factors

For immigrants, refugees and asylum seekers coming to Australia and other countries, departure can be a means of escaping famine, poverty, torture, persecution, civil unrest, political turmoil or war. Therefore, it can serve as a means of alleviating the stress response. However, the demands of adjusting to a new culture can produce or exacerbate the stress response. Establishing a new life in one's adopted country can be a very difficult and challenging adjustment, especially when there are significant cultural differences. Inevitably, there is a need to become *acculturated*; that is, to adopt the values, customs and language preferences of the new dominant culture. Thus, acculturative stress refers to the stress people experience in trying to adapt to a new culture.

Acculturative stress can occur whether people willingly emigrate for better opportunities or flee as refugees or asylum seekers. People entering new cultures frequently encounter language difficulties, racial or ethnic prejudice, lower socioeconomic status (such as overseas-trained engineers or doctors working in Australia as labourers because their qualifications are not recognised) and separation from family. Immigrants also face conflicts over preserving their old values and

Figure 12.14 Acculturation is a stressor faced by many immigrants, refugees and asylum seekers struggling to meet the demands of adjusting to a new dominant culture. Embracing cultural diversity can alleviate racism-related stress.

beliefs and adapting to the customs of their new culture. Many refugees and asylum seekers must also come to terms with torture or with the torture or murder of loved ones back home. All of these can be significant stressors. Research findings indicate that belonging to an ethnic or cultural minority group significantly increases the risk of developing a stress-related physical or mental health problem (Travis & Maltzer, 2008; Westen, Burton & Kowalski, 2006).

In Australia, considerable research has been undertaken on a specific aspect of acculturative stress that is sometimes referred to as *racism-related stress*. For example, as shown in table 12.4, studies have found that being the target of racism is associated with chronic stress-related responses such as anxiety disorders, depression, diabetes, hypertension, heart disease and poor immune system functioning, as well as smoking and alcohol abuse (Larson & others, 2007; Paradies, 2007). Box 12.3 summarises some of the experiences reported by ethnic or cultural minority groups in Victoria that have the capability of producing a stress response.

Table 12.4 Research findings on relationships between self-reported ethnic and race-based discrimination and poor health outcomes

Established link	Probable link	Possible link
• depression • psychological distress • stress • anxiety	• poor general health • quality of life • alcohol misuse • substance misuse • cigarette smoking • peer violence • low birth weight	• high blood pressure • heart disease • diabetes • obesity

Source: VicHealth (2007). *Ethnic and race-based discrimination as a determinant of mental health and wellbeing*. Research Summary 3. Carlton South: VicHealth.

Box 12.3

Prevalence of ethnic and race-based discrimination in Victoria

A survey of more than 4000 Victorians in 2007 conducted by researchers for VicHealth found that people who were born in a country in which the main language spoken was not English were:

- more than twice as likely as Australian-born people to report being treated with disrespect because of their ethnicity or race (42% compared with 18%)
- two-and-a-half times as likely to report being treated with distrust on the basis of their ethnicity or race (33% compared with 13%)
- nearly twice as likely to report experiences of name-calling and/or insults on the basis of their ethnicity or race (43% compared with 22%)
- twice as likely to experience discrimination either at a shop, restaurant or at a sporting or other large public event
- three times as likely to experience discrimination in the workplace
- twice as likely to experience discrimination in education
- around four times as likely to experience discrimination from police and when seeking accommodation.

Source: VicHealth (2007). *More than tolerance: Embracing diversity for health*. Melbourne: Victorian Health Promotion Foundation.

Environmental factors

Environmental factors that can influence the stress response include crowding, loud noise, air pollution, extremes of temperature and catastrophes such as technological and natural disasters. Crowding is one of the first environmental factors influencing the stress response to be scientifically studied through experimental research.

The term crowding is used in psychology to refer to the feeling of being cramped; of having less space than preferred. This is different from population density, which is the actual number of people (or animals) in a specific area of physical space; for example, 100 people per hectare. Crowding is a subjective experience. Although it can arise in situations when many people are crammed into a small space (that is, high population density), it can also arise in situations in which there are few people and a great deal of space (that is, low population density). For example, you may feel crowded if a stranger takes a seat next to you on an empty bus despite the fact that the population density is low, but you may not feel crowded in an overflowing nightclub. Similarly, two lovers in a dual compartment chairlift probably will enjoy the intimacy but two strangers in the same compartment may feel crowded.

What causes a person to feel crowded? One explanation relates to the concept of personal space. *Personal space* refers to the immediate and small area (up to about 50 cm) with an invisible boundary that surrounds each person. People do not like others to invade, or cross, this boundary. The more intimate two people are, the closer they can become without feeling uncomfortable. Generally, strangers usually are kept at least around 1.5 metres away, whereas close friends are allowed to come within 50 centimetres, and a partner or family member can actually be touching. In crowded settings, it is often impossible not to invade someone else's personal space.

Experiments with animals provided the first insights on potential effects of crowding. Among the best-known experiments are those conducted by American ecologist John Calhoun in collaboration with various psychologists. In one experiment, Calhoun (1962) exposed mice to uncrowded then severely overcrowded conditions in a specially constructed enclosure (see figure 12.16). The enclosure held ample

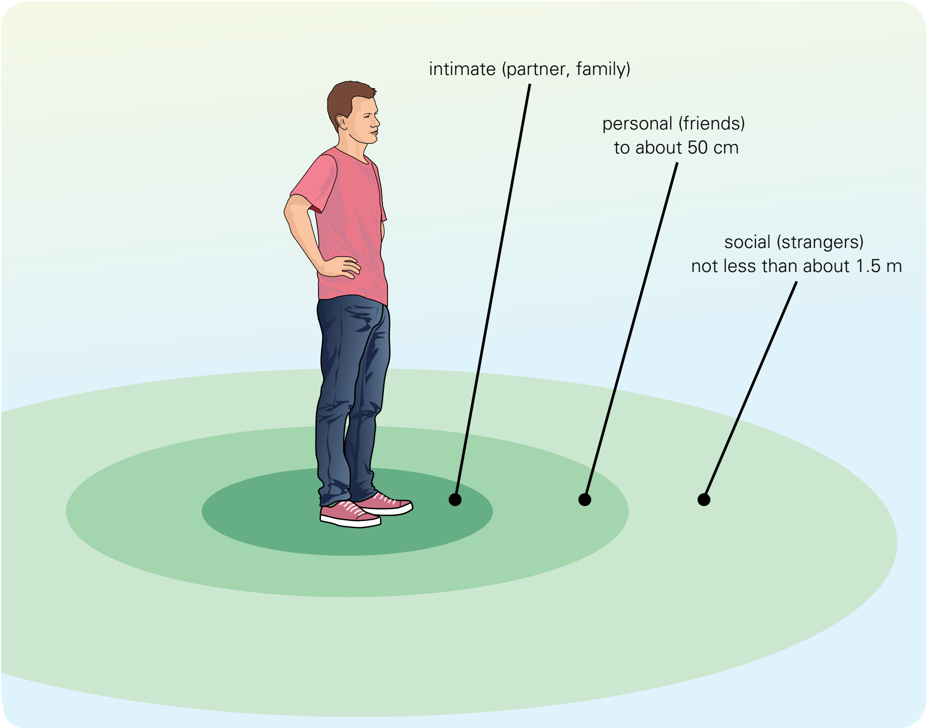


Figure 12.15 Personal space refers to a small area with an invisible boundary that surrounds each person. People do not like others to invade, or cross, this boundary.

food, water and nesting material to sustain the rapidly increasing population. At first, there was ample space. Males scurried about, explored their environment, gathered females as sexual partners, and defended territories, all of which are normal behaviours for mice. However, the population grew, doubling every 55 days. As time passed, the enclosure became increasingly crowded, then overcrowded. Associated with the overcrowding was the production of 'maladaptive behaviours' commonly observed in stressed mice. The mice became aggressive and cannibalistic, explored less and were either hyperactive or extremely lethargic. Males became withdrawn, never engaging in courtship or fighting. Females wounded their young and stopped reproducing. Upon dissection, many mice showed physiological changes characteristic of stress. Calhoun concluded that when all the available space had been taken up, the stress responses of individual mice had resulted in a complete breakdown of normal social behaviour.

Of course, Calhoun could only infer that the mice were stressed because of the crowded conditions. Because of these limitations, psychologists turned to laboratory studies of people. However, because

Figure 12.16 John Calhoun (1917–1995) with the mice in the overcrowded enclosure.

these are often conducted in 'artificial' settings, and because of ethical reasons and difficulties of accessing participants, they tend to focus on the effects of short-term crowding.

One way psychologists have tried to get around these problems is to compare two groups of people—one group living under relatively dense conditions and the other under sparse conditions. However, the groups are similar in many other characteristics such as education, income and religious and racial background. Data on adult and adolescent crime, psychiatric hospital admissions and other measures of stress are collected. Some of these correlational studies have found that high household density is associated with high stress levels and poor health, but others have found little relationship.

There is no clear answer from experimental research on the effects of crowding on the human stress response. However, many studies using self-report methods indicate that the experience of crowding can be stressful. For example, people in crowded environments often report feeling stressed or psychological responses associated with stress such as feeling anxious, fearful, unhappy, frustrated and angry. They also report physiological symptoms of stress such as higher blood pressure, increased heart rate, 'light-headedness', 'feel like fainting' and nausea (Evans, 1980, 1979).

It seems that the effects of crowding on the human stress response in real life depend on both the situation and the individual involved; for example, factors such as the length of time spent in a high-density situation (short term or long term), the individual's personality characteristics (for example, temperament, sociability), the individual's perception of whether a situation is constricting (for example, a room packed with people is not necessarily 'crowded' for *everyone* within), and the individual's sense of personal control over the situation (for example, believing they can change the situation if so desired). Several studies have also found that people prepared in advance for a crowded situation are likely to experience a lower level of stress in the crowd than those who have not expected to be crowded.

Figure 12.17 Crowding can be an environmental stressor for people.

Box 12.4

Catastrophes and stress

In February 2009, Australia and the rest of the world responded with shock and disbelief on hearing that Australia's worst-ever bushfires had broken out around many areas of Victoria. The death toll rose quickly and before long entire towns had been completely devastated.

The Victorian bushfires were a catastrophe. A *catastrophe* is an unpredictable large-scale event that causes great damage or suffering, such as a natural disaster, technological disaster or war. The event is one that the majority of people involved would appraise as being stressful. Undoubtedly, the bushfires were a significant stressor and distressing experience for those involved. The extent of the devastation was such that, for many, it will be a long time before their lives return to normal, if at all.

While most of the bushfire survivors will be able to gradually come to terms with what happened on their own, or with the support of family and friends, many develop chronic stress-related symptoms and need more help. Some survivors and witnesses to such fast-moving, destructive bushfires may also experience physiological and psychological symptoms that can last long after the event has passed. Psychologists have several names for these reactions, including acute stress disorder (ASD) and post-traumatic stress disorder (PTSD) (see box 12.5).

Of course, it is unrealistic to think that one can be fully prepared, emotionally and cognitively, for such a stressful and confronting situation as that experienced by many Victorians in February 2009. Nonetheless, the concept of stress inoculation, proposed by Canadian clinical psychologist Donald Mieichenbaum, can assist people to prepare themselves psychologically for catastrophes. *Stress inoculation*, sometimes called *psychological preparedness*, involves planning to be better protected from stress by working through the likely psychological reactions beforehand and learning strategies to cope. These strategies 'inoculate' people against being overly anxious or overwhelmed by their emotional responses, and can help prevent getting caught up in unhelpful thinking in an emergency situation.

The matter of 'psychological preparedness' takes on particular relevance in the context of the tragic bushfire experience in Victoria. A commonly expressed view of residents and firefighters was that 'we were not really prepared for what happened', referring as much to the ferocity, speed and intensity of the fire storms, as to the residents' own experience of feeling terrified, and, for many, not really knowing what to do when the fire was imminent (Reser & Morrisey, 2009).

When people are experiencing acute stress, and their fight–flight response has been activated, they are usually not able to think as clearly as usual and this can affect decisions and reactions. These are normal, although not always helpful, responses to a highly stressful situation. Being 'psychologically prepared' means that these natural reactions to stress can be anticipated and managed to help people feel more in control and confident. In stressful situations, people can feel more in control through slowing down their breathing to help calm their physiological stress response and replacing frightening thoughts with more helpful ones (APS, 2009).

There are three main steps to being 'psychologically prepared' for a catastrophe ('AIM'):

- **A**nticipate that you will be feeling worried or anxious and remember that these are normal, although not always helpful, responses to a possibly life-threatening situation.
- **I**dentify what the specific physical feelings associated with anxiety and other emotions are and whether you are having any frightening thoughts that are adding to the fear.
- **M**anage your responses using controlled breathing and self-talk so that you stay as calm as possible and can focus on the practical tasks that need attending to.

Figure 12.18 Catastrophes such as the 2009 bushfires in Victoria can cause the stress response.

Figure 12.19 'Psychological preparedness' can assist people to prepare themselves psychologically for a catastrophe, by planning to be better protected from stress; for example, by working through the likely psychological reactions beforehand and learning strategies to cope.

Box 12.5

Post-traumatic stress disorder (PTSD)

The effects of a stressful event are not always immediately apparent. There may be a time delay between the stressful event and the appearance of its effects. *Post-traumatic stress disorder* (PTSD) is a severe anxiety disorder that may develop after experiencing a traumatic or very stressful event (such as sexual assault, a car crash, a natural disaster or combat duty), being a witness to a traumatic event or even learning about a violent or an unexpected death of a family member.

According to the DSM-IV-TR, the symptoms of PTSD may begin shortly after the traumatic event, or months or years afterwards. Furthermore, the symptoms typically last for at least one month, but may persist for years or even a lifetime. If the symptoms begin within four weeks of the traumatic event and last for less than a month, then the person is diagnosed as having *acute stress disorder* rather than PTSD. The symptoms of PTSD (and acute stress disorder) fall into three groups.

Re-experiencing the traumatic event

Individuals may find that the traumatic event constantly intrudes on everyday life as they relive the experience, again and again. These intrusions can take the form of sudden mental images of scenes from the event (flashbacks) or distressing dreams about specific experiences (nightmares). Intrusions can be so realistic that the person feels as if the traumatic event is actually happening again. Physiological reactions may also be experienced during intrusions or when reminded of the event; for example, sweating and having a 'racing heart'.

Avoidance and numbing

Avoidance involves attempts to block out unpleasant memories and feelings associated with the traumatic event. This can include efforts to avoid thoughts, feelings or conversations associated with the event; efforts to avoid activities, places or people that arouse recollections of the event; or an inability to recall an important aspect of the event.

A person who has been exposed to a traumatic event may also experience *numbing*. This means that they feel detached and distant from other people, lose their ability to feel any emotion (such as love or sadness) and lose their interest in participating in many activities.

Increased arousal

Exposure to a traumatic event can also result in the feeling of being constantly in danger. People are likely to feel 'jumpy' and always on guard. These types of symptoms are called hyperarousal symptoms. They include difficulty falling or staying asleep (insomnia), irritability or outbursts of anger, difficulty concentrating and hypervigilance (always on the lookout) for signs of danger.

Figure 12.20 Australian Defence Force personnel deployed to combat duty are at an increased risk of developing post-traumatic stress disorder (or acute stress disorder).

Learning Activity 12.10

Review questions

1 Explain, with reference to an example, how lifestyle change and cultural change can either exacerbate or alleviate the stress response.

2 **a** Explain how crowding can exacerbate the stress response.
b Suggest a way that crowding could alleviate the stress response.

3 Briefly describe the relationship between social, cultural and environmental factors and explain why factors from each domain are difficult to isolate and study independently.

4 **a** Explain, with reference to an example, how social, cultural and environmental factors can interact to influence the stress response.
b Draw a diagram (for example, a concept map) that shows how these factors can interact to influence the response to a stressor.

Allostasis

The GAS and fight–flight models focus on physiological responses to stress and overlook cognitive processes, whereas the transactional model of stress and coping focuses on psychological determinants of the stress response and overlooks physiological responses. The biopsychosocial framework focuses on the importance of both biological (physiological) and psychological factors, as well as equally important social factors, emphasising the combination and interaction of factors from within each of the three domains. However, the biopsychosocial framework does not explain *how* factors from within each domain actually combine, or 'come together', when we are exposed to a stressor. More recently, theorists have used a construct called *allostasis* to explain this.

Allostasis refers to the body's ability to maintain a stable physiological environment by adjusting and changing to meet internal and external demands. Allostasis therefore helps the body achieve stability by *changing*. However, there are also costs associated with allostasis that can result in permanent damage to the body.

Allostasis revises and extends the biological construct of homeostasis. *Homeostasis* is the body's ability to maintain a stable physiological environment by keeping certain bodily conditions *constant*, such as body temperature and blood oxygen level. These are maintained within a narrow range of values, referred to as 'set points'. At first, homeostasis might seem to mean almost the same thing as allostasis, but they are entirely different constructs. Unlike allostasis, which helps the body achieve stability by *changing*, homeostasis helps the body achieve stability by *staying the same*. Furthermore, homeostasis applies to a relatively limited number of internal bodily conditions that are essential for life. In addition to core body temperature and blood oxygen level, these include maintenance of an appropriate blood glucose level, pH (acidity), water content, ion content and oxygen-carrying capacity (McEwen & Wingfield, 2003). Many other internal bodily conditions, such as blood pressure and heart rate, have wider ranges of functioning. The mechanisms involved in homeostasis regulate them and deviations from 'normal' are corrected automatically by 'feedback' mechanisms. For example, the normal level of glucose in the blood is about 80 mg/mL. A rise above this level can trigger the release of insulin from the pancreas, which leads to the uptake of glucose by liver and muscles, thereby restoring the amount of blood glucose back to within the normal range.

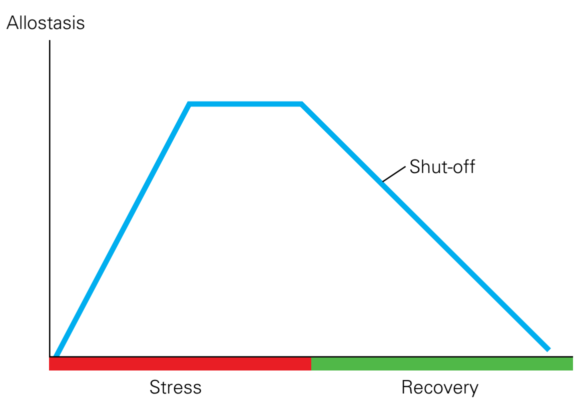
Homeostatic systems are often likened to a thermostat in a centrally heated home that constantly adjusts the burner to maintain a relatively stable room temperature. Similarly, when internal and external events cause deviation from ideal physiological conditions, homeostatic mechanisms take corrective action and operate to restore the steady state or balance. Changes associated with homeostasis occur within a relatively narrow range with upper and lower limits. For example, consider body temperature. In order to survive in an environment in which there is constantly changing temperature, there exists a very narrow range of acceptable temperatures. Even though the temperature of the external environment can change more than 20 degrees in the course of single day, our body temperature remains constant. When we experience conditions that push our body temperature above or below its normal set limits, homeostatic mechanisms trigger responses such as sweating or chills as a part of the body's attempts to restore our temperature to its 'set point'.

Although homeostasis is a useful construct for understanding mechanisms important for environmental adaptation and survival, it has limitations. One limitation is that it excludes the role of cognitive processes and is therefore of limited usefulness in explaining the human stress response and other states with a psychological component. Another limitation is that our body also needs to be able to adjust to wider-ranging internal changes, both to adapt to a changing environment in situations that do not challenge survival and also to meet significant demands imposed by stressors. Finally, some physiological systems within the body are *not* held constant and actually help keep the body stable by changing and fluctuating at higher or lower levels than normal. For example, our body changes its heart rate in response to different demands. When we are asleep, our heart rate drops to a relatively low level. When we are awake, heart rate increases substantially, and when we are engaged in aerobic exercise, heart rate climbs even higher. These changes indicate that heart rate adjusts to changing demands to enhance our functioning and adaptation to the environment. Furthermore, in order to do aerobic exercises, our body must be able to sustain a heart rate at a *higher* level than 'normal' (otherwise we wouldn't be able to do the exercises). Therefore, in one state, the blood pressure is maintained 'low' for a long period without restoration (that is, without forcing it to a specific set point) and in another state it is held 'high' for long periods, also without restoration. To achieve stability, our bodies must be able to function efficiently in either of these states and be able to move flexibly between them. With each change in behaviour, the heart rate must be 'reset' to match the new state. These limitations of the homeostatic model led Americans neurobiologist Peter Sterling and medical doctor Joseph Eyer (1988), who specialises in the study of diseases (epidemiology), to propose the construct of allostasis.

In contrast to homeostasis, which emphasises that the body needs to be kept within set limits for healthy functioning, allostasis emphasises that healthy functioning requires continual physiological fluctuations and adjustments. That is, in responding and adapting to internal and external demands, normally functioning physiological systems *should* exhibit fluctuating levels of activity. Our physiological systems must vary and be able to reset their limits to perform everyday activities and meet demands triggered by stressors—and they do so through allostasis. Allostasis therefore enables us to respond to our physical states (for example, being awake or asleep, lying down, standing, exercising) and to cope with noise, crowding, isolation, hunger, extremes of temperature, danger and microbial or parasitic infection (McEwen, 1998). Consequently, allostasis is often defined as involving the 'maintenance of stability through change'. It enables our bodies to adjust beneficially to internal and external demands in a manner that is different from that of homeostasis. This is emphasised by the choice of terms to describe the construct—*allo* means 'different' and *stasis* means 'stability'.

According to Sterling and Eyer (1988), allostasis is achieved through the brain's regulation of the activities of our allostatic systems. These *allostatic systems* include the HPA axis, the autonomic nervous system, and the immune and cardiovascular and systems. All of these systems act to protect the body by responding to internal and external stimuli. In contrast to homeostatic systems, large variations in processes regulated by allostatic systems do not lead directly to death, as would large deviations in processes regulated by homeostatic systems (such as blood oxygen and pH levels).

When an individual perceives a situation as stressful and experiences a stress response, their brain activates, or 'turns on', their body's allostatic response. The most common allostatic response involves activation of the HPA axis and sympathetic nervous system. Then, when an individual has been successful in coping with the demands of a stressor, or the stressor has passed, the brain 'turns off' the allostatic response. Inactivation returns the allostatic systems to 'normal', which usually happens when the threat has passed, the infection is contained, the living environment is improved, or the speech has been given. Allostasis therefore enables an individual to adapt to the demands of stressors by initiating and supporting a state of physiological arousal, which is then shut off when it is no longer needed. As long as our brain can 'turn on' an allostatic response when needed and 'turn off' the response when no longer needed, the body is able to adapt to the demands of a stressor and, at the same time, is not likely to suffer adverse long-term effects (see figure 12.21).



Source: McEwen, B.S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338*(3), 173.

Figure 12.21 Allostatic systems respond to stress by initiating an adaptive response, sustaining it until the stress ceases, and then shutting it off (recovery).

Allostatic load

When the systems involved in allostasis are not 'turned off' after a stress-producing experience, or when they are overused by one or more stressors, there is overexposure to stress hormones. Cumulative exposure to increased secretion of the stress hormones (over weeks, months or years), can lead to 'wear and tear' on the brain and body, known as **allostatic load** (McEwen & Stellar, 1993). Increased allostatic load occurs with increased frequency of exposure to stressors, increased intensity of these stressors or decreased efficiency in coordinating the onset ('turning on') and termination of ('turning off') the allostatic response. The concept of allostatic load helps to explain how prolonged (chronic) stress can influence the onset of physical disorders such as cardiovascular disease, immunosuppression (reduced efficiency of the immune system), obesity, atherosclerosis (hardening of the arteries) and diabetes, and mental disorders such as major depression and anxiety (McEwen, 2004). Allostatic load therefore represents the 'price' we pay for repeatedly being challenged by a variety of stressors (see box 12.6).

The allostatic model acknowledges that all types of factors within the individual and in their external environment are potential stressors and that the individual's lifestyle can alleviate or exacerbate stress. The model also emphasises the crucial role of the brain in perceiving stressors and in regulating the body's response to stress. As shown in figure 12.22, the allostatic model adopts the perspective of the biopsychosocial framework by explaining the stress response in terms of the complex combined interaction of biological, psychological and social factors. For example, our perception or appraisal (psychological factor) of a potential stressor (biological, psychological or social factor) will determine whether the HPA axis and systems involved in an allostatic response are activated (biological factor). Appraisal is influenced by prior experience (psychological factor), the context in which it occurs and our current circumstances (social factor), as well as underlying influences of our genetic inheritance (biological factor). When the allostatic response is activated (biological), the brain will detect and regulate bodily processes and determine how quickly they will return to their normal levels (biological), taking account of the stressor and the context (biological, psychological, social). The brain will also play a role in the use of coping strategies that may exacerbate or alleviate the stress response (biological, psychological, social).

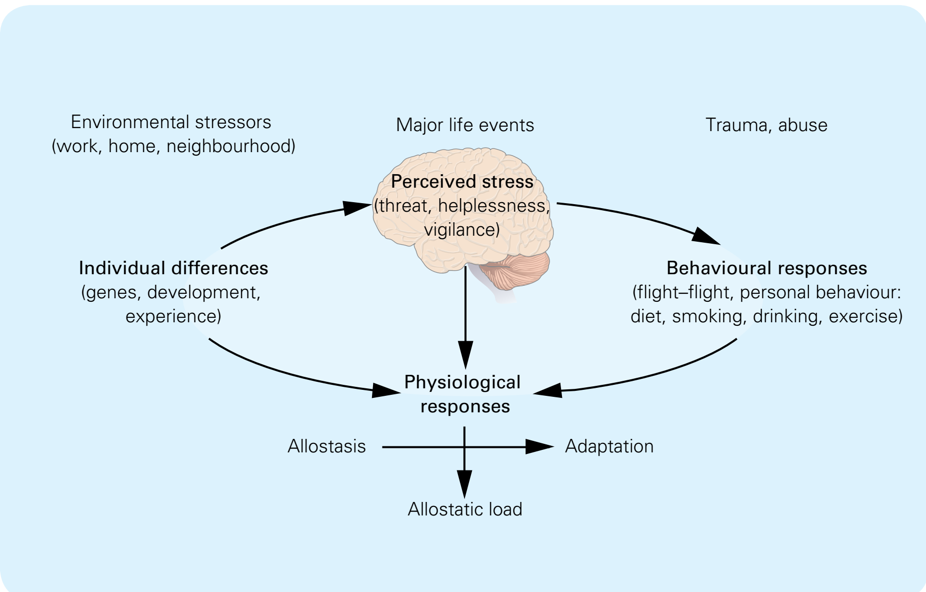


Figure 12.22 Allostasis, the stress response and development of allostatic load. Perception of stress is influenced by one's experiences, genetics and behaviour. When the brain perceives an experience as stressful, physiological and behavioural responses are initiated, leading to allostasis and adaptation. Over time, allostatic load can accumulate and have adverse effects on various bodily organs and systems, leading to disease.

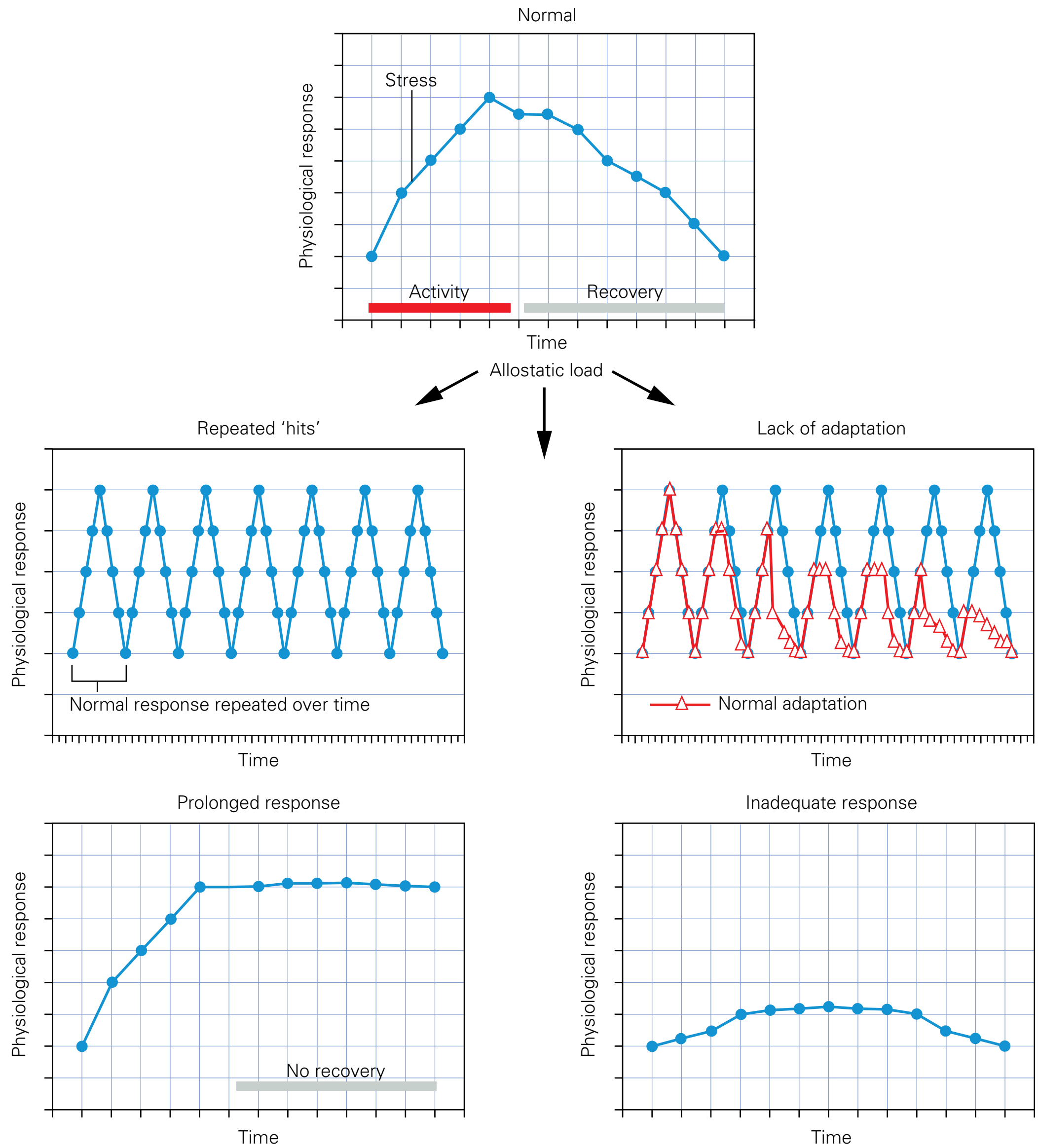
Source: McEwen, B.S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338*(3), 172.

Box 12.6

Types of allostatic load

The construct of allostatic load was devised by American medical doctors and stress researchers Bruce McEwen and Elliott Stellar (1993). McEwen (1998) has subsequently identified four types of allostatic load.

1. *Repeated 'hits'*—the most common type, when we are repeatedly exposed to multiple stressors during a relatively short period of time. For example, imagine racing to the staffroom at the end of the day to hand in a SAC that is due only to find that your teacher has gone home, then running off to catch the school bus but just missing it, then arriving home and finding you left homework at school and then finding that your younger sibling has spilt paint over the jeans you wanted to wear the next day. For this series of events, the allostatic response associated with the first stressor was just starting to lessen when the second stressor hit, and likewise, recovery from the second stressor was interrupted by the onset of the third stressor and so on. In this type of allostatic overload, the damaging effects of stress are associated with the frequency of the stressors encountered.
2. *Lack of adaptation*—adaptation to repeated stressors of the same type is lacking, resulting in prolonged exposure to stress hormones. For example, imagine that you work as a sales assistant and deal with five irate customers in a row, who are demanding their money back for a defective product that you sold them. Normally, one's allostatic response to this series of encounters would decrease, or habituate, with each subsequent encounter. When the body fails to exhibit the normal habituation response, this type of allostatic overload occurs.
3. *Prolonged response*—when the body is unable to 'turn off' allostatic responses after a stressful situation has passed, resulting in delayed physiological recovery from a stressor. In this case, the frequency or magnitude of the physiological response may be entirely normal; however, it is the length of time that the response is sustained that leads to allostatic overload. For example, imagine having an argument with a family member and experiencing some physiological arousal associated with the argument. Rather than the arousal gradually declining after the argument, in this type of allostatic overload the physiological recovery is delayed and the arousal is still apparent hours or days later.
4. *Inadequate response*—when one allostatic system does not respond or responds very weakly to a stressor when it 'turns on', the activity of other systems increases to compensate for the underactive system that is not making its usual response. For example, imagine walking home late at night and a threatening person approaches you, only to find that your body's fight–flight response was inadequate and therefore did not provide the necessary energy and altered blood flow to run away from the threat.



Source: McEwen, B.S. (1998). Protective and damaging effects of stress mediators. *New England Journal of Medicine, 338*(3), 174.

Figure 12.23 The four types of allostatic load: repeated 'hits', lack of adaptation, prolonged response and inadequate response

Learning Activity 12.11

Review questions

1 Explain the meaning of allostasis with reference to an example.

2 In what ways is allostasis similar and different to homeostasis?

3 **a** What is an allostatic system?
b List the main allostatic systems.
c What role do allostatic systems have in allostasis?

4 **a** Explain the meaning of allostatic load.
b What is the relationship of allostatic load to stressors?
c In what way is allostatic load the 'price we pay' for repeatedly being challenged by a variety of stressors?

5 How does allostasis integrate biological, psychological and social factors to explain an individual's response to stress?

Strategies for coping with stress

Given the adverse effects stress can have on our physical and mental health, various types of strategies have been devised by psychologists, psychiatrists and medical practitioners to help cope with stress, minimise its effects and promote health. In addition to coping strategies and resources that emphasise the psychological and social domains of the biopsychosocial framework, such as accessing and using social support, there are also other more direct, action-oriented strategies that reflect the biological domain, such as biofeedback, meditation or relaxation and physical exercise. However, all of these strategies also reflect the close mind–body relationship in mental and physical health.

Biofeedback

Physiological responses to stressors involve the coordinated interaction of numerous bodily processes, which usually operate automatically at an unconscious level. For example, when the fight–flight response is experienced in response to a threatening stressor, we do not consciously think 'my fight–flight seems to be kicking in' or 'there goes my autonomic nervous system'. We just 'feel' physiologically aroused and experience a growing 'sense' of fear or concern. We may be able to exert some control over some of our bodily reactions (such as how fast we breathe), but most of our reactions cannot be easily controlled (such as pupil dilation) or cannot be controlled at all (such as hormonal secretions). With training, however, we can learn to consciously control some of these automatically occurring responses, thereby minimising their potential adverse affects when they are repeatedly 'turned on and off' and/or occur at elevated levels for a prolonged period of time. This can be achieved through biofeedback training.

Biofeedback is a technique that enables an individual to receive information ('feedback') about the state of a bodily process ('bio') and, with appropriate training, learn to control a related physiological response using thought processes. During *biofeedback training*, electrical or mechanical sensors, like electrodes used on the EEG or a blood pressure cuff, are attached to the person. These sensors respond to a particular physiological response, such as tension in a particular muscle, blood pressure or skin temperature. The signals that are detected are then analysed and displayed, often visually (for example, as a graph) or in an auditory form (for example, sounds coming through

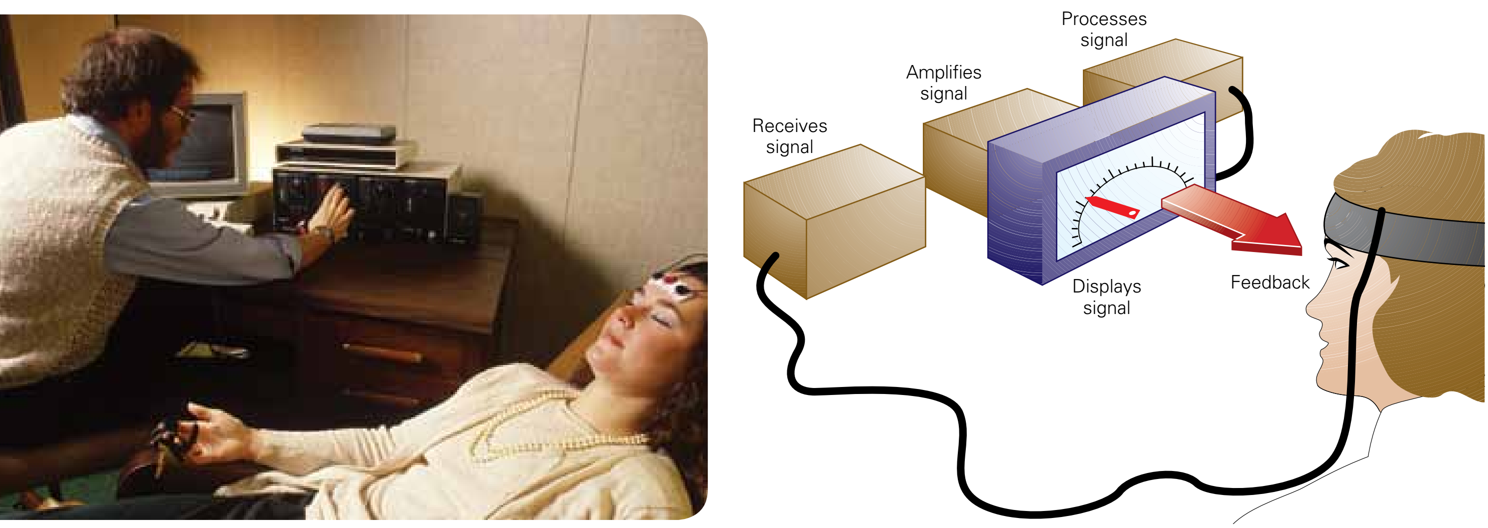


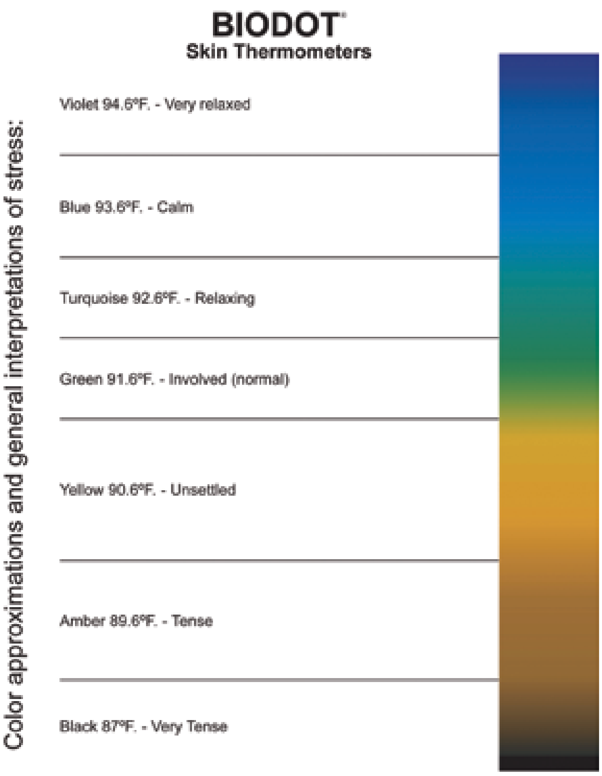
Figure 12.24 A psychologist teaches a client to control muscle tension in the forehead. The client suffers from persistent tension headaches. A sensor records tension in the forehead muscles and the physiological information is processed by a computer and then is instantly fed back to the client in the form of a visual signal. As the person relaxes their forehead muscle, the pointer on the display screen may go lower, indicating a reduction in muscle tension. The person's task is to learn to use this feedback to control the pointer and thereby learn to control the tension in the forehead muscle and thus control the tension headaches (Myers, 2001).

earphones), to provide the person with information about the state of a relevant bodily process. The person is then taught a series of physical and mental exercises designed to help them learn how to gain control over the physiological response that is being monitored. For example, a person may learn how to decrease their heart rate by using visual imagery to imagine a stress-free tranquil scene, while they are obtaining feedback about their heart rate.

Biofeedback can be useful in helping people learn how to recognise and control specific physiological responses to stressors in their lives. It is used most often to relieve stress-induced problems related to blood flow such as headaches, migraines and hypertension. For example, someone who experiences chronic tension headaches in response to an ongoing stressor might use biofeedback to learn to relax shoulder, neck and facial muscles.

In one study with people who suffered frequently from tension headaches, half the participants were taught to control a muscle in their forehead that was believed to be involved in causing the headaches. Using biofeedback, these participants learned to relax this particular muscle. The procedure involved participants sitting in a comfortable chair in a dimly lit room with electrodes attached to their forehead. The electrodes were also attached to a biofeedback device that monitored muscle tension (an electromyograph). When the muscles of the forehead relaxed, the person heard a low tone through earphones. The other half of the participants were not taught biofeedback techniques and were asked to manage their headaches as they would normally. After several weeks, only those who had practised biofeedback reported a decrease in the number of tension headaches as compared with before they started the biofeedback program (Budzynski & others, 1973).

A common criticism of biofeedback is that although it can be successful in clinical or laboratory settings, its effects don't always last after the person leaves the setting in which they learnt and used biofeedback, as they no longer have access to the expensive feedback device. However, recent advances in technology have led to the development of less expensive, portable biofeedback devices, such as the Biodot® Skin Thermometer shown in figure 12.25. In addition, other simpler methods that do not require biofeedback equipment, such as meditation or relaxation techniques, can be used for many of the benefits attributed to biofeedback.



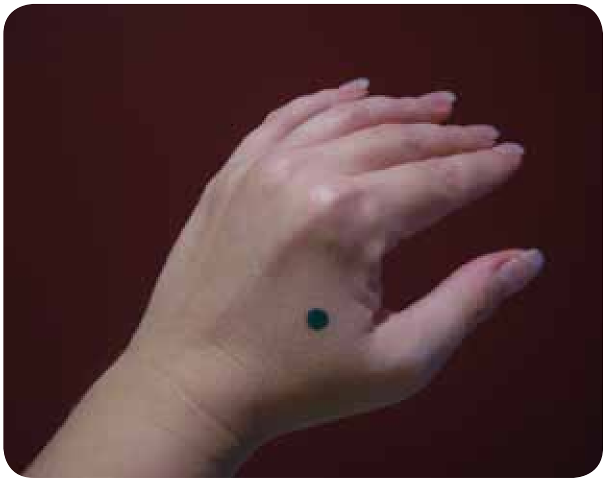


Figure 12.25 Biodots are small self-adhesive temperature-sensitive discs that can be stuck to the skin. They indicate changes in temperature by changing colour. When a person is tense and stressed the blood vessels constrict—reducing skin blood flow—and the Biodot will appear yellow, amber or black. When the person is calm and relaxed their blood vessels dilate—increasing skin blood flow—and the Biodot will appear turquoise, blue or violet.

Learning Activity 12.12

Practical activity: testing biofeedback

This practical activity enables you to test biofeedback using your pulse rate. The aim is to attempt to lower your heart rate using measurements of the pulse rate taken at the wrist. Measurement of the pulse rate is taken by placing a fingertip (but not a thumb) on the radial artery, which is prominent.

You should work in a group of three. One person is the experimenter, who takes the pulse readings; one person is a participant, who is inactive ('at rest') and will attempt to use the biofeedback; and one person is a research assistant, who records measurements on a previously prepared data sheet. You can rotate the roles so each person has an opportunity to use biofeedback.

The experimenter takes a pulse reading of the participant over four consecutive 15-second periods to establish a baseline pulse rate using the mean of the four readings. After each 15-second period, the experimenter announces the pulse rate so both the recorder and the participant can hear. The recorder should write each measurement on the data sheet.

Immediately after the fourth baseline reading, the recorder should calculate the mean pulse rate as quickly as possible and inform the participant.

The participant should then try to lower their heart rate below the baseline reading by relaxing and focusing their thoughts on the required task. The participant's pulse rate is measured for ten more 15-second periods. Feedback is given at the end of each 15-second period with the experimenter starting the decrease or increase in pulse rate from the baseline; for example –3, 0, +1 and so on. Data should be recorded in a graph, as shown in figure 12.26, and discussed in relation to the effectiveness of biofeedback, with reference to limitations of this activity.

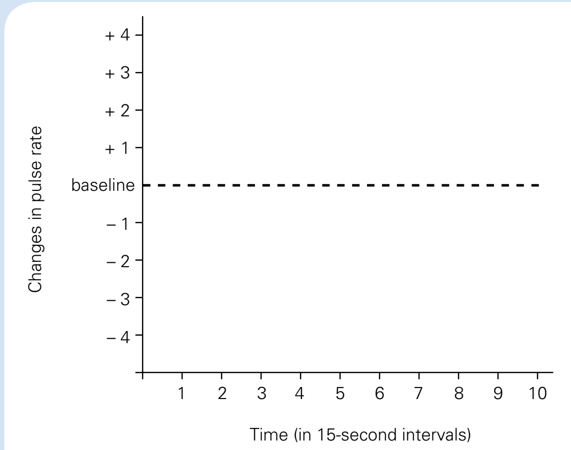


Figure 12.26

Meditation and relaxation

Meditation can be used as a stress-management strategy by anyone, regardless of their religious, philosophical or spiritual or point of view. When used for stress management, **meditation** is an intentional attempt to bring about a deeply relaxed state in order to reduce one or more effects of stress-related symptoms. The term 'meditation' is sometimes used interchangeably with 'relaxation' because meditation involves relaxation, and a relaxed state can be achieved by using a meditative technique. However, relaxation does not necessarily require the use of a meditative technique. **Relaxation** is any activity that brings about a state of reduced psychological and/or physiological tension. The activity may simply involve resting, going for a walk or a jog, reading a book, watching television or engaging in a hobby.

Since meditation and relaxation are so closely interrelated, they have similar effects on stress-related symptoms. When in a relaxed or meditative state, people typically report feeling calm, a low level or absence of anxiety and responses associated with a low level of overall physiological arousal such as a lower heart rate, slower breathing rate and loss of muscle tension. In the case of those who achieve a relaxed state through meditation, many also report heightened self-awareness, but this may also be achieved through certain relaxation methods that do not involve meditation, such as when going for a walk or jog by oneself. Research findings indicate that a deep state of relaxation, which is equivalent to a relaxed meditative state, is essentially the *opposite* of a typical stress response.

Although medications can be prescribed to enable a person to achieve a relaxed state, a key feature of meditation and relaxation techniques promoted by psychologists for stress management is that they are not biological or 'medically based'; that is, they do not involve the use of chemicals. There is also an assumption that physical relaxation will lead to a state of psychological relaxation. Although there are a wide variety of relaxation techniques, they typically involve focusing on an internal stimulus with one's eyes closed to block distracting thoughts or intrusions from the external environment (see box 12.7). In one commonly used version of relaxation training, often called *progressive muscle relaxation*, clients are taught to identify individual muscle groups, tense them, release the tension, and ultimately relax the whole body. With continued practice, this can bring on a state of deep muscle relaxation at will, reducing anxiety and other psychological or physiological responses to stressors.

Research findings indicate that relaxation training and meditation are more effective than no treatment or placebo treatments in treating cases of stress-related anxiety problems and disorders (Comer, 2001). In one longitudinal study on the effects of meditation, researchers randomly assigned 73 residents in accommodation for elderly people either to daily meditation or to none. After three years, about 25% of participants in the non-meditation group had died, but all participants in the meditation group were still alive (Alexander & others, 1989). A more recent longitudinal study conducted over a 19-year period found that patients diagnosed with hypertension who were randomly assigned to meditation training had a 30% lower death rate due to cardiovascular problems when compared with hypertension patients who received non-meditation-type treatments (Schneider & others, 2005).

Figure 12.27 The term 'meditation' is sometimes used interchangeably with 'relaxation' because meditation involves relaxation and a relaxed state can be achieved by using a meditative technique.

Physical exercise

Physical activity encompasses all movements in everyday life, including work, recreation, exercise and sporting activities. Everyone engages in some physical activity as part of their daily routines. For example, walking up a flight of stairs, walking to school, going shopping, cleaning your room, riding a bike and playing basketball or netball at school are all forms of physical activity. **Physical exercise** is physical activity that is usually planned and performed to improve or maintain one's physical condition. For example, going for a walk or a run to improve your fitness and doing bicep curls to develop upper-arm strength all involve physical activity considered to be physical exercise because they have the goal of improving physical condition. A distinction is often made between aerobic exercise and anaerobic exercise. *Aerobic exercise* requires a sustained increase in oxygen consumption and promotes cardiovascular fitness. Examples of aerobic exercise include running and jogging, walking at more than a leisurely pace, dancing, swimming, bicycle riding and basketball. By contrast, *anaerobic exercise* involves short bursts of muscle activity that can strengthen muscles and improve flexibility. Examples of anaerobic exercise include weight training, calisthenics and softball.

There is now worldwide acceptance among mental health professionals and medical practitioners in all types of cultures that physical activity and exercise are important elements of healthy living, not just for our physical wellbeing but also our psychological wellbeing. It is now also widely believed that traditional definitions of

Box 12.7

Relaxation response

American cardiologist Herbert Benson has conducted numerous research studies on the effects of stressors. His findings on their potential adverse effects on our physical and mental health led him to develop a meditative technique for achieving the relaxation response.

According to Benson (1993), the relaxation response is 'a physical state of deep rest that changes the physical and emotional responses to stress—and the opposite of the fight or flight response'. Benson has found that there are lasting stress-reducing benefits when the relaxation response is achieved once or twice daily. The technique takes only minutes to learn and only 10 to 20 minutes are required to achieve the relaxation response.

Although any one of a number of techniques can be used to achieve the relaxation response, Benson gives the following instructions to his patients.

1. Sit quietly in a comfortable position.
2. Close your eyes.
3. Deeply relax all your muscles, beginning at your feet and progressing up to your face. Keep them relaxed.
4. Breathe through your nose. Become aware of your breathing. As you breathe out, say the word, 'one' or 'calm' silently to yourself. For example, breathe in … out 'one', in … out 'one', etc. Breathe easily and naturally.
5. Continue for 10 to 20 minutes. You may open your eyes to check the time, but do not use an alarm. When you finish, sit quietly for several minutes, at first with your eyes closed and later with your eyes open. Do not stand up for a few minutes.
6. Do not worry about whether you successfully achieve a deep level of relaxation. Maintain a passive attitude and permit relaxation to occur at its own pace. When distracting thoughts occur, try to ignore them by not dwelling upon them and return to repeating 'one'. With practice, the response should come with little effort. Practise the technique once or twice daily.

physical exercise should be broadened to refer to the improvement of an individual's mental condition as well as their physical condition (Alters & Schiff, 2005; WHO, 2005).

Physical activity and exercise is ranked second only to tobacco control in being the most important factor in overall health promotion and disease prevention in Australia (VicHealth, 2010). Being physically active can substantially reduce the risk of a serious disease, including diseases associated with chronic stress, such as cardiovascular heart disease, kidney disease, hypertension, digestive disorders, stroke and certain forms of cancer. In addition to improving physical health, regular exercise and physical activity can enhance psychological health and overall sense of wellbeing. Research evidence indicates that aerobic exercise is best for physical and mental health, although anaerobic exercise is better than no exercise. Individuals who engage in regular aerobic exercise have high levels of aerobic fitness and are able to reduce their anxiety levels and cope with stress more effectively than their less-exercised counterparts (Alters & Schiff, 2005; Holmes, 1993). Considering the evidence, it should not be surprising that brisk walking, jogging, running, playing netball or basketball and similar activities are commonly included as an aspect of nearly all effective stress-management programs.

Exercise can help reduce adverse effects of stress in several ways. First, when an individual experiences stress, the sympathetic nervous system and HPA axis are activated, releasing the body's stress hormones. Exercise uses up the stress hormones secreted into the bloodstream, thereby helping the immune system return to normal functioning sooner. Exercise can also help work out tension that has built up in the muscles. Second, exercise increases the efficiency of the

"What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?"

Figure 12.28

Learning Activity 12.13

Review questions

1. **a** Explain the meaning of biofeedback.
   b What is a key assumption underlying the use of biofeedback for coping with effects of stress?
   c Give an example of the use of biofeedback for coping with effects of stress.
2. **a** Explain the meaning of relaxation.
   b What is the relationship between relaxation and meditation?
   c In what way are relaxation, meditation and biofeedback similar?
   d Explain why meditation and relaxation can help alleviate effects of stress.
3. **a** Describe three potential benefits of physical exercise for coping with effects of stress.
   b Briefly explain why aerobic exercise is considered to be more beneficial than anaerobic exercise for coping with effects of stress.

cardiovascular system and increases strength, flexibility and stamina for encountering future stressors. Third, many people experience short-term psychological benefits during or immediately after exercising. Strenuous physical activity produces chemical changes in the body that can improve psychological health. For example, the brain releases beta-endorphins during exercise. Beta-endorphins relieve pain and increase a sense of wellbeing and relaxation. In addition, physical exercise can divert a person's attention away from the stressor(s) and the negative emotional states associated with stress. It also has the advantage of removing the individual from the stress-producing situation. Finally, people who exercise with others can experience long-term psychosocial benefits from the social interaction and potential social support the interactions can provide.

Figure 12.29 Physical exercise can be an effective way of reducing stress. Aerobic exercise (a) is better than anaerobic exercise (b), which is better that no exercise (c).

Social support

The growing prominence of the biopsychosocial framework has placed increased emphasis on the importance of social factors that can affect our physical and mental health, particularly our access to various types of support from other people and how this can offset the effects of stressors.

Social support is help or assistance from other people when needed. The people who provide social support can vary and include anyone with whom we may have a relatively stable or ongoing interpersonal relationship, although this does not necessarily mean a close interpersonal relationship or an intimate relationship. For example, people who may provide social support can include family members, friends, neighbours, work colleagues, peers at school, teachers we trust, fellow members of a church or self-help group, professionals (for example, a counsellor, a psychologist or nursing staff in a hospital ward) and even people we have never met (for example, online support groups, chat rooms, telephone help lines).

According to American psychologists Jerry Suls and Kenneth Wallston (2003), social support can take four main forms: appraisal support, tangible assistance, information support and emotional support.

Appraisal support is help from another person that improves the individual's understanding of the stressful event and the resources and coping strategies that may be needed to deal with it. Through the exchange of appraisals, a person facing a stressful event can determine how threatening the stressful event is likely to be and can reduce uncertainty associated with the nature of the stressor and its potential impact.

Tangible assistance involves the provision of material support, such as services, financial assistance or goods, that may help offset the effects of a stressful event. The giving of food to someone who has lost a job or experienced a death of a loved one is an example. Access to tangible assistance means that the person will not have to perform certain routine chores at a time when their energy and enthusiasm for such tasks may be low.

Figure 12.30 Social support can be provided in the forms of (a) appraisal support, (b) tangible assistance, (c) information and (d) emotional support.

Other people can also provide *information support* about how to cope with a stressful event. For example, a person having a problem managing their workload may get information from school friends or co-workers about how they manage their own workloads or about how best to approach their team leader or supervisor about restructuring their job.

During stressful times, people may experience emotional changes that influence the way they think, feel and behave; for example, fear, sadness, grief or depression. Supportive friends, family and acquaintances can provide *emotional support*, which targets these emotional reactions by reassuring a person under stress that they are an individual who is cared for and valued. The warmth and nurturance provided by other people can enable a person under stress to approach the stress with greater confidence, based on the realisation that if they are feeling emotionally overwhelmed by the stress at some time in the future, there are others they can rely upon.

Learning Activity 12.14

Review questions

1 Explain the meaning of social support with reference to an example of social support available at your school.

2 Name and describe the four forms of social support.

3 Consider the following examples of social support that could potentially alleviate stress for someone who has just been informed that they have a terminal illness. Name the form of social support provided in each example.

- offering hope and encouragement that 'things will work out fine'
- listening to the person's concerns and offering advice
- giving money to pay for home care
- providing a Cancer Council brochure
- providing a cooked lasagne
- providing the website address for a cancer hospital
- offering compliments that boost the person's self-esteem
- bringing a comedy DVD and some popcorn to the person's house and watching the DVD with them
- participating in a cancer support group
- providing assistance to work out an action plan for hospital visits

Learning Activity 12.15

Essay on stress and stress management

Write an essay of about 600–700 words in which you use a biopsychosocial framework to explain the causes and management of stress. References may be used in obtaining information for your essay. In your essay, ensure that you:

- explain the meaning of stress, stressors and stress response
- distinguish between physiological and psychological responses to stress and specific types of responses
- explain what the biopsychosocial framework is, with reference to its key assumptions and characteristics
- explain causes of stress and stress management in terms of a biopsychosocial framework approach, including the role of allostasis
- accurately define and explain all key terms and concepts
- use relevant examples to demonstrate your understanding of key terms and concepts
- express your ideas in a clear and concise way
- organise your information in a logical way
- accurately cite and reference all material using appropriate conventions.

Learning Activity 12.16

Visual presentation on stress coping strategies

Using an example of a potential stressor at school, college or in the workplace, construct a concept map in which you show potential strategies for coping with stress, including biofeedback, meditation, relaxation, physical exercise and social support, and give relevant examples of each strategy. For each example, include key words indicating how it may alleviate stress.

Learning Activity 12.17

Visual presentation on stress and stress management

Prepare a visual presentation in which you use a biopsychosocial framework to explain the causes and management of stress. References may be used in obtaining information for your presentation. In your presentation, ensure that you:

- distinguish between stress, stressors and stress response
- distinguish between physiological and psychological responses to stress and specific types of responses
- use images and key terms to explain causes of stress and stress management in terms of a biopsychosocial framework approach, including the role of allostasis
- accurately represent all key terms and concepts
- use relevant examples to demonstrate your understanding of key terms and concepts
- organise your information in a logical way.

Chapter 12 true/false quiz

Indicate whether each item is true or false by writing ‘T’ or ‘F’ in the blank space next to each statement.

1 ______ The biopsychocial framework places greater emphasis on the biological basis of the stress response.

2 ______ Internal stressors are psychological in nature.

3 ______ The fight–flight response is a psychological response to a stressor.

4 ______ A person can die from the effects of stress.

5 ______ Biofeedback involves manipulation of physiological responses.

6 ______ The GAS is a theory on the causes of stress.

7 ______ Lifestyle changes can exacerbate or alleviate the stress response.

8 ______ The HPA axis increases the amount of stress hormone adrenaline, which stimulates the pituitary gland to release cortisol.

9 ______ The immune system is an allostatic system.

10 ______ Meditation can be an effective technique for stress management.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 12 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 The activation of the body's physiological systems to deal with a potential threat is called
- **A** the exhaustion stage.
- **B** the resistance stage.
- **C** stress.
- **D** the fight–flight response.

Q2 The sympathetic nervous system
- **A** activates bodily functions to deal with a stressor.
- **B** activates muscular relaxation and decreases heart rate.
- **C** is slower to respond in an emergency situation than is the parasympathetic nervous system.
- **D** maintains the internal systems of the body in a balanced state.

Q3 The stage of Selye's general adaptation syndrome (GAS) in which an organism can no longer cope with continuing stress is called
- **A** resistance.
- **B** exhaustion.
- **C** alarm reaction.
- **D** countershock.

Q4 Selye described eustress as
- **A** the subjective experience of stress.
- **B** stress that lasts too long.
- **C** stress that has a positive effect.
- **D** stress that has a negative effect.

Q5 The biopsychosocial framework describes stress in terms of
- **A** the combined effects of a complex interaction of biological, psychological and social factors.
- **B** the integration of physiological and psychological factors.
- **C** an individual's appraisal of whether or not they experience stress.
- **D** the combined effects of the two-way interaction between the individual and their internal and external environments.

Q6 Which of the following reactions to stress is an example of problem-focused coping?
- **A** 'I make myself believe that the stressful problem never arose.'
- **B** 'I do things to keep my mind free from the constant intrusions of the stressor.'
- **C** 'I will change my behaviour so that I can reduce the stressor's effects.'
- **D** 'I actively reduce the effects of the problem by accepting that I can't do anything to change things.'

Q7 Which of the following is a psychological stressor?

A persistent loud noise over a prolonged period of time

B lifting heavy objects over a prolonged period of time with few rest breaks

C achieving a lower grade than expected for a SAC

D having an outdoor job that requires working under conditions of extreme temperatures

Q8 The cumulative 'wear and tear' on the brain and body resulting from repeated and/or continual activation of physiological systems involved in allostasis is referred to as

A allostatic dysfunction.

B allostatic load.

C allostatic overload.

D allostatic transaction.

Q9 As you walk down the street on your way to visit a friend, a ferocious dog jumps a fence and chases you, barking and growling. Which of the following systems is **least** likely to be active as you try to flee from the dog?

A sympathetic nervous system

B circulatory system

C endocrine system

D parasympathetic nervous system

Q10 The three organs involved involved in the HPA axis and the order in which they are activated in the chain of reaction are

A hypothalamus, pituitary gland, adrenal gland

B hypothalamus, pituitary gland, ACTH

C pituitary gland, ACTH, hypothalamus

D pituitary gland, adrenal gland, hypothalamus

Q11 Prolonged activation of physiological systems as the result of a stressor

A occurs only because of the presence of external stimuli.

B occurs only in the alarm reaction stage of the GAS.

C can improve our performance on tasks involving allostasis.

D can deplete the body's resources and lead to long-term illness or disease and/or psychological difficulties.

Q12 The stage of Selye's general adaptation syndrome (GAS) in which an organism initially responds to a stressor is called

A resistance.

B exhaustion.

C alarm reaction.

D countershock.

Q13 Which of the following is an example of primary appraisal according to the Lazarus and Folkman transactional model of stress and coping?

A determining the extent to which additional resources are needed to cope

B evaluating the potential impact of the stressor

C judging the usefulness of coping resources that are available

D any exchange between the individual and the environment

Q14 Which of the following is an example of secondary appraisal according to the Lazarus and Folkman transactional model of stress and coping?

- **A** making a judgment about whether a situation is actually stressful
- **B** minimising harm or loss that may occur
- **C** estimating the value of coping options and resources that may be accessed
- **D** minimising harm or loss that has occurred

Q15 Prolonged physiological response to a stressor may

- **A** maintain the parasympathetic nervous system in an active state.
- **B** deplete the body of all its hormones.
- **C** cause cancer, but only if the person is in a negative emotional state.
- **D** contribute to a breakdown in the functioning of the immune system.

The answers to the Chapter 12 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the meaning of stress.

____

____

____

____

2 marks

Question 2

Describe the role of appraisal in the Lazarus and Folkman transactional model of stress and coping.

____

____

____

____

1 mark

Question 3

a What is allostasis?

1 mark

b What is an important role of each of the following in allostasis?

i HPA axis

1 mark

ii psychological factors

1 mark

Question 4

Describe a strength and limitation of Selye's general adaptation syndrome (GAS) in explaining physiological responses to stress.

2 marks

Question 5

Explain, with reference to an example, emotion-focused coping in response to a stressor.

2 marks

The answers to the Chapter 12 short-answer questions are available at www.OneStopScience.com.au.

13 Anxiety disorder: phobia

Carina is a 37-year-old woman. Her neighbour, a mental health nurse, encouraged her to see a clinical psychologist because of her fear of cats. Carina told the psychologist that her fear of cats has existed for as long as she can remember. The earliest incident she could remember was at the age of five, when a cat suddenly ran out on the road in front of her father's car when she was on the way to Luna Park with her dad. This caused her father to swerve and their car nearly crashed into a parked car. When she was 14 her brother put a bit of fur inside her bed and she remembers screaming hysterically and running straight out of the house in fear upon finding it. Carina had another vivid memory of being very frightened when she was 18 years old. At this time, she and her family visited some friends and she unexpectedly encountered a cat when she went to wash her hands in the bathroom.

Since then, over a period of many years, including the time of her father's death, her fear has remained unchanged. However, in the last six months, her fear has become steadily worse. About six months ago, the people living in the house next door moved out and the house has been empty ever since. The grass in the front of the house has grown very long and has attracted a lot of the local cats. Carina says that she is terrified that the cats will spring at her and attack her. Although she knows that this is very unlikely, she cannot rid herself of the fear.

At the sight of a cat, Carina will panic and sometimes be completely overwhelmed with terror. She always walks on the roadside edge of the footpath in case cats are roaming in front gardens of houses, and she will never go out alone at night. She will not, if she can possibly help it, go into any room where there is a cat. When visiting friends or relatives who have a cat, her husband or children have to enter ahead of her, and make sure the cat is taken away. She is afraid to go into her backyard alone. The days when she has to hang out the washing are extremely stressful and the task is becoming impossible. Pictures of cats in books, on television or in film make her feel uneasy and she certainly would never step inside the door of a pet shop.

In recent months her life has been filled with fear of cats, and she can't think of anything else. She interprets any unexpected movement, shadow or noise as being a cat. From time to time she has terrifying nightmares involving cats. On waking in the morning her first thought is of how many cats she might meet during the day. Her life is now filled with anxiety.

Figure 13.1 Many people will experience at least a brief burst of anxiety just before making a presentation in front of others.

Anxiety and anxiety disorders

Most people experience anxiety at some time. **Anxiety** is a state of physiological arousal associated with feelings of apprehension, worry or uneasiness that something is wrong or that something unpleasant is about to happen. It is normal to experience anxiety in certain situations. For example, many people will experience a brief burst of anxiety when an unexpected test is announced or just before making an oral presentation in front of others. Feeling anxious in these situations is appropriate, and usually we feel anxious for only a limited time. In everyday life, anxiety is an adaptive response. A severe anxiety response can be very useful in the short term to deal with threatening or dangerous situations. Physiologically, it is like the fight–flight response and therefore makes us more alert and our reactions faster. Mild to moderate levels of anxiety can also make us more alert and improve our ability to cope. For example, it is anxiety that can prompt us to slow down when running on a slippery surface, to avoid other dangerous situations, to study for an exam or to have a medical check-up.

Although we can all experience anxiety in certain situations, it should be brief and temporary, and its intensity ought to be related to the significance of the situation. If anxiety is severe or exaggerated and does not subside, it can be counterproductive and disabling. It can reduce our ability to concentrate, learn, think clearly and logically, plan, make accurate judgments and perform motor tasks, such as crossing a busy road and shooting for goal from a difficult angle. While most people feel mild to moderately anxious from time to time, some people experience severe anxiety most of the time.

Severe anxiety is generally accompanied by intense physiological sensations and responses, such as breathlessness, sweating, trembling, feelings of choking, nausea, abdominal distress, dizziness, pins and needles, feelings of losing control and/or feelings of impending doom. For people experiencing severe anxiety that is unwanted and persistent, anxiety is not an adaptive response. It can affect the way a person thinks, feels and behaves and, if not managed effectively, can cause considerable distress and disruption to the person's life.

Experiencing severe anxiety can indicate the presence of an anxiety disorder. The term **anxiety disorder** is used to describe a group of disorders that are characterised by chronic feelings of anxiety, distress, nervousness and apprehension or fear about the future, with a negative effect. Anxiety disorders are not so severe that individuals lose touch with reality or consistently behave in socially unacceptable ways. However, people are likely to be diagnosed with an anxiety disorder when their level of anxiety is so severe that it significantly interferes with their daily life and stops them doing what they want to do. As shown in box 13.1, the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) describes many different types of anxiety disorders.

Box 13.1

DSM-IV-TR anxiety disorders

Disorder	Description
Agoraphobia without history of panic disorder	Disorder characterised by the presence of agoraphobia and panic-like symptoms but without a history of unexpected panic attacks
Panic disorder with/without agoraphobia	*With*: disorder characterised by both recurrent unexpected panic attacks and agoraphobia; *without*: disorder characterised by recurrent unexpected panic attacks about which there is persistent concern
Specific phobia	Disorder characterised by significant anxiety provoked by exposure to a specific feared object or situation, often leading to avoidance behaviour
Social phobia	Disorder characterised by significant anxiety provoked by exposure to certain types of social or performance situations, often leading to avoidance behaviour
Obsessive-compulsive disorder (OCD)	Disorder characterised by obsessions (recurring, unwanted thoughts that produce anxiety) and/or by compulsions (a need to perform repetitive and rigid actions to reduce the anxiety)
Post-traumatic stress disorder (PTSD)	Disorder characterised by the re-experiencing of an extremely traumatic event accompanied by symptoms of increased arousal and by avoidance of stimuli associated with the trauma
Acute stress disorder	Disorder characterised by symptoms similar to those of PTSD that occur immediately in the aftermath of an extremely traumatic event
Generalised anxiety disorder	Disorder characterised by at least six months of persistent and excessive anxiety and worry
Anxiety disorder due to a general medical condition	Disorder characterised by prominent symptoms of anxiety that are judged to be a direct physiological consequence of a general medical condition; e.g. congestive heart failure
Substance-induced anxiety disorder	Disorder characterised by prominent symptoms of anxiety that are judged to be a direct physiological consequence of a drug of abuse, a medication or toxin exposure

Anxiety is also common in the following disorders included in other categories of the DSM-IV-TR.

Disorder	Description	Category of DSM-IV-TR
Separation anxiety disorder	Essential feature is excessive anxiety about separation from the home or from those to whom a child is attached	Usually first diagnosed in infancy, childhood or adolescence
Sleep terror disorder	Although not regarded as an anxiety disorder, the criteria for diagnosis includes intense fear and signs of autonomic arousal such as rapid heartbeat, rapid breathing and sweating upon awakening abruptly from sleep	Sleep disorders

Phobias

We all have fears, but they are not necessarily severe enough to interfere with our daily lives. For example, we may not feel comfortable around spiders or dogs, but this is quite different to having a phobia. A **phobia** is an excessive or unreasonable fear directed towards a particular object, situation or event that causes significant distress or interferes with everyday functioning. The term 'phobia' is Greek for 'fear' or 'in dread of'. People with a phobia often become fearful even when they think about the object, situation or event they dread. However, they can usually keep the anxiety associated with their fear at a manageable level as long as they avoid the object or thoughts about it.

It is estimated that phobias affect approximately 3% of the Australian population (Mental Health Research Institute, 2004). As is the case with other anxiety disorders, more women than men have phobias. Most people with phobias are very aware that their fears are excessive and unreasonable, but may not know how they started. Phobias are divided into three categories in the DSM: agoraphobia, social phobia and specific phobia. We examine specific phobia as an example of an anxiety disorder. As shown in figure 13.2, this example is viewed from the perspective of the biopsychosocial framework.

Specific phobia

A **specific phobia** is a disorder characterised by significant anxiety provoked by exposure to a specific feared object or situation, often leading to avoidance behaviour. The specific object or situation producing the fear associated with a phobia is commonly referred to as the *phobic stimulus*.

Carina's fear of cats, described at the beginning of the chapter, is an example of a specific phobia. Another specific phobia is an extreme fear of being

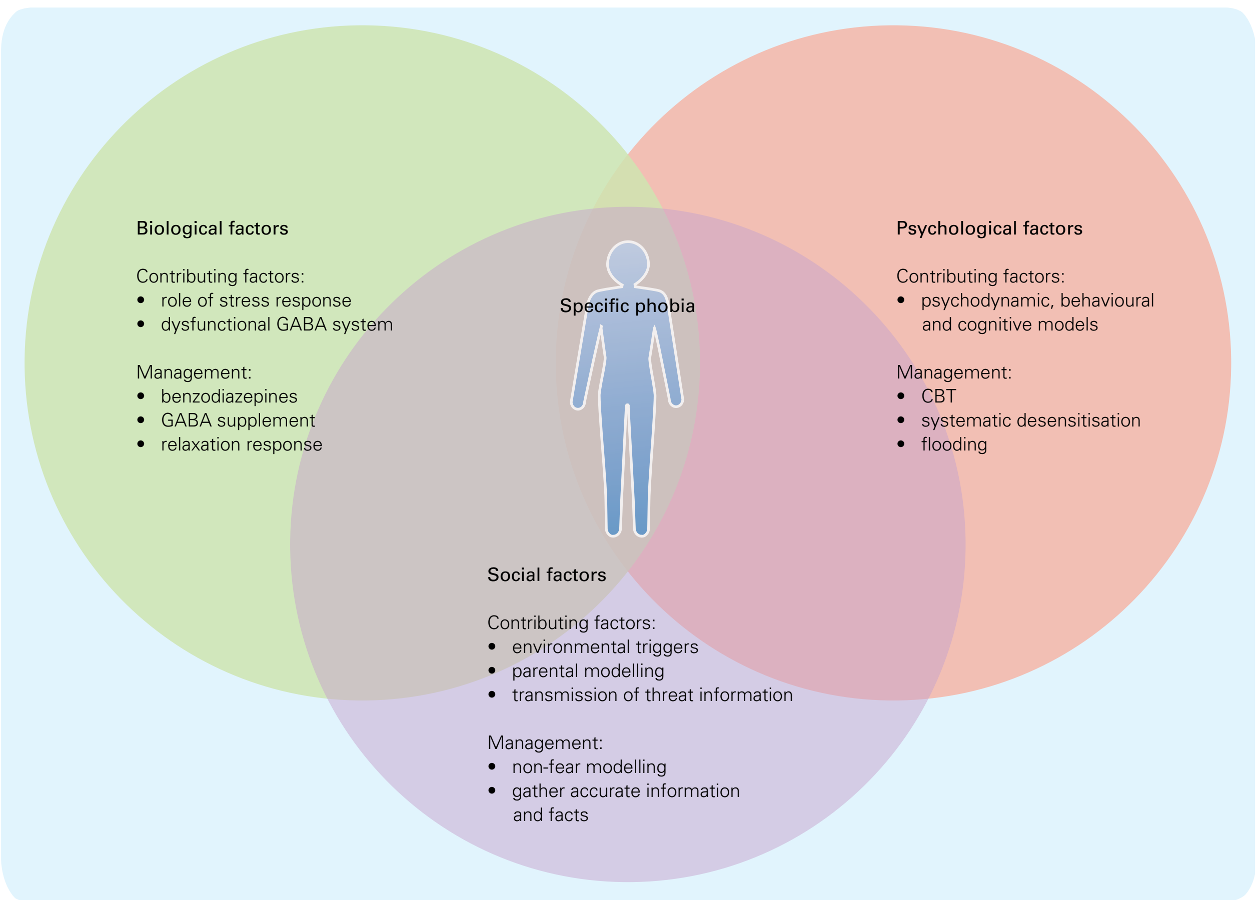


Figure 13.2 The biopsychosocial framework applied to specific phobia and its management

in a lift. Some people will not enter a lift despite the inconvenience or hardship they experience as a result, such as walking up many flights of stairs. They unreasonably believe that the lift's cables could break, that the ventilation could fail or that they could get stuck in midair waiting for repairs. These possible problems are not uncommon, but it does not make sense for most people to walk up and down several flights of stairs on every single occasion to avoid them.

According to the DSM, any specific phobia falls into one of five categories: (1) of animals (e.g. spiders, snakes, dogs, insects, birds, fish, mice); (2) of situations (e.g. lifts, bridges, enclosed spaces, flying, tunnels); (3) of blood, injections and injury (e.g. seeing blood, having blood taken, having an injection, watching a caesarean birth, getting a cut); (4) of natural environments (e.g. heights, darkness, thunder, lightning, being near water); and (5) other phobias (e.g. choking, vomiting, loud noises, costumed characters, falling down, becoming ill, dying).

Traditionally, specific phobias are named using Greek prefixes that stand for the object or situation that is feared; for example, *xeno*phobia (fear of foreigners), *claustro*phobia (fear of enclosed places) and *acro*phobia (fear of heights). The newspaper article below includes some of the technical terms for different phobias. While these terms sound technical enough to be included in the DSM, most are not listed there because there is almost no limit to what people may fear. However, all phobias share common symptoms but primarily differ in that they occur in response to different objects or situations.

Scare tactics

Delicate jewellery, storm clouds and pigeons can be the stuff of nightmares for some. Annie Lawson meets three people dealing with their unusual phobias.

Edan Gill's phobia of jewellery could be dismissed as a quirky chink in his armour, were it not for the fact that he plays bass guitar in a heavy metal band. Given he has immersed himself during the past 16 years in a musical subculture dominated by unfeasibly loud guitars, gothic tattoos and black-clad headbangers, you would think he'd be accustomed to body piercings. 'I have played in bands where musicians have had piercings—it used to disgust me,' he says.

Gill's phobia is quite specific—dainty, jangling jewellery. Little trinkets are also a problem. Even worse is small, metal beading, says the 34-year-old father of one. 'It revolts me and makes me feel physically sick,' he says.

The 1990s were a particularly difficult period for him given the prevalence of nose, tongue, belly button and eyebrow piercings. He's not sure but thinks the problem started at primary school. Lots of children, he says, sucked on coins so it might be a hygiene issue. He is reluctant to be treated for the problem and prefers to avoid jewellery (his partner doesn't wear any).

Mainstream phobias, such as fear of flying, spiders and injections, receive far more attention because sufferers find it more difficult to live with them and are forced to seek treatment. But more obscure fears tend to be easily avoidable, says Professor Bob Montgomery, president elect of the Australian Psychological Society. 'Unless it is interfering with their lives, for the most part, they will put up with it,' he says. 'Things have got to be pretty bad before they will consult a psychologist.' Famous phobics include actor Billy Bob Thornton, whose fear of antique furniture is one of the few, along with Gill's jewellery fear, without an official name. Film director Alfred Hitchcock had a bizarre fear of eggs and country music star Lyle Lovett is apparently afraid of cows. A fear of buttons, being afraid of lint and a fear of staying single are among the less common phobias. Then there are others, published recently in *New Scientist* magazine, which sound like a fabrication of some linguist's imagination. These include pentheraphobia, a fear of mother-in-laws; keraunophobia, fear of lightning; arachibutyrophobia, fear of peanut butter sticking to the roof of the mouth; and hippopotomonstrosesquippedaphiliophobia, fear of long words.

Apparently, we can become phobic about the most innocuous things.

About 10% of the population suffer a phobia at some stage in their lives. The basic fear categories are animals, nature, situations, injection or blood and illnesses. Most common phobias are of spiders, snakes and heights, fears that kept our ancestors alive and continued to be wired deep in our brains.

Professor Don Jefferys, adjunct professor at Deakin University's department of psychology, has helped patients overcome some less common fears of clowns, dolls, chickens and Father Christmas, at his private practice, the Melbourne Clinic. 'There's a tendency to trivialise phobias but, in reality, they can be very impairing in people's lives,' he says. 'We all have fears but phobias are where there is a significant avoidance.' John [not his real name] became fearful of thunderstorms 20 years ago after watching a documentary about fatal lightning strikes. This intensified after firecrackers unexpectedly exploded near him at the Melbourne Showgrounds where the 53-year-old worked as a volunteer medical officer. The explosion sent a shower of ash into a crowd of onlookers.

'Before I had treatment, it would scare me to walk from the building to the car—I wouldn't even go out to the rubbish bin if there was thunder in the distance,' John says. 'I'm an avid golfer and the last place a golfer wants to be is on a golf course in the middle of a thunderstorm surrounded by trees and holding a graphite stick.'

So consumed by the threat of storms was John that he bought a small lightning detector and pored over the Bureau of Meteorology's website most days. During storms, he used to close the curtains, turn off all electrical equipment in the house and lock himself in the bathroom or listen to his iPod to block out the sound. 'I had to do something because it was affecting my interaction with my wife and a group of social golfers I played with,' he says. 'At the first rumble of thunder, I would hightail it off the course.'

Following many sessions with Professor Jefferys and armed with relaxation techniques, John has thrown away his lightning detector and remains relatively calm during storms.

It's ironic that Eyvonne Stork, 49, should suffer such a debilitating fear of birds. Understandably, she doesn't find it remotely amusing given her phobia has forced to her rearrange her life. She avoids eating outside lest she encounter a bird, she refuses to go for walks during the day, and will wait inside until her back garden is cleared of all birds before hanging the washing out.

'I don't ever remember not being scared of birds,' she says. 'I don't like them flapping near me and if I go outside and one flies by, I'm on high alert and my heart starts racing.'

Stork's fear of birds has since expanded to a fear of anything that flies. This has precipitated moments of panic, which motivated her to seek treatment. 'I tried treatment 10 years ago before a trip to Europe because I knew it would be full of pigeons,' she says. She has made some progress in that she is much calmer in the presence of a bird but she still avoids them.

Kerry Hempenstall, a senior lecturer in psychology at RMIT University, says phobics can blame their amygdala, the threat-warning device buried deep in the brain, which can overreact in situations it perceives to be risky.

A traumatic incident or hearing about another person's experiences are sufficient triggers for a phobia. And these irrational fears can easily magnify—for example, a fear of spiders can morph into a fear of all creatures with legs. 'The people who suffer from phobias recognise the irrationality of it,' he says. 'It's the separation of the cerebellum, the thinking part of the brain, from the emotional part of the brain—the thinking part says this is stupid but nevertheless the other part of the brain is still active, you can't necessarily subjugate it.'

Unusual phobias

Anuptaphobia: fear of staying single
Arachibutyrophobia: fear of peanut butter sticking to the roof of the mouth
Coulrophobia: fear of clowns
Hippopotomonstrosesquippedaliophobia: fear of long words
Keraunophobia: fear of lightning
Nucleomituphobia: fear of nuclear weapons
Odontophobia: fear of dentists
Ornithophobia: fear of birds
Papaphobia: fear of the Pope
Pentheraphobia: fear of mother-in-laws
Plutophobia: fear of wealth
Quadrataphobia: fear of quadratic equations
Rhytiphobia: fear of wrinkles
Vuteuthindon: fear of picnics

Source: Lawson, A. (2008, June 2). Scare tactics. *Metro, The Age*, p. 14.

Earlier versions of the DSM used the term 'simple phobia' to describe a phobia such as Carina's fear of cats, but the DSM now uses the term 'specific phobia' because a 'specific' object or situation is the focus of the fear. The *International Classification of Diseases and Related Health Problems* (ICD-10) also uses the term 'specific phobia', but uses it interchangeably with the term 'isolated' to convey the fact that this category of phobia is associated with a specific, or 'isolated', object or situation. This is in contrast to agoraphobia and social phobia, whereby the fears are not about anything specific

Figure 13.3 There is no limit to what people may fear. A clown or the pope may be a phobic stimulus, with any type of exposure triggering an involuntary anxiety response.

but more 'general' situations. Agoraphobia and social phobia are therefore sometimes referred to as 'complex phobias'.

When someone has a specific phobia, exposure to the phobic stimulus triggers an involuntary anxiety response that is like the stress response. In some cases, an anxiety response is so intense that it takes the form of a panic attack. A *panic attack* is the unexpected onset of intense anxiety that can last for a few minutes or up to an hour or so. The person may feel sick, dizzy, short of breath, tight in the chest, become disorientated and feel as if they have no control over their reactions or circumstances (see box 13.2).

People with a specific phobia are aware that their level of fear is excessive or unreasonable. That is, they know that their fear is grossly in excess of any real danger posed by the phobic stimulus. Consequently, they are often embarrassed and feel 'stupid' because of their fear, and the way the fear interferes with their lives. The experience of a phobia can be contrasted with that of watching a very scary horror movie. This type of movie can frighten us but, deep down, we know that we are safe. When a phobic stimulus frightens someone with a phobia, deep down they feel unsafe, despite the fact that they know their fear and insecurity are irrational (Butler & Hope, 2007).

Although people with a specific phobia recognise their level of fear is excessive or unreasonable, they usually feel compelled to avoid the phobic stimulus. They begin to organise their life around avoiding the phobic stimulus and, when this is not possible, they endure it with intense anxiety or distress. The possibility of encountering a phobic stimulus also causes anticipatory anxiety. *Anticipatory anxiety* is the gradual rise in anxiety level as a person thinks about, or 'anticipates', being exposed to a phobic stimulus in the future. Most people have experienced a mild form of anticipatory anxiety when they have an 'attack of nerves' before making a presentation to an audience. For many, it is handled with little worse than 'rubbery knees' or a slight quavering of the voice. For those with a phobia, however, their anxiety may rise to a level where they are incapacitated by it.

As with all other disorders in the DSM-IV-TR, the person's anxiety, anticipatory anxiety or avoidance behavior significantly interferes with their everyday life and/or causes them great distress (American Psychiatric Association, 2000). According to the DSM-IV-TR criteria, a diagnosis of specific phobia is only made if the fear of the specific object or situation has persisted for at least six months. Specific phobia is the most common mental disorder among women and the second most common among men, second only to substance-related disorders (Sadock, Kaplan & Sadock, 2007).

Box 13.2

Panic attack

A *panic attack* is the unexpected onset of intense anxiety that can last for a few minutes or up to an hour or so. People who suffer from panic attacks experience great discomfort and may feel sick, dizzy, short of breath or tight in the chest, and become disorientated. There is also often a fear that the panic attack will happen again and lead to a total loss of control or even death.

A panic attack is not classified as a separate disorder in the DSM-IV-TR. However, panic attacks are included as a symptom in a number of the anxiety disorders described in the DSM; for example, panic disorder, specific phobia, social phobia and post-traumatic stress disorder (PTSD). According to the DSM, a panic attack is diagnosed when four (or more) of the following symptoms develop suddenly and reach a peak within 10 minutes:

- palpitations, pounding heart or accelerated heart rate
- sweating
- trembling or shaking
- sensations of shortness of breath or smothering
- a feeling of choking
- chest pain or discomfort
- nausea or abdominal distress
- feeling dizzy, unsteady, lightheaded or faint
- de-realisation (feelings of unreality) or depersonalisation (being detached from oneself)
- fear of losing control or going crazy
- fear of dying
- paresthesias (numbness or tingling sensations)
- chills or hot flushes.

Source: American Psychiatric Association (2000). *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision.* Arlington, VA: American Psychiatric Publishing.

Learning Activity 13.1

Review questions

1. Explain the meaning of the term anxiety.
2. Give an example of when anxiety may be (a) useful and (b) not useful.
3. Explain the meaning of the term anxiety disorder with reference to three examples of anxiety disorders.
4. In what way is anxiety experienced as a 'normal' part of everyday life different from the experience of anxiety that characterises an anxiety disorder?
5. What is a phobia and how does it differ from an ordinary fear?
6. List the three key characteristics of a specific phobia.
7. According to the DSM, how long must a person's fear of a specific object or situation have persisted for them to be diagnosed as having specific phobia?
8. Distinguish between the terms simple (specific) phobia and complex phobia.
9. For both of the following cases, identify the relevant DSM-IV-TR phobia category.

Case 1

Mina has a couple of good friends who she has known since primary school, but that's all. She doesn't go to parties and hasn't had a boyfriend. Mina tries hard to avoid taking subjects that involve making presentations in front of the class as she feels completely incapable of doing so. Even the thought of it causes her heart to pound and makes her feel dizzy. Mina is also extremely self-conscious—she worries about drawing attention to herself for fear that she might do or say something to embarrass herself.

Case 2

Kathryn is terrified of dogs. She travels everywhere by car, avoids walking in parks and has given up netball because of the location of the courts. She is convinced that dogs sense her fear and will come for her even when they might leave other people alone.

Figure 13.4 For people with a specific phobia, such as a phobia of cats, the fight–flight stress response is triggered in the absence of any real threat or danger.

Biological contributing factors

Many research studies on biological factors that contribute to specific phobias and other types of anxiety disorders have investigated whether some people are more genetically predisposed than others to specific fears and high anxiety levels. These studies indicate that we may inherit a predisposition, or 'tendency', to develop an anxiety disorder. Genetic influence on anxiety disorders is suggested by research showing that if one identical twin has an anxiety disorder, the other is more likely to have an anxiety disorder than is the case in non-identical twin pairs and other siblings. Overall, research involving twins and other people of genetic relatedness indicates a moderate level of heritability of anxiety disorders (Schacter, Gilbert & Wegner, 2009). Psychologists have also conducted research studies on other biological factors that can contribute to specific phobias and phobic reactions. One of these factors is the role of the stress response. The other factor involves the role of the brain's neurochemistry, specifically the neurotransmitter called GABA.

Role of the stress response

Anxiety in response to a phobic stimulus involves feelings of apprehension, worry or uneasiness that something is wrong or something unpleasant is about to happen. This is considered to be the psychological component of anxiety. Underlying and interacting with this component is a physiological component that is like the physiological response to stress. Because there is a perceived threat or impending harm at the sight or thought of a phobic stimulus, the fight–flight response is activated. The heart rate and strength of heartbeat increase to speed up blood flow, blood is redirected from places where it is not needed, the speed and depth of breathing increase, adrenal hormones surge into the bloodstream, and so on. These types of reactions account for many of the symptoms associated with phobic anxiety, such as palpitations resulting from a pounding heart or accelerated heart rate, and sweating due to increased perspiration. Feeling dizzy or even fainting are believed to be the result of an initial increase in autonomic nervous system arousal followed by a sudden drop in blood pressure and heart rate.

Phobic anxiety becomes problematic when the stress response is triggered in the *absence* of any real threat or danger; for example, in response to objects or situations that have very little or no potential for actual harm, such as clouds (nephophobia) or flowers (anthophobia). For a person with a specific phobia, their stress response is triggered by exposure, or anticipated exposure, to objects or situations *perceived* to be dangerous. Anxiety is therefore also problematic for someone with a specific phobia as their anxiety tends to be excessive because their perception of threat is unreasonable and out of proportion to what it should be. This means that the stress response they experience is often very severe and can persist at this high level for at least as long as the exposure or anticipated exposure to the phobic stimulus.

Role of GABA

GABA and glutamate are naturally occurring neurotransmitters that carry messages between neurons in the brain. They are also the brain's most common and widespread neurotransmitters. **gamma-amino butyric acid (GABA)** is the primary inhibitory neurotransmitter in the central nervous system and works throughout the brain to make postsynaptic ('receiving') neurons less likely to fire (that is, it 'inhibits' firing). One of its roles is to fine-tune neurotransmission in the brain and maintain neurotransmission at an optimal, or 'best possible', level. Without the inhibitory effect of GABA, activation of postsynaptic neurons might get out of control and spread throughout the brain, causing seizures similar to those of epilepsy. For example, glutamate, which is the second most abundant neurotransmitter in the brain, is the primary excitatory neurotransmitter in the central nervous system. It works throughout the brain to make postsynaptic neurons *more* likely to fire. It is involved in fast-acting neuronal transmission throughout the brain (and also aids learning and memory by strengthening synaptic connections). The inhibitory action of GABA counterbalances the excitatory activity of glutamate and vice versa. Consequently, GABA and glutamate have important roles in regulating central nervous system arousal. GABA is also believed to play a role in anxiety.

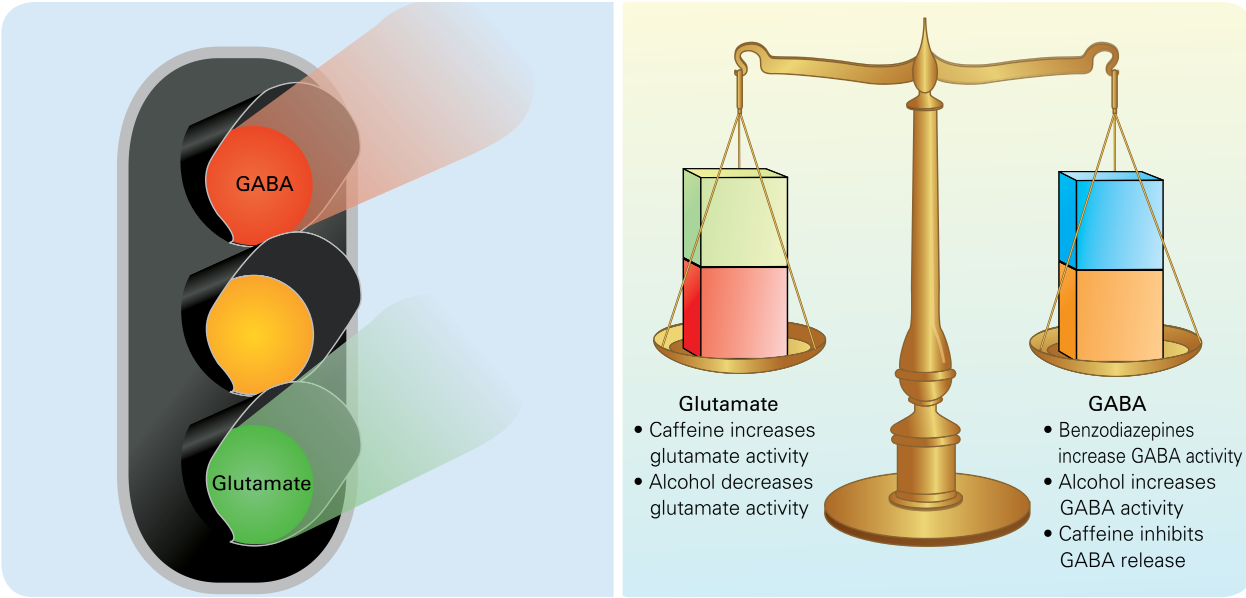
The effectiveness of using a group of drugs called benzodiazepines in the management of phobic anxiety provides evidence for the role of GABA in anxiety. **Benzodiazepines** are a group of drugs commonly referred to as minor tranquillisers as they have the effect of 'calming down' the body by reducing physiological arousal and promoting relaxation. However, they also induce drowsiness and are highly addictive. A large number of benzodiazepines are available on prescription in Australia. The most common ones are Valium, Serepax, Temazepam, Rohypnol and Xanax (see box 13.3).

These drugs and other medications work either by imitating and therefore stimulating a neurotransmitter's activity (called **agonists**) or by inhibiting a neurotransmitter's activity (called **antagonists**). Benzodiazepines are GABA agonists. Therefore, they imitate GABA and stimulate activity at the site of a postsynaptic neuron where GABA is received from a presynaptic ('sending') neuron. In this way, benzodiazepines have inhibitory effects on postsynaptic neurons throughout the brain and reduce the symptoms of anxiety by imitating GABA's inhibitory effects.

Studies have shown that benzodiazepines are effective in the management of specific phobias, panic disorder and other anxiety disorders. For example, someone with a fear of flying may take a benzodiazepine tablet before getting on a plane to reduce their severe anxiety to a tolerable level. Ethyl alcohol—the type that people drink—has similar effects on GABA receptors, which is why alcohol is typically experienced as relaxing (Gazzaniga & Heatherton, 2006). Studies with drugs that are antagonists have found that they have the opposite effect on phobic anxiety—antagonists reduce GABA function and therefore produce anxiety symptoms. For example, animal studies with apes and other primates have found that the physiological symptoms of anxiety can be induced when a benzodiazepine antagonist is administered. This provides further evidence of the role of GABA in anxiety (Sadock, Kaplan & Sadock, 2007).

The connection between the level of GABA in the brain and anxiety symptoms has led researchers to hypothesise that some people develop anxiety because they have a dysfunctional GABA system, which is the result of a failure to produce, release or receive the correct amount of GABA that is needed to regulate neuronal transmission in the brain. A dysfunctional GABA system can result in low levels of GABA in the brain. For example, in one study, it was found that participants with a diagnosed panic disorder had a GABA level that was 22% lower than that of control group participants with no history of panic disorder (Sadock, Kaplan & Sadock, 2007).

The level of GABA in a person's brain may be affected by a wide range of factors. These include biological factors such as genetic inheritance, socio-cultural factors such as exposure to prolonged stress or environmental toxins, nutritional deficiencies such as in vitamin B6 and citric acid, and high caffeine intake (see box 13.4). Various socio-cultural factors are believed to either inhibit GABA release or stimulate overproduction of glutamate in some way (see figure 13.5).



Source: Genetic Science Learning Center (2010). Beyond the reward pathway. *Learn. Genetics,* Salt Lake City: The University of Utah, http://learn.genetics.utah.edu/content/addiction/reward/pathways.html.

Figure 13.5 GABA and glutamate are like traffic lights regulating neuronal traffic in the brain. GABA is an inhibitory neurotransmitter and makes receiving neurons less likely to fire. Glutamate is an excitatory neurotransmitter and makes receiving neurons more likely to fire.

Some researchers have proposed that GABA levels can be increased 'naturally' by drinking green tea or eating foods 'high in GABA'. For example, GABA-type substances can be found naturally in beans, dairy products, eggs, seafoods and whole grains. GABA supplements, marketed as a 'natural anxiety cure', are also available from many health food stores. However, there is no significant research evidence that GABA supplements can penetrate the blood–brain barrier. The *blood–brain barrier* is a physiological mechanism that protects the brain (and spinal cord) from undesirable toxins and poisons in the blood that may cause harm. The blood–brain barrier consists of blood vessels that are semi-permeable. This means that the blood–brain barrier allows some blood-borne chemicals to pass through but not others. Many drugs such as heroin and cocaine can cross the blood–brain barrier and affect neurotransmitter functioning. Since it is unknown whether GABA supplements can cross the blood–brain barrier, their effectiveness in the management of anxiety disorders is unclear.

Figure 13.6 'Natural' GABA supplements may not be able to penetrate the blood–brain barrier and would therefore have no effect on phobic anxiety. People with a chronic anxiety condition should seek advice from a medical practitioner or mental health professional before buying a GABA supplement that claims to relieve anxiety.

Box 13.3

Benzodiazepines

Benzodiazepines are a group of drugs called minor tranquillisers, often known as 'benzos'. These drugs are prescribed by a doctor to help people with anxiety or sleep problems. As shown in table 13.1 on the next page, there are many different types of benzodiazepines, each of which is sold under a different brand name.

Some slang names for benzodiazepines include 'benzos', 'rowies', 'serries', 'moggies', 'vals', 'V', 'normies', 'downers', 'tranks' and 'sleepers'. Some people use benzodiazepines without a prescription from a doctor. This is illegal and can be very dangerous.

How are benzodiazepines used? Benzodiazepines slow down the workings of the brain and the central nervous system. They are used medically to reduce anxiety, to help people sleep and to relax the body. They should only be prescribed for short periods of time. This is because it is possible to become dependent on them after as little as four weeks' use as directed by a doctor.

Different types of benzodiazepines work in the body for different lengths of time. They come in the form of tablets or capsules. Some people inject benzodiazepines and/or use them at the same time as they use heroin, alcohol or other drugs. This can be very dangerous and can cause an overdose or death. Injecting benzodiazepines that are intended to be swallowed in tablet or capsule form can also cause severe damage to veins, leading to loss of limbs from poor circulation, organ damage or stroke.

Immediate effects—The effects of benzodiazepines may last from a few hours to a few days, depending on the dose and type of benzodiazepines you take. Some of their immediate effects are that they can make you feel relaxed; feel drowsy, sleepy or tired; have no energy; become confused or dizzy; feel really good; have mood swings; slur your words or stutter; misjudge distances or movement; have blurred or double vision; forget things from just a short time ago. If you take a very high dose of benzodiazepines with other drugs you can lapse into a coma or die.

Long-term effects—If you use benzodiazepines often and for a long time, you may have no energy or interest in doing normal things, be cranky, feel sick in the stomach, have headaches, have dreams that make you feel bad, lose interest in sex (or your body doesn't work properly during sex), get skin rashes, be more hungry and put on weight, have menstrual problems if you are female, and be depressed.

Tolerance and dependence—Anyone can develop a 'tolerance' to benzodiazepines or other drugs. Tolerance means that you must take more of the drug to feel the same effects you used to feel with smaller amounts or lower doses. This may happen very quickly with benzodiazepines. 'Dependence' on benzodiazepines affects your thoughts, emotions and activities. You spend a lot of time thinking about using benzodiazepines, looking for them, using them and getting over the effects of using them. You also find it difficult to stop using or control how much you use. Dependence can lead to a variety of health, money, legal, work and relationship problems. Not all people who ever use benzodiazepines become dependent, but it is very easy to become dependent on benzodiazepines and it can happen within four weeks.

Withdrawal—People who are dependent on benzodiazepines find it very hard to stop using them or cut down, because of withdrawal symptoms. Suddenly stopping using benzodiazepines can be dangerous. You should get help and withdraw gradually if you have been using benzodiazepines regularly or using high doses of them. Symptoms of withdrawal can include convulsions; disturbed sleep; feeling nervous or tense; being confused or depressed; feeling afraid or thinking other people want to hurt you; panicking and feeling anxious; feeling distant or not connected with other people or things; sharpened or changed senses (for example, noises seem louder than usual); shaking, pain, stiffness or muscle aches or spasms; flu-like symptoms; heavier than usual menstrual bleeding and breast pain in women.

Table 13.1 The different generic and brand names of benzodiazepines in Australia

Drug name	Brand name
diazepam	Valium, Ducene, Antenex
oxazepam	Serepax, Murelax, Alepam
nitrazepam	Mogadon, Alodorm
temazepam	Euhypnos, Normison, Temaze
lorazepam	Ativan
flunitrazepam	Rohypnol, Hypnodorm
bromazepam	Lexotan
clonazepam	Rivotril

Source: adapted from NSW Health (2006), Benzodiazepines. *Drug Facts.* www.health.nsw.gov.au/pubs/2006/pdf/benzos.pdf.

Box 13.4

Caffeine-induced anxiety disorder

Caffeine is the most widely consumed drug in the world, most commonly from the beverages coffee and tea and soft drinks such as Coca-Cola. An estimated 80% of the world's population consumes a caffeine-containing substance daily. A typical 250 mL cup of instant coffee contains about 100 mg of caffeine—about twice as much as a cup of tea or a 360 mL can or bottle of soft drink. A 30-gram chocolate bar might contain as much caffeine as half a cup of tea.

In low doses, caffeine is believed to be associated with an improvement in sporting performance, increased alertness and reduction in fatigue, and is potentially able to temporarily lift a person's mood. Coffee and tea also contain some antioxidants that have positive effects on heart health. Caffeine can also be helpful for some types of headaches such as migraine headaches, which in some cases can be reduced by caffeine.

However, researchers are increasingly becoming concerned about caffeine's role in panic and other anxiety disorders. The potential psychological effects of caffeine identified through research led the American Psychiatric Association to add caffeine-induced anxiety disorder to the DSM-IV-TR.

Anxiety symptoms associated with high levels of caffeine use can resemble those of generalised anxiety disorder (see box 13.1). In one study, the results showed that when a caffeine dose equivalent to the amount found in 4 to 5 cups of coffee was given to participants with panic disorder, nearly half of the participants experienced a reaction that was indistinguishable from their panic attacks. People with caffeine-induced anxiety disorder may appear 'wired', overly talkative and irritable; have tachycardia (rapid heart rate); be restless; and complain about not being able to sleep well and of having energy 'to burn'. It is believed that these symptoms develop because caffeine inhibits GABA release. The physiological effects of too much caffeine are a direct consequence of having high glutamate production without enough GABA being released in the brain to counterbalance it.

Research studies have also found that too much caffeine can keep a person in a chronically tense, aroused condition, leaving them vulnerable to feelings of anxiety. It may also induce and intensify panic attacks. Conversely, stopping caffeine intake has been found to produce a reduction in overall level of anxiety, and some clients require no further treatment. Therefore, some mental health professionals advise people with anxiety symptoms to avoid caffeine (Sadock, Kaplan & Sadock, 2007).

Figure 13.7 Caffeine can cause symptoms of anxiety because it inhibits GABA release.

Learning Activity 13.2

Review questions

1. Draw a simple flow chart to describe and explain how the stress response contributes to the experience of a phobic reaction.
2. What is GABA and where is it found?
3. Explain how GABA may contribute to phobic anxiety and make some people more predisposed to developing a specific phobia.
4. **a** What are benzodiazepines?
   b Explain how benzodiazepines may be used to manage or treat phobic anxiety, ensuring you refer to their role as GABA agonists.
   c In what way do studies with drugs that are GABA antagonists provide evidence of the role of GABA in phobic anxiety?
   d Current scientific opinion is that GABA taken as a supplement may not cross the blood–brain barrier. If GABA does not reach the brain, it will have no effect. However, some people claim that GABA supplements are effective in reducing their anxiety symptoms. Assuming a GABA supplement cannot cross the blood–brain barrier, suggest a possible explanation of its effectiveness for some people.

Psychological contributing factors

Although finding the origin of a specific phobia is often difficult, a number of different models, or theories, have been proposed to describe and explain how a specific phobia can develop due to psychological factors. These models include the *psychodynamic model*, which emphasises the role of an unresolved psychological conflict occurring at an unconscious level; the *behavioural model*, which emphasises the role of learning and experience; and the *cognitive model*, which emphasises the roles of 'distorted' ways of thinking and other cognitive processes.

Psychodynamic model

The psychodynamic model was first proposed by Sigmund Freud in the late 1800s. The **psychodynamic model**, or *psychodynamic theory*, is based on an assumption that all mental disorders are caused by unresolved psychological conflicts that occur in the unconscious part of the mind, beneath the level of ordinary conscious awareness. These conflicts have their origins in early childhood experiences, during which our instinctive impulses ('urges') and society's view of what is 'acceptable' behaviour often clash.

According to Freud, the *unconscious* part of our mind is a storage place for all the information about ourselves that is not acceptable to the conscious mind. It is not, however, a storage place for all the information in our memory. It can be thought of as the 'skeletons in the closet' part of the mind where all the 'unacceptable' thoughts, feelings, experiences, images, impulses, motives and ideas are buried. Freud believed the unconscious contains all the memories of experiences that may be a source of anxiety and therefore very difficult for us to bring into our conscious minds. Although you are not directly aware of your unconscious thoughts and feelings, Freud believed they still have a considerable influence over your conscious thoughts and behaviour.

Freud also proposed that following birth, we each progress through a series of five different *psychosexual stages* called the *oral stage* (0–2 years), *anal stage* (2–3 years), *phallic stage* (4–5 years), *latency stage* (6 years–puberty) and *genital stage* (puberty–early adulthood). In defining these stages, Freud used the term ‘sex’ very broadly to refer to something that was ‘physically pleasurable’ rather than something specifically sexual or involving sexual activity. He believed that as we progress through the psychosexual stages, different parts of the body become the focus of our attention and pleasure. In addition, each stage has a crucial developmental conflict that must be satisfactorily resolved in order to move on to the next stage. When a conflict is not resolved, this can be a source of anxiety. In his psychodynamic model, Freud described *anxiety* as an uncomfortable or unpleasant psychological feeling that often arises from the fear that our instincts will make us do something we will be punished for. Usually, we protect ourselves against anxiety by using defence mechanisms. Freud used the term **defence mechanism** to describe the unconscious process by which the conscious part of our mind, called the ego, ‘defends’ or protects itself against anxiety arising from unresolved internal conflicts. Freud proposed that defence mechanisms reduce anxiety by denying, falsifying or distorting reality at an unconscious level. In using defence mechanisms, the ego interprets events in a way that denies or changes reality so that we can believe there is no need to feel anxious or ‘psychologically uneasy’. But it is not as if we say ‘I’m feeling anxious. I had better project my hostile feelings onto someone else and reduce my anxiety’! According to the psychodynamic model, we are usually not aware that we are using defence mechanisms.

In the early 1900s, Freud first proposed a psychodynamic explanation of how a specific phobia develops. Although other psychodynamic theorists have proposed alternative views, Freud’s is the most commonly described explanation. According to Freud, a specific phobia, which he called *anxiety hysteria*, develops as a consequence of an unresolved Oedipal complex.

The **Oedipal complex**, as described by Freud, is a developmental conflict that emerges during the phallic (third) stage of psychosexual development (4–5 years), and describes the unconscious, powerful, passionate love and desire that the male child has developed toward his mother. The term ‘Oedipal complex’ is now used to describe the desire of either a male or female child to ‘possess’ the opposite-sex parent and ‘eliminate’ the same-sex parent. Freud described this desire as unconscious because the boy is not ‘consciously aware’ of it. Soon after developing their desire, the boy begins to fear that his father, who is bigger and more powerful than he is, will become aware of his son’s desire for his mother and punish him. The boy believes that his punishment will take the form of castration; that is, cutting off his male sex organ. As a consequence, the boy experiences *castration anxiety*—a fear that he will be ‘emasculated’ by his father as a punishment for having desire for his mother.

According to Freud, in order to successfully resolve the Oedipal complex, the male child uses the defence mechanism called *repression* to prevent the socially unacceptable desire for his mother, and the anxiety accompanying this desire, from entering conscious awareness. It also results in the boy *identifying* with his father. This means that the male child comes to act, think and feel as if he were his father. The boy thinks that if his father sees him as ‘similar’ to himself, he will not feel hostile towards him and want to castrate him. When repression does not work, and the Oedipal complex therefore remains unresolved, another type of defence mechanism called displacement will be used to try to resolve the conflict. **Displacement** involves directing feelings away from the object or person that causes them to a substitute object or person that is less threatening. This means that the anxiety caused by the unresolved Oedipal complex is displaced, or ‘redirected’, onto a seemingly unimportant, irrelevant object or situation, which then becomes the phobic stimulus. The male child can then deal with their unresolved conflict and the anxiety associated with it by avoiding the phobic stimulus. According to Freud’s psychodynamic model, the phobic stimulus is related to and ‘symbolises’ the male child’s unconscious desire for their mother. Therefore, any feared object or situation associated with a specific phobia symbolises the source of an unresolved Oedipal complex and triggers anxiety.

Freud (1909) first explained his ideas about how specific phobias develop in a case study called ‘Analysis of a phobia in a five-year-old boy’. In this case study, Freud explained how an unresolved Oedipal complex accounted for a specific phobia of horses (equinophobia) developed by a young

Figure 13.8 Freud's 'Little Hans' revealed as an adult that he was Herbert 'Hans' Graf (second from right), a successful opera producer. However, it is unknown whether Herbert had retained the specific phobia for horses he developed when he was four years old.

'patient' he referred to as 'Little Hans'. One day, Little Hans saw a horse that was pulling a carriage fall over and kick its feet in the air. This was terrifying to Little Hans, especially as he thought that the horse had died. After this incident, Little Hans remained terrified of horses, particularly any horse with blinkers and a black harness over its nose. He refused to leave the house and go into the street for fear of 'being bitten by a horse'. As Little Hans explained to Freud, 'When the horse fell down it gave me such a fright really; that was when I got the nonsense'. The incident was Little Hans's explanation of when he developed his phobia and his use of the word 'nonsense' referred to his description of the phobic symptoms he experienced after the incident. In Freud's view, this incident only had the effect it did on Little Hans because 'horses had formerly been of importance to him' (1909). Freud therefore looked beyond the incident and sought an explanation in terms of an unconscious conflict and the meanings of symbols in the incident.

According to Freud, Little Hans developed a specific phobia because he was struggling to resolve his Oedipal complex. Freud believed that, at the time of the incident, Little Hans was experiencing powerful, passionate love and desire towards his mother and consequently feared punishment from his father. The punishment was symbolised by his fear that horses would 'bite' him. Because the defence mechanism of repression had proved ineffective to prevent the anxiety associated with his socially unacceptable feelings

"Er...Nice tattoo, Oedipus."

Figure 13.9

and thoughts, Little Hans used displacement instead. Through the use of displacement, Little Hans created a phobic stimulus that could be avoided and thereby reduce his anxiety. Little Hans did this by redirecting ('displacing') his fear of his father onto horses (which symbolised, or reminded him, of his father). For example, the blinkers worn by horses reminded Little Hans of his father's thick-rimmed glasses, horses reminded him of playing 'horsie' with his father by riding on his father's back, and the black harness around the horse's nose symbolised his father's black beard and moustache. Furthermore, Little Hans's father recalled an unusual comment made by his son shortly after Little Hans's only interview with Freud—'Daddy, don't trot away from me!'

Behavioural model

According to the **behavioural model**, phobias are learned through experience and may be acquired, maintained or modified by environmental consequences such as rewards and punishment. Traditional behavioural models are based on the learning theories of Pavlov, Watson and Skinner. It should therefore not be surprising that behavioural models assume that phobias—like most other 'abnormal', or dysfunctional, ways of thinking, feeling and behaving—are learned through classical and operant conditioning processes in much the same way as 'normal' ways of thinking, feeling and behaving are learned. Generally, explanations of phobias by behavioural models propose that classical conditioning processes play a role in the *acquisition* (or development) of a specific phobia and operant conditioning processes play a role in the *persistence* (or maintenance) of specific phobia.

Watson's controversial experiment with 'Little Albert', reported in 1920, was among the earliest demonstrations that specific phobias can be acquired through classical conditioning. Watson conditioned the 11-month-old infant to be terrified of a white rat (initially a neutral stimulus that did not produce anxiety or fear) through repeated association with an unpleasant loud noise (an aversive unconditioned stimulus). Little Albert's fear had become a conditioned response to a conditioned stimulus (the white rat). In addition, the fear generalised to other superficially similar stimuli, leading him to burst into tears at the sight of a rabbit, a dog, a Santa Claus mask and even a white fur coat.

Figure 13.10 Some people acquire a spider phobia through classical conditioning.

Since Watson's experiment on Little Albert, classical conditioning processes have been used to explain the acquisition of all types of specific phobias. For example, in much the same way as Little Albert acquired a phobia of white rats, 23-year-old Sam became extremely frightened of spiders (arachnophobia) when he unexpectedly came across a spider while playing in the sandpit in his backyard when he was four years old. Since then, Sam has never intentionally gone near any sandpit and will not even go to the beach for fear that there may be a spider in the sand. He also avoids any other situation in which there may be a spider, even if the spider is likely to be harmless, fake or dead. For example, Sam will never read a book or watch a documentary about spiders. Nor will he watch any movie if he believes there is any chance whatsoever of a spider appearing. In effect, Sam developed a conditioned response (fear) to a conditioned stimulus (the spider) that has been generalised to similar stimuli—any spider. Many people feel anxious around spiders, but Sam's fear is disproportional to any actual risk and his fear has imposed unwanted restrictions on his life.

After acquisition through classical conditioning, the phobia is typically maintained though operant conditioning. Sam begins to avoid the fear- and anxiety-producing phobic stimulus (spiders), because avoiding the stimulus reduces the unpleasant feelings of fear and anxiety (negative reinforcement). This is shown in figure 13.11.

Consider also the case of 32-year-old Hayley who has claustrophobia (a fear of small and enclosed spaces) and has started a new job on the fifth floor of an office building. Hayley uses the stairs to get to her office in order to avoid the terrifying experience of being in the lift. Using the stairs reduces the unpleasant feelings of fear and anxiety (negative reinforcement) and increases the likelihood that her avoidance behaviour of using the stairs will occur again. In this way, the operant conditioning process of negative reinforcement is contributing to the persistence of her avoidance behaviour and therefore her phobic response.

Operant conditioning can also contribute to the acquisition of a phobia. For example, consider the experience of eight-year-old Samir when on a camping holiday with his parents. One day, Samir and his parents went for a walk and came across a small lake. Samir ‘saw something moving’ in the lake and reacted with terror. He started crying, screaming and shaking all over. Samir’s parents promptly reassured, hugged and kissed him. In addition, to help him ‘feel better’, Samir’s father gave him a piggy-back all the way back to their cabin and then drove him into town to buy Samir his favourite chocolate ice-cream. Although well-intentioned, Samir’s parents may have inadvertently provided positive reinforcement for his fear response in the form of reassurance, kisses, hugs, a piggy-back and a chocolate ice-cream. The positive reinforcement could therefore strengthen Samir’s fear response or increase the likelihood that he behaves fearfully the next time he encounters a lake or body of water.

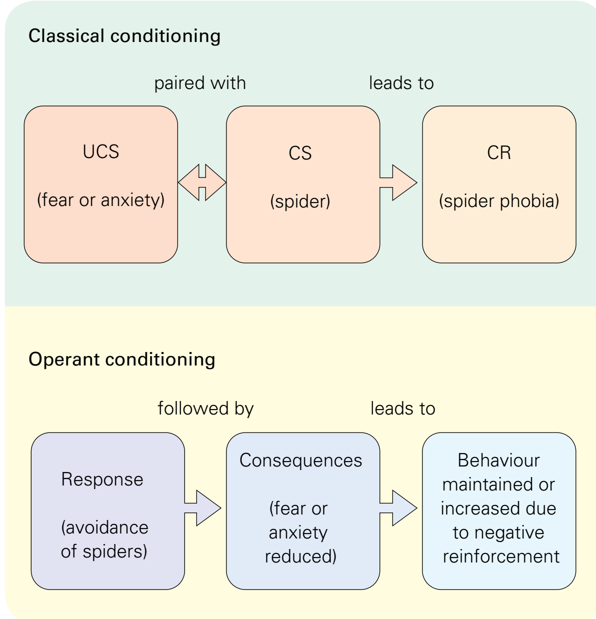


Figure 13.11 Explaining Sam’s spider phobia from the perspective of behavioural models. Sam’s phobia was acquired through classical conditioning and is maintained through operant conditioning.

Box 13.5

The Fear of Spiders Questionnaire (FSQ)

Clinical psychologists can use a variety of measures for assessing the severity of a client’s specific phobia. An example is the Fear of Spiders Questionnaire (FSQ) developed by American psychologists Jeff Szymanski and William O’Donohue (1995). The FSQ is a self-report questionnaire requiring responses to 18 statements. Sample items from the FSQ include:

- If I came across a spider now, I would get help from someone else to remove it.
- Currently, I am sometimes on the lookout for spiders.
- If I saw a spider now, I would think it will harm me.
- I now think a lot about spiders.
- I would be somewhat afraid to enter a room now, where I have seen a spider before.
- I now would do anything to try to avoid a spider.
- If I encountered a spider now, I wouldn’t be able to deal effectively with it.
- If I came across a spider now, I would leave the room.
- If I saw a spider now, I would think it will try to jump on me.
- If I saw a spider now, I would feel very panicky.

Source: Szymanski, J., & O’Donohue, W. (1995). Fear of spiders questionnaire. *Journal of Behaviour Therapy and Experimental Psychiatry, 26*(1), 31–34.

Learning Activity 13.3

Review questions

1. What two key assumptions does the psychodynamic model make in explaining the development of specific phobia and other mental disorders?
2. **a** What is the Oedipal complex?
   b Use a simple flow chart to explain why the Oedipal complex occurs.
3. How does Freud's psychodynamic model explain the development of a specific phobia?
4. According to Freud, why did and how did Little Hans develop a phobia of horses?
5. To what extent does the psychodynamic model account for the development of phobias by girls?
6. What key assumption does the behavioural model make in explaining the development of specific phobia and other mental disorders?
7. Explain how a specific phobia may be acquired through classical conditioning processes with reference to a diagram and an example not used in the text.
8. Explain how a specific phobia may be acquired and maintained through operant conditioning processes with reference to a diagram and an example not used in the text.

Learning Activity 13.4

Visual presentation on Little Albert's and Little Hans's specific phobias

Draw flow charts to compare and contrast the psychodynamic and behavioural explanations of how Little Hans and Little Albert may have developed their respective phobias. There should be four flow charts, organised in pairs, as follows:

- Little Hans: two flow charts, one summarising how his phobia developed through psychodynamic processes and the other how it developed through classical conditioning processes and was maintained through operant conditioning processes
- Little Albert: two flow charts, one summarising how his phobia developed through psychodynamic processes and the other how it developed through classical conditioning processes and was maintained through operant conditioning processes.

Cognitive model

In explaining how a specific phobia may be acquired and persist, a **cognitive model** focuses on how the individual processes information about the phobic stimulus and related events. For example, explanations of phobias from a cognitive perspective tend to examine how people with phobias tend to think about a phobic stimulus and its context, and their perceptions, memories, beliefs, attitudes, biases, appraisals, expectations and other cognitive processes that may be relevant. While there is recognition of the role of conditioning and other types of learning in the development and persistence of a phobia, cognitive models emphasise how and why people with a phobia have an unreasonable and excessive fear of a phobic stimulus.

A key assumption of many cognitive models is that people with a specific phobia often have one or more cognitive biases. A **cognitive bias** is a tendency to think in a way that involves errors of judgment and faulty decision-making. Essentially, a cognitive bias involves a 'mistake in thinking', which is why it is also sometimes referred to as a *cognitive distortion* (Johnston, 2004). Cognitive biases can be habitual ways of thinking and therefore make someone more prone or vulnerable to experiencing fear and anxiety in response to a phobic stimulus. Several different types of cognitive bias have been identified as being associated with the development and/or persistence of specific phobias. These include *attentional bias*, *memory bias*, *interpretive bias* and *catastrophic thinking*.

Attentional bias

In relation to phobias, **attentional bias** is the tendency to selectively attend to threat-related stimuli rather than to neutral stimuli. This means that someone with a specific phobia tends to pay greater attention to threatening information ('signs of danger') in their external environment, while ignoring non-threatening information ('signs of safety'). For example, someone with a phobia of horses will notice a horse walking towards them but not the farmer behind the horse carrying hay, and someone with a spider phobia will often be the first or only person to see a spiderweb in a room, whereas people without a spider phobia fail to notice it. People with phobias also tend to be *hypervigilant*; that is, they are always alert and constantly looking around for something relevant to their phobia that may be potentially threatening (Eliasz, Hampson & de Raad, 2005). This is like having a radar specifically set to pick up information in the environment relating to the specific phobia. For example, when reading a newspaper, someone with a phobia of flying will notice the small print referring to 'near misses', engine trouble or the difficulties pilots experience in fog. This 'hypervigilance' is not helpful and maintains symptoms.

Memory bias

People with phobias may also have a specific type of memory bias, sometimes referred to as 'selective memory'. In relation to phobias, **memory bias** occurs when recall or recognition is better for negative or threatening information than for positive or neutral information. For example, a person with a phobia of horses will tend to remember the one and only time they were chased by a horse but forget all of the other times when horses showed no response to their presence. Similarly, someone with a spider phobia will tend to reconstruct their memory of a past experience with a spider in a way that describes it as bigger, faster or more frightening than it actually was (Eliasz, Hampson & de Raad, 2005).

Interpretive bias

In relation to phobias, **interpretive bias**, also called *judgmental bias,* is the tendency to interpret or judge ambiguous stimuli and situations in a threatening manner. For example, a person may interpret a piece of fluff on the carpet as being a spider or tomato sauce as blood, depending on their specific phobia.

Research studies provide evidence that anxious children are judgmentally biased toward interpreting the presence of threat when there is none or when the situation is ambiguous. In one series of studies, children and adolescents heard or read homophones (words that sound alike but have different meanings and sometimes spellings). The particular words in these studies (for example, 'whipping' and 'hang') each had a threatening meaning and a non-threatening one. When asked to indicate the meaning of each word, the anxious children and adolescents were more likely than their non-anxious peers to go with the threatening option (Foa & Wasner Andrews, 2006).

Catastrophic thinking

Catastrophic thinking is a type of negative thinking in which an object or event is perceived as being far more threatening, dangerous or insufferable than it really is and will result in the worst possible outcome. For example, a person with a dog phobia may think that any dog they encounter will attack them and leave them with permanent facial disfigurement or a person with a fear of driving may think that if they get into a car they will definitely have a crash and die. When catastrophic thinking occurs, individuals experience heightened feelings of helplessness and grossly *underestimate* their ability to cope with the situation. For example, a person may think 'if this rat turns towards me, there is nothing I can do to stop it biting me'. Equally, they may believe that they will be completely unable to cope with the symptoms of anxiety they may experience. For example, 'if I faint, I may never regain consciousness'.

Figure 13.12 Some people with claustrophobia engage in catastrophic thinking and imagine the worst possible outcome when confronted by a phobic stimulus; for example, 'If I get into that lift, I will suffocate and die'.

Learning Activity 13.5

Review questions

1. What is the focus or emphasis of cognitive models in explaining the development and persistence of a specific phobia?
2. What are cognitive biases?
3. Name, define and explain three types of cognitive biases that are associated with specific phobias. Give an example of each type of bias, other than an example used in the text.
4. Briefly compare and contrast the cognitive, psychodynamic and behavioural models for explaining phobias, referring only to key assumptions.

Socio-cultural contributing factors

Many different socio-cultural factors may contribute to an individual developing a phobia. Three of the most common contributing factors have been identified by Canadian psychologist Stanley Rachman (1977). These factors are referred to as *specific environmental triggers* (developing a phobia after a direct negative experience with an object or situation), *parental modelling* (observing and reproducing a parent's fear of an object or situation) and *transmission of threat information* (exposure to negative or frightening information about an object or situation). Specific environmental triggers involve *direct* ('firsthand') experience with a phobic stimulus at some time in the past, whereas modelling and transmission of threat information involve *indirect* ('secondhand') experience.

Specific environmental triggers

Many people diagnosed with a specific phobia report having a negative and traumatic experience with a particular phobic stimulus at some time in the past and attribute this specific encounter as the cause of their phobia. For example, a phobia of dogs may result from being bitten by a neighbourhood dog, a phobia of heights after a ride on a ferris wheel on a windy day, a phobia of injections after unexpected pain when immunised at school or a phobia of driving after a serious car accident. These 'specific' objects or situations in the 'environment' produced, or 'triggered', an extreme fear response at the time, hence the use of the term **specific environmental trigger** to describe this type of factor contributing to the development of a phobia.

Often, an initial fear response to a specific environmental trigger becomes a conditioned fear response through classical conditioning processes and is produced whenever the specific stimulus (or a generalised version) is subsequently encountered. For example, 17-year-old Van has had an extreme fear of dogs ever since he was bitten by a neighbour's poodle when he was five years old. Van will not even go shopping at the local milkbar because it is next to a pet shop, which often displays pups for sale in the front window. In effect, Van developed a conditioned response (fear) to a conditioned stimulus (the poodle) that has been generalised to similar stimuli—any dog.

Research findings indicate that the more severe the trauma associated with an unpleasant or harmful initial fear experience, the more likely it is that a phobia will develop. In addition, if the experience is sufficiently traumatic, one encounter may be enough to produce and maintain the fear response. For example, a single experience of being bitten by a dog might be sufficient to produce and maintain a dog phobia even if never bitten again, whereas barking might not lead to a dog phobia until after a number of subsequent exposures to a barking dog (Beck, 1976).

People who develop a phobia after a single traumatic encounter with a phobic stimulus (that is, a specific environmental trigger) are usually able to identify that particular traumatic event as causing their phobia. For example, an eight-year-old child developed a strong fear and fainting reaction that was triggered by hospitals, doctors and smells of anesthesia after he had a very serious operation, and a 23-year-old woman with a phobia of high places developed her phobia when she fell from a high diving board and seriously injured herself (Sue, Sue & Sue, 2009).

A single traumatic experience does not explain the origin of all phobias through direct experience. It is possible that two individuals may have a traumatic experience with the same object or situation and one subsequently develops a specific phobia while the other does not. This indicates that the development or onset of specific phobias is not necessarily explained by one event or factor alone. One reason is each individual's prior experience.

Figure 13.13 American actress Jennifer Aniston developed aerophobia (fear of flying) after flying during an electrical storm. Although she has now managed to overcome her fear, she reports that she still gets nervous every time she has to board a plane.

For example, an individual who has grown up with dogs may be less likely to develop a phobia of dogs after being bitten, compared to an individual who is bitten the very first time they ever encounter a dog. A second factor involves subsequent exposure to the object or situation after the negative or traumatic experience occurs. For example, an individual who resumes driving as soon as possible after a car accident will be less likely to develop a phobia of driving than someone who avoids driving for a period of time after the accident.

Parental modelling

Observational learning, or modelling, can also be involved in the development of phobias. In relation to phobias, specific phobias can develop through observation and subsequent modelling of another person's fearful behaviour towards a particular object or situation. For example, a child who observes a parent react with sheer panic to the sight of a spider or mouse may imitate the same behavioural response. Similarly, hearing parents discussing their fear of a specific object or situation may be sufficient for observational learning and modelling of a phobia.

Children are most vulnerable to developing specific phobias via *parental modelling* (that is, modelling the behaviour of either parent or both parents) as they do not have knowledge or experience or know whether their parents' behaviour is appropriate or rational. For instance, Australian psychologist Neville King and his colleagues (1997) asked the parents of 30 children (mean age five years) with a dog phobia to indicate the most influential factor in the onset of their child's phobia. More than half the parents rated parental modelling to be the major factor in the acquisition of their child's phobia. Many of the parents themselves reported being afraid of dogs since childhood and being still 'nervous' around dogs. Therefore, parents who, in the presence of their children, react fearfully at the sight of a mouse or shudder at the sound of a thunderclap are likely to be unintentionally contributing to the learning of their observant and impressionable children. Fears developed through observational learning can be as strong as fears developed through direct experience, although direct experience seems to be the most common pathway to a phobia (Kleinknecht, 1994; Öst, 1992).

Figure 13.14 This child has an exaggerated fear of injections, acquired through parental modelling. Note the apparent anxiety experienced by her mother.

Parents can help prevent excessive fears developing in their children by modelling 'bravery' and other positive methods for coping with fears. For example, if a child has witnessed a parent acting fearfully in a response to phobic stimulus, the parent could reassure the child that they are actually fine, or a different relative could demonstrate that they are not fearful of the stimulus. The parent could also engage in positive modelling, such as playfully engaging with a dog after their child has witnessed someone acting fearfully during an encounter.

Box 13.6

Observational learning of phobias by monkeys

In a study on observational learning and the development of phobias, American psychologists Michael Cook and Susan Mineka (1989) showed videotapes to four groups of laboratory-bred rhesus monkeys. The tapes featured another monkey apparently experiencing extreme fear of a toy snake, a toy crocodile, a toy rabbit and images of flowers. Monkeys that saw these fear reactions were later afraid of the toy snake and toy crocodile but did not acquire a fear response to the toy rabbit or flowers.

These findings suggest that phobias may be acquired through observational learning. However, the fact that the monkeys only developed fear of the snake and crocodile also suggests that monkeys may have a biological (genetic) predisposition to acquire fears of certain animals that represent natural threats to their survival.

Prominent American psychologist Martin Seligman (1971) has proposed that humans may also be biologically predisposed to develop fears of certain objects and situations (such as snakes, spiders and heights) that may have once posed a threat to our survival. According to Seligman, this may account for the fact that extreme irrational fears of snakes, spiders, heights and small enclosed spaces are relatively common, whereas few people have phobias of stairs, ladders, electrical outlets or appliances, even though these objects are more likely to be associated with a traumatic experience or harm.

More recently, other psychologists have proposed that humans may also be biologically predisposed to develop phobias towards creatures that arouse disgust, such as slugs, maggots and cockroaches. This is believed to occur because these types of creatures are associated with disease, infection or filth, and therefore represent a threat to our survival through contamination or infection (Hockenbury & Hockenbury, 2006).

Figure 13.15 One of the monkeys in Cook and Mineka's experiment, showing extreme fear of a snake.

Transmission of threat information

Most people who have a phobia of flying have never been in a plane crash, yet fear of flying is one of the more common specific phobias. Similarly, most children have never had an encounter with an intruder after going to bed, yet such an encounter is a common night-time fear during childhood. Research findings indicate that some people develop phobias and fears through the acquisition of negative information from people and/or the media that a specific object or situation poses a threat to their personal wellbeing and should therefore be avoided.

Transmission of threat information refers to the delivery of information from parents, other family members, peers, teachers, the media and other secondary sources about the potential threat or actual danger of a particular object or situation.

Media reports include information in print media such as books, newspapers, and magazines, and electronic media such as television, movies and the internet (see box 13.7). For example, a child can develop a specific insect or animal phobia if their parents repeatedly warn them about the danger of certain insects or animals. And someone may develop a flying phobia after watching graphic TV coverage of a plane crash or after hearing friends talk about their fear of flying and their reasons, such as 'planes are no longer safe'.

In one research study on fear development, Neville King and his American colleague Thomas Ollendick (1991) devised a questionnaire to identify 'pathways' for the development of ten fears prevalent among children. The questionnaire was administered to 1092 Australian and American school children aged nine to 14 years. The results indicated that exposure to negative information was the most common pathway to fear: 89% of the participants reported that that they had been exposed to informational sources of fear, such as TV, newspapers and so on. In another study, King and his colleagues presented 285 children, aged four to 13 years, with either negative or positive information about a fictitious dog-like animal called 'the beast'. Their results indicated that the type of information to which the children were exposed influenced their fear of the beast. Negative information was associated with a high level of fear and positive information was associated with a low level of fear. Furthermore, fear of the beast appeared to generalise to similar stimuli. That is, children who became more fearful of the beast after receiving negative information also became more apprehensive of other dogs (Muris & others, 2003).

Figure 13.16 A child who receives repeated threat information about dogs from their parents may go on to develop a phobia of dogs. If a child is presented with positive information by their parents, they will usually experience a low level of fear.

Box 13.7

Transmission of threat information by movies

Research studies have found that movies watched during childhood and adolescence may have a lingering effect, even to the point of causing a long-lasting anxiety or phobia. Many people who watched certain movies as children can trace their fear of sharks, snakes, insects or blood back to specific movies and scenes that have left a lasting impression.

For example, in a study conducted by American psychologists Kristen Harrison and Joanne Cantor, it was found that more than 90% of the 150 university students they interviewed reported a 'fright reaction' from a movie seen in childhood or adolescence. About 26% reported that they were still experiencing 'fright effects', which for some participants included a continuing avoidance of the objects or situations portrayed in the movies. The movies recalled by the participants in the study included *Jaws* (sharks), *The Birds* (birds), *It* (clowns), *Anaconda* (snakes), *Arachnophobia* (spiders) and *Raiders of The Lost Ark* (snakes).

Figure 13.17 Research participants who saw *Jaws* (1975) reported that they were adversely affected by it and for some time afterward thought twice about swimming in the sea.

Box 13.8

The Dental Anxiety Scale—revised (DAS)

The Dental Anxiety Scale (DAS) (1969) was developed by American psychologist Norman Corah, a recognised authority on measuring, evaluating and treating stress related to dental care. The scale, used by researchers and dental practitioners worldwide, is designed to specifically measure the levels of anxiety individuals experience when faced with a trip to the dentist. The Dental Anxiety Scale consists of four multiple-choice questions.

1 If you had to go to the dentist tomorrow for a check-up, how would you feel about it?
   - A I would look forward to it as a reasonably enjoyable experience.
   - B I wouldn't care one way or the other.
   - C I would be a little uneasy about it.
   - D I would be afraid that it would be unpleasant and painful.
   - E I would be very frightened of what the dentist would do.

2 When you are waiting in the dentist's office for your turn in the chair, how do you feel?
   - A relaxed
   - B a little uneasy
   - C tense
   - D anxious
   - E so anxious that I sometimes break out in a sweat or almost feel physically sick

3 When you are in the dentist's chair waiting while the dentist gets the drill ready to begin working on your teeth, how do you feel?
   - A relaxed
   - B a little uneasy
   - C tense
   - D anxious
   - E so anxious that I sometimes break out in a sweat or almost feel physically sick

4 Imagine you are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist or hygienist is getting out the instruments that will be used to scrape your teeth around the gums, how do you feel?
   - A relaxed
   - B a little uneasy
   - C tense
   - D anxious
   - E so anxious that I sometimes break out in a sweat or almost feel physically sick

Scoring the DAS

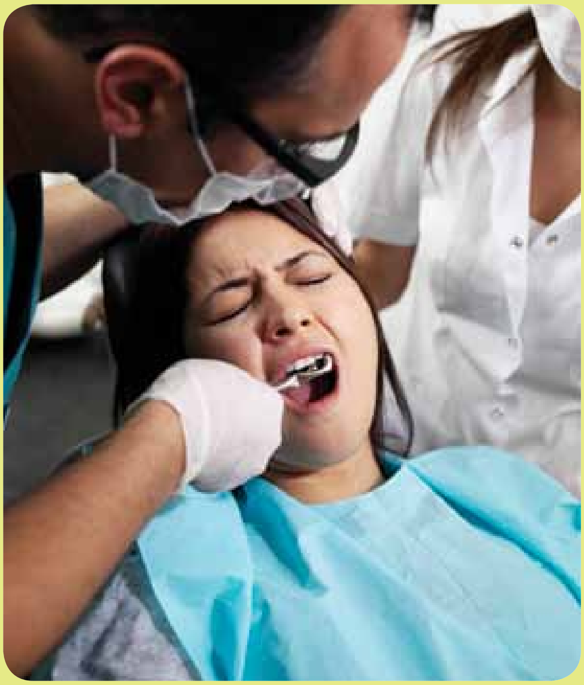
A = 1, B = 2, C = 3, D = 4, E = 5
(total possible = 20)

Anxiety rating:

- 9–12 = moderate anxiety
- 13–14 = high anxiety
- 15–20 = severe anxiety (or dental phobia); might require the help of a mental health professional

In 1969, Corah reported that he had administered the scale to five people with diagnosed dental phobias and a sample of 1232 female university students. The people with dental phobias achieved scores ranging from 17 to 20, whereas the mean score of the university students was 8.89.

Source: Corah, N.L. (1969). Development of a dental anxiety scale. *Journal of Dental Research, 48*(4), 596.



Learning Activity 13.6

Summarising socio-cultural contributing factors

Complete the following table to summarise socio-cultural factors that may contribute to the development of a specific phobia.

Socio-cultural factor	Definition	Explanation	Example
Specific environmental triggers			
Parental modelling			
Transmission of threat information			

Learning Activity 13.7

Media response on the transmission of threat information by movies

Box 13.7 gives examples of movies that transmit threat information and may therefore contribute to the development of a specific phobia. Watch one of these movies, or another similar movie featuring a potential phobic stimulus, and write a report in which you provide the following information:

1. State the name of the movie and year of release.
2. Write a brief summary of the plot.
3. What is the potential phobic stimulus?
4. What 'threat information' is transmitted by the movie about the potential phobic stimulus? (For example, what 'messages' does *Jaws* give about sharks?) List the threat information under the categories 'Subtle' and 'Obvious' and give five specific examples of scenes in the movie.
5. Comment on the accuracy of the threat information transmitted in the movie about the phobic stimulus.
6. Explain how watching this movie could contribute to the development of a specific phobia, ensuring that you refer to relevant theory and examples in the movie.

Learning Activity 13.8

Research investigation on specific phobias

This research investigation involves conducting a survey to collect self-reports on the prevalence of phobias and specific contributory factors among a research sample of interest.

Data may be collected using the questionnaire on the next page or a modified version. The data collected will be combined to form class results. The population, sample and sampling procedure should be determined through a class discussion. Once these have been decided, construct two research hypotheses based on theory and/or research findings described in the text. The hypotheses used for the investigation can be constructed independently, by small groups or by the class.

Each participant should receive a copy of the questionnaire and a briefing statement. The briefing statement should be completed as a small group or class exercise and should describe what the research investigation is about, what it requires of participants and how the results will be used. The questionnaire should also record relevant participant variables, such as age group and sex.

All participants should be volunteers, give informed consent and complete the questionnaire anonymously. Ensure all other relevant ethical guidelines are followed.

Sample questionnaire

A specific phobia is an intense fear of a specific object or situation. Examples of specific objects or situations include flying, heights, animals, receiving an injection or seeing blood. When a person has a specific phobia and they are exposed to their feared object or situation, they experience intense anxiety. Intense anxiety can include symptoms such as rapid heartbeat, chest pain, sweating, feelings of choking and shaking. The person also goes to great lengths to avoid coming into contact with their feared object or situation. For example, a person with claustrophobia may walk up ten flights of stairs (in order to avoid going into a lift) and a person with a specific phobia of dogs may walk the 'long way around' to get somewhere (in order to avoid a dog on the shortest route).

1 After reading the definition of a specific phobia above, do you believe that you have a specific phobia? Yes/No (please circle)
If No, thank you for your time.
If Yes, continue to Question 2.

2 My specific phobia is of ______________________________

3 The situation that would make me feel most frightened is ______________________________
____
____

4 My earliest memory of a bad or frightening experience relevant to my phobia is when I was __________ years old and it involved ______________________________
____
____

5 At some time in the past, my parents have shown extreme fear of ______________________________
____

6 I have heard or seen frightening things relating to my phobia from:
☐ a parent
☐ a teacher
☐ a friend
☐ television
☐ movies
☐ magazines or newspapers
☐ other ______________________

Please tick one or more.

Report

Prepare a report on the research investigation. Your report should include:

1 a statement of the aim of the investigation
2 the research hypotheses
3 a summary of the results using appropriate descriptive statistics
4 a conclusion(s) based on the results and referring to the hypothesis
5 a potential limitation that may have affected the results in an unwanted way
6 other relevant information that may be requested by your teacher.

Psychological management of specific phobias

For some people, a specific phobia can cause major disruptions to their everyday lives because they have to go to great lengths to avoid the object or situation that triggers their anxiety. For example, a tradesperson may avoid taking jobs in high places due to their fear of heights, an executive may have to turn down a promotion involving overseas travel because of their fear of flying and someone who works on the 30th floor of a city office building may have to walk up and down the stairs each day due to an intense fear of being in enclosed and small places. Similarly, people whose phobias are focused on everyday objects or situations will continually encounter them, so phobic anxiety and avoidance may become central to their lives. However, if the phobic stimulus is rarely encountered, it will not continually interfere with the person's functioning or cause distress, so in these instances, the person is not likely to seek professional help. For example, a person might have a fear of being buried alive (taphephobia) but this situation is very unlikely to be encountered and is therefore not likely to cause disruption to a person's life.

People typically only seek help in the form of therapy by a mental health professional if the phobic stimulus is frequently encountered or cannot be avoided. Some of the therapies available include *cognitive behavioural therapy (CBT)*, and the exclusively behavioural approaches called *systematic desensitisation* and *flooding*.

Cognitive behavioural therapy (CBT)

In response to certain stimuli, people with specific phobias have cognitive biases and exaggerated behavioural reactions, so a commonly used therapeutic approach involves altering the thoughts and behaviours that maintain their phobia. This type of approach is called cognitive behavioural therapy. As the name suggests, **cognitive behavioural therapy**, commonly referred to as CBT, combines cognitive and behavioural therapies to help people manage mental health problems and disorders.

Cognitive therapy is a type of 'talking therapy' that focuses on the role of 'cognitions' (thoughts, beliefs and attitudes) in determining emotions and behaviour. The therapist is interested in how people think about and create meaning about situations, symptoms and events in their lives and develop beliefs about themselves, others and the world. Cognitive therapy uses techniques to help people become more aware of how they reason, and the kinds of 'automatic thoughts' that spring to mind and give meaning to things. Cognitive therapy is based on the idea that certain maladaptive beliefs and ways of thinking can trigger, or 'fuel', mental health problems and disorders.

Behavioural therapy is the clinical application of learning theories, such as classical and operant conditioning, which have been described by 'behaviourists' such as Pavlov, Watson and Skinner. While cognitive therapy deals with maladaptive beliefs and thoughts, behavioural therapy deals directly with maladaptive behaviours such as avoidance and reduced activity levels, which can maintain or worsen a person's psychological problems and the thoughts and feelings associated with them. Unlike cognitive therapy and psycho-dynamic psychotherapy, behavioural therapy is *not* fundamentally a 'talking therapy'. Rather, when using behavioural therapy, the therapist exposes their client to new environmental conditions that are designed to 'retrain' them, so that maladaptive, habitual or reflexive ways of responding become extinguished and new, more adaptive, habits and reflexes are conditioned (Gray, 2007). For example, this might include helping the individual to gradually face feared or avoided situations as a means to reducing anxiety or helping them to gradually increase their activity levels over time.

When using CBT, the emphasis on the 'cognitive' or 'behavioural' component can vary, depending upon the disorder and the symptoms the person reports. For example, there is often more emphasis on the 'behavioural' component when treating obsessive-compulsive disorder (OCD), for which repetitive and uncontrollable actions are a main problem. Conversely, the emphasis may be more on the 'cognitive' component when used to manage mild to moderate major depression. However, if a person has severe major depression and they are virtually inactive, both the 'cognitive' and 'behavioural' components could be equally important.

CBT is based on the assumption that the way people feel and behave is largely a product of the way they think. Therefore, according to the principles of CBT, anyone can change the way they feel and behave by thinking about a situation in a more balanced and helpful way. CBT does not aim to persuade someone that their current way of thinking about an object or situation is wrong, irrational or too negative. Instead, CBT aims to assist the individual to identify where they may have become trapped or stuck in their way of thinking and to assist them to learn and use other ways of thinking about their situation.

Unlike other types of talking therapies, however, CBT does not involve 'talking freely' or dwelling on events in a person's past to gain an insight into their psychological state. It is not a 'lie on the couch' type of therapy. CBT tends to be relatively short-term, structured and focused on the ‘here and now’—that is, how a person’s current thoughts, feelings and behaviours are affecting them *now*. Although CBT recognises that events in a person’s past have shaped the way they currently think and behave, this is not the focus. CBT aims to find solutions on how to change a person’s current thoughts and behaviours so that they can function better now and in the future.

When using CBT, it is essential that, from the outset, the mental health professional clearly explains to their client the difference between thoughts, feelings and behaviour and their interrelationship. This may be achieved using an example such as the one in box 13.9. The mental health professional then encourages the client to challenge thinking patterns that may lead them to experience distressing feelings and engage in unhelpful behaviours. This may be achieved through discussion during therapy sessions.

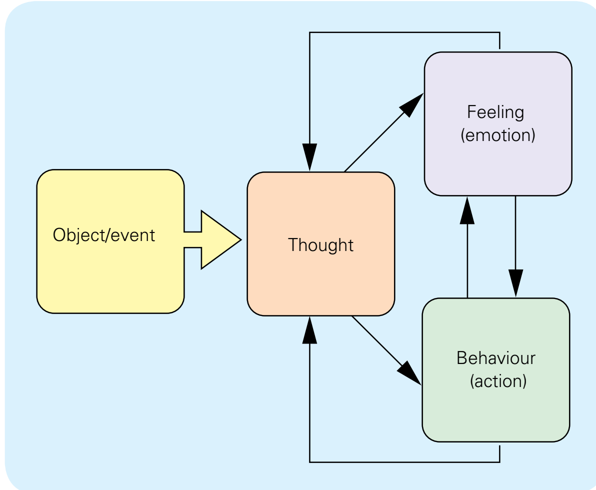


Figure 13.18 A key assumption of CBT is that an object or event encountered in the environment (for example, a phobic stimulus) is initially cognitively appraised or interpreted, which leads to the individual ‘feeling’ and ‘behaving’ in ways that reflect their ‘thinking’. Behaviour may also influence the individual’s emotional response and their emotional response may also influence their behaviour.

Box 13.9

Helping clients understand the difference between thoughts, feelings and behaviour

When using CBT with a client, it is important that, from the beginning, the client has a good understanding of the difference between thoughts, feelings and behaviour and their interrelationship. Examples such as the one below are used to demonstrate that it is not simply what happens to a person that determines how they react emotionally and behaviourally. Rather, it is the meaning that is attached to an experience that leads a person to feel and behave in certain ways.

Consider the following situation. You have had a bad day and feel fed up, so you go out shopping. As you walk down the road, someone you know walks by and, apparently, ignores you.

As shown below, the same situation has led to two very different outcomes, depending on how a person thought about the situation. How they *thought* has affected how they *felt* and what they *did*. In the example in the left column, the person has jumped to a conclusion without very much evidence for it. This matters because it led to a number of uncomfortable feelings and unhelpful behaviour. The person went ‘over and over’ what happened and felt worse. In the right column, the person assumed they were not the cause of the other person’s behaviour, and if they had got in touch with the other person, there’s a good chance they’d have felt better about themself.

	Unhelpful	**Helpful**
Thoughts	They ignored me—they don’t like me	They look a bit wrapped up in themselves —I wonder if there’s something wrong?
Feelings	Low, sad and rejected	Concern for the other person
Behaviour	Go home and go over all past interactions with the person in your mind and try to pinpoint what you might have done to cause them not to like you anymore	Get in touch to make sure they’re okay

The client is taught to identify unhelpful thoughts and how to identify alternative, more helpful and balanced thoughts. To practise this skill, clients are also often required to keep a diary where they record what they think, how they feel and the behaviour associated with these thoughts and feelings. The interconnection between thoughts, feelings and behaviours is shown in figure 13.18.

CBT for specific phobias

In addressing the thoughts underlying a specific phobia, the *cognitive* component of CBT aims to assist the client to develop a new understanding that the feared stimuli is not (or is unlikely to be) dangerous, so their avoidance and safety behaviours are unnecessary.

When using CBT, mental health professionals encourage their client to first identify their fear- and anxiety-related thoughts and their cognitive biases, as these strongly affect whether someone will experience fear and anxiety when exposed to a phobic stimulus. For example, if a person believes that all birds might attack them, it should not be surprising that they will be frightened around birds. It can be quite difficult for some individuals to identify the thoughts they have when they feel anxious. Some even deny having any such thoughts at all. Different mental health professionals take different approaches to helping their client identify their distortions in thinking. Some take an approach called the 'Socratic approach' whereby, through questioning, they help the client to discover their maladaptive thoughts. Others, in contrast, may take a more direct and blunt approach. For example, the well-known American cognitive therapist Albert Ellis frequently gave humorous names to certain styles of maladaptive thinking. For example, the word 'awfulising' in Ellis's vocabulary is similar to catastrophising. A client who states that 'If I look at a bird, it will see the fear in my eyes, fly towards me and attack me' might be told to 'stop awfulising'.

The client is then encouraged to look for evidence that supports their fear cognitions and evidence that does not support them. One way of helping clients to achieve this is to encourage them to think about their thoughts as hypotheses or guesses (rather than facts) that must be subjected to objective evaluation. The assumption is that once these thoughts are recognised as hypotheses and not facts, they are open to questioning and challenging.

Sometimes, a person's cognitive distortions result from a lack of information or from inaccurate information. Therefore, one of the first steps toward changing thoughts can be for the mental health professional to encourage the client to gather accurate information about their phobic stimulus; for example, from experts, books or other reliable sources. Information may also be provided to the client by the mental health professional. For example, a client who is having panic attacks and believes that the panic-like symptoms are signs of an impending heart attack will usually be informed about the physiology of anxiety and fear and how these symptoms relate to cardiac functioning. There are also a number of courses that have an 'education component' and provide accurate information about particular phobic stimuli. For example, fear of flying is often related to misperceptions about the vibrations, movements and sounds heard during the flight. Most of these reflect the normal operation of a flying aeroplane and others reflect aspects of flight that are not at all suggestive of an impending crash. Several airlines, including Qantas, now offer courses for people who are afraid of flying that provide extensive information about all aspects of flying (see box 13.10). Furthermore, fear of spiders is often based on the assumption that all spiders are poisonous and/or aggressive. In fact, only two Australian spider species can give a fatal bite and, when handled in the right way, are unlikely to attack. Several zoological gardens, including the Melbourne Zoo, offer courses for people with arachnophobia that provide accurate information about spiders.

Once the person has identified their cognitive distortions and evaluated the 'evidence', they are then more able to counter them with alternative, more objective and useful, thoughts. For example, if the person thinks that birds are likely to fly away as they approach them (instead of thinking that they are likely to attack them), they are less likely to be afraid or feel compelled to avoid them. Engaging in more balanced and objective thinking about their phobic stimulus will then lead to changes in their feelings and behaviour, particularly a reduction in fear, anxiety and avoidance.

Box 13.10

Qantas Fearless Flyers program

The odds of being in a plane crash are one in 700 000 and the odds of being killed in a plane crash are one in 25 million. Although most people with a phobia of flying (aerophobia) would be unaware of these statistics, many would know that there is a very low likelihood of a plane they are travelling in crashing. Yet this does not reduce their anxiety about flying.

One program to help people overcome aerophobia is called Fearless Flyers. The program is conducted by volunteers in association with Qantas. Fearless Flyers offers courses to help people conquer their fear of flying. Topics covered include:

- understanding the physiology of fear and effective relaxation techniques
- pilots, engineers and cabin crew (their qualifications and training)
- aircraft design, testing and maintenance; what makes an aeroplane fly
- meteorology: turbulence (what causes it and what effect it has on an aircraft); weather forecasting for aviation
- air traffic control and navigation of commercial aircraft
- a comprehensive tour of a jet aircraft on the ground: participants sit in the cockpit with a pilot, who will explain the basics of the flight deck and aircraft controls; tour around the outside of the aircraft with a maintenance engineer; tour of the aircraft cabin with a senior flight attendant

Figure 13.19 A program participant learns about flight safety standards in the air traffic control tower.

- tour of the air traffic control tower; observe air traffic controllers at work and learn about their training
- tour of the flight simulator training facility and the emergency procedures training facility.

At the end of the course, participants graduate with a short flight to a major capital city for the day. To find out more, visit the website at www.fearlessflyers.com.au.

The *behavioural* component of CBT aims to change any behaviours that are maladaptive (that is, not helpful or even harmful). One way a mental health professional using CBT may attempt to reduce or eliminate their client's maladaptive behaviours is by encouraging them to engage in one or more behavioural experiments.

Behavioural experiments are planned experiential ('hands-on') activities that are undertaken by clients in or between cognitive behavioural therapy sessions. Their primary purpose is to help the client 'test out' the accuracy of their cognitive distortions. By using behavioural experiments, clients may come to realise that the likelihood of some terrible catastrophe occurring is in fact exaggerated—but this is something that they may not fully believe until it is put to the test in a behavioural experiment.

The steps involved in setting up a behavioural experiment are similar to the steps involved in carrying out scientific research:

- *Make a prediction*: the client is asked to specify the thought that the experiment will test. For example, 'If I encounter a bee, it will attack me'.
- *Review existing evidence for and against the prediction*: for example, evidence *for* may be 'Africanised honeybees are more aggressive than common honeybees so I could encounter an Africanised bee' and evidence *against* may be 'bees only sting when they are touched or sense a threat'.
- *Devise a specific experiment to test the validity of the prediction*: both the mental heath professional and client must be clear about exactly what the client will do. For example, the mental health professional and client may agree that the client will go somewhere and encounter a bee. But instead of doing what she normally does during a bee encounter (which is to flap her arms, scream and then run away) she will instead stay where she is, stand as still as possible and quietly observe the bee's behaviour. If necessary, the encounter and behavioural response can be role-played.
- *Note the results*: after this behavioural experiment, the client should realise that the bee wasn't concerned about her presence, that it was more interested in looking for pollen than attacking her and was more likely to pay attention to her when she was moving than when she was still.

Figure 13.20 A behavioural experiment may be set up so that someone with a specific phobia will have an encounter with a phobic stimulus (e.g. a bee) but not respond as they usually do (e.g. screaming and running away). Instead, the person must stay and observe the bee's behaviour. This experiment could help challenge the person's belief that all bees are aggressive insects that want to attack anyone nearby.

- *Draw conclusions*: from this experiment, the client may conclude that her beliefs about bees were exaggerated, were partly caused by her reactions to them rather than bees being aggressive insects, and that there is no need to avoid encountering a bee in the future (Bennett-Levy & others, 2004; Butler, 2001).

The behavioural component of CBT may also include the use of *systematic desensitisation* or *flooding*.

Learning Activity 13.9

Review questions

1. Briefly explain what cognitive behavioural therapy (CBT) is.
2. What is the key assumption of CBT?
3. What does CBT *not* aim to do?
4. In what two ways does CBT differ from psychodynamic therapy?
5. Draw a version of the diagram in figure 13.19 to explain how a specific phobia is acquired from the perspective of a mental health professional who uses CBT.
6. From the CBT perspective, explain why escape, avoidance and safety behaviours are *not* helpful to a person with a specific phobia.
7. **a** What is the aim of the cognitive component of CBT?
   b Outline a procedure that may be used to achieve this aim.
8. **a** What is the aim of the behavioural component of CBT?
   b Outline a procedure that may be used to achieve this aim.

Learning Activity 13.10

Visual presentation on CBT

Construct a flow chart that summarises the possible management of a specific phobia using CBT.

Your flow chart should start with an example of a specific phobia, refer to the phobia when summarising the use of CBT and conclude with a statement on how the person who had the phobia may think, feel and behave in relation to the phobic stimuli following a successful intervention.

Systematic desensitisation

Systematic desensitisation is a commonly used and effective form of behavioural therapy and has been used to help people manage their fear of dogs, spiders, snakes, heights, dentists, mice, balloons, feathers, violins, tunnels, needles or eating in public, sometimes in a single session (Kassin, 1995). It was first developed in the 1950s by South African psychiatrist Joseph Wolpe (1958) to successfully 'treat' an adult female client with agoraphobia (fear of open spaces), but the technique has since been modified (Antony & Swinson, 2000).

Systematic desensitisation is a kind of behaviour therapy that aims to replace an anxiety response with a relaxation response when an individual with a specific phobia confronts a fear stimulus. Systematic desensitisation applies classical conditioning principles in a process that involves *unlearning* the connection between anxiety and a specific object or situation and *reassociating* feelings of relaxation (and safety) with that particular object or situation. Generally, the three-step process requires the client to learn to relax while gradually facing increasingly anxiety-producing phobic stimuli. Over time, the person associates being relaxed with their phobic stimuli instead of anxiety. Because it is physiologically impossible to be anxious and relaxed at the same time, the person gradually, or 'systematically', becomes 'desensitised' to anxiety caused by the phobic stimulus.

The first step in systematic desensitisation involves teaching the client a relaxation strategy that they can use to decrease the physiological symptoms of anxiety when confronted by a phobic stimulus. Strategies may include progressive muscle relaxation, visual imagery or the slow breathing technique (SBT). As its name suggests, SBT involves learning to slow down the rate of breathing, either during hyperventilation or, preferably, before its onset. The technique is summarised below:

- hold your breath for six seconds
- breathe in and out on a six-second cycle, saying the word 'relax' as you breathe out
- after one minute, hold your breath again, then continue to breath on a six-second cycle
- repeat the sequence until anxiety has diminished.

The second step in systematic desensitisation involves breaking down the anxiety-arousing object or situation into a sequence arranged from least to most anxiety-producing. This is called a fear hierarchy or an *anxiety hierarchy*. A **fear hierarchy** is a list of feared objects or situations, ranked from least to most anxiety-producing. Working with the therapist, the person identifies different phobic stimuli and constructs a 'stepladder' of anxiety-producing objects and/or situations, with the steps gradually increasing in difficulty (see figure 13.21). Ideally, fear hierarchies should consist of ten to 15 specific situations, each of which is rated and then ranked ('ordered') on a 100-point scale. For example, the least anxiety-producing situation may be rated at 30 on a 100-point scale and the most anxiety-producing situation may be rated at 100. Each situation should be quite detailed, including relevant variables such as time of day, duration of exposure and presence of other people.

The third step involves the systematic graduated pairing of items in the hierarchy with relaxation by working upward through items in the hierarchy, one 'step' at a time. This can be achieved either *in vivo* (in real life) or using *visual imagery* (using imagination) and, more recently, using virtual reality during which computer-generated three-dimensional scenes of the phobic stimulus are viewed using a special motion-sensitive headset, as shown in figure 13.22. At all steps, the person is encouraged to relax and no advancement is made to the next step until relaxation is achieved.

Systematic desensitisation sessions continue until the person is able to master the most anxiety-producing situation in the fear hierarchy in a relaxed state. For example, an anxiety-producing situation such as travelling in a lift could be broken down into a sequence of steps starting with looking at lifts (watching them come and go); standing in a stationary lift with a support person; standing in a stationary lift alone; travelling up or down one floor with a support person then gradually extending the number of floors travelled, first with a support person and then alone with the support person waiting outside the lift; and finally travelling on a lift alone without a support person nearby. The person is asked to visualise the least frightening of the steps while in a relaxed state. If the person can successfully visualise the fear-producing stimulus and remain relaxed, the next step is tackled.

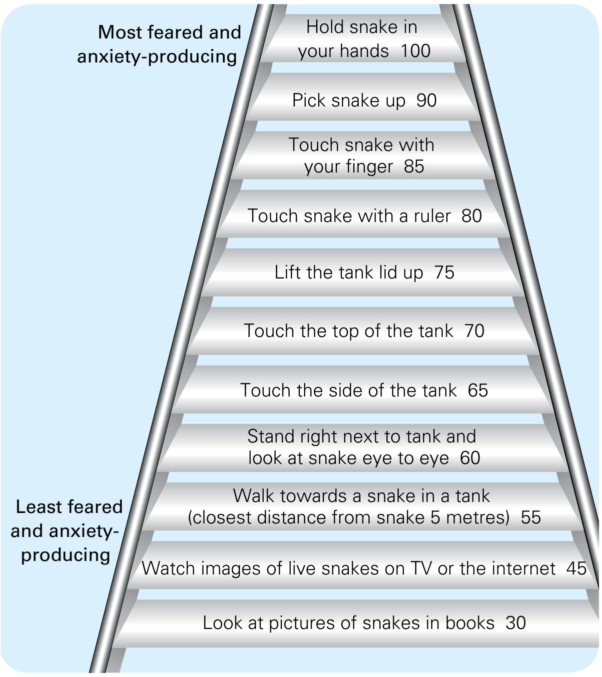


Figure 13.21 Sample fear hierarchy for a snake phobia (ophidiophobia)

Figure 13.22 Virtual reality devices can be used for systematic desensitisation and flooding. A person can be exposed to their phobic stimulus using computer-generated 3D images. The headwear is motion-sensitive, so whenever the person moves their head, the scene they are viewing changes accordingly. A handgrip lets the person use a virtual hand to reach out and touch objects, such as a spider, a snake or a lift button.

Box 13.11

The case of Peter (1924)

Joseph Wolpe is well known for developing systematic desensitisation. However, Wolpe was not the first therapist to use this type of technique. American psychologist Mary Cover Jones had already used a similar technique in treating specific phobias in young children. Jones's best-known work was a case she reported in 1924. This involved the successful treatment of a specific phobia of rabbits and other furry objects in a boy called Peter, which she conducted in consultation with John B. Watson.

Little Peter was a three-year-old boy who was especially afraid of a tame rabbit, so Jones focused on eliminating the rabbit phobia. Jones (1924a) described Peter as 'almost to be Albert grown a bit older'. The method used by Jones (1924b) to eliminate Peter's fear is called counter-conditioning. *Counter-conditioning* involves learning a new conditioned response that is incompatible with a previously learned response. In treating Peter, this specifically involved pairing the rabbit that produced a fear response in Peter with another stimulus (milk and biscuits) that produced a different response (positive feelings), and one that was incompatible with the conditioned response (fear).

At first, Peter was placed in a room with the rabbit in a cage some distance from him, and was given the milk and biscuits. This helped to ensure that his fear would remain at a low level. Otherwise, Peter might have learned to fear milk and biscuits. Gradually, over a period of about three months (which involved many pairings of the rabbit with the milk and biscuits), the rabbit was brought closer and closer to Peter. Eventually, he was able to sit with the rabbit in his lap without fear, playing with it with one hand while he ate and drank with the other.

Along with counter-conditioning, Jones (1924a) used *observational learning* (*modelling*), techniques to help eliminate Peter's fear of rabbits. As part of the treatment, Peter observed other children petting or holding the tame rabbit. Eventually, Peter imitated the actions of the non-fearful children. For her pioneering efforts in the treatment of children's fears, Jones is widely regarded as the first behaviour therapist (Hockenbury & Hockenbury, 2006).

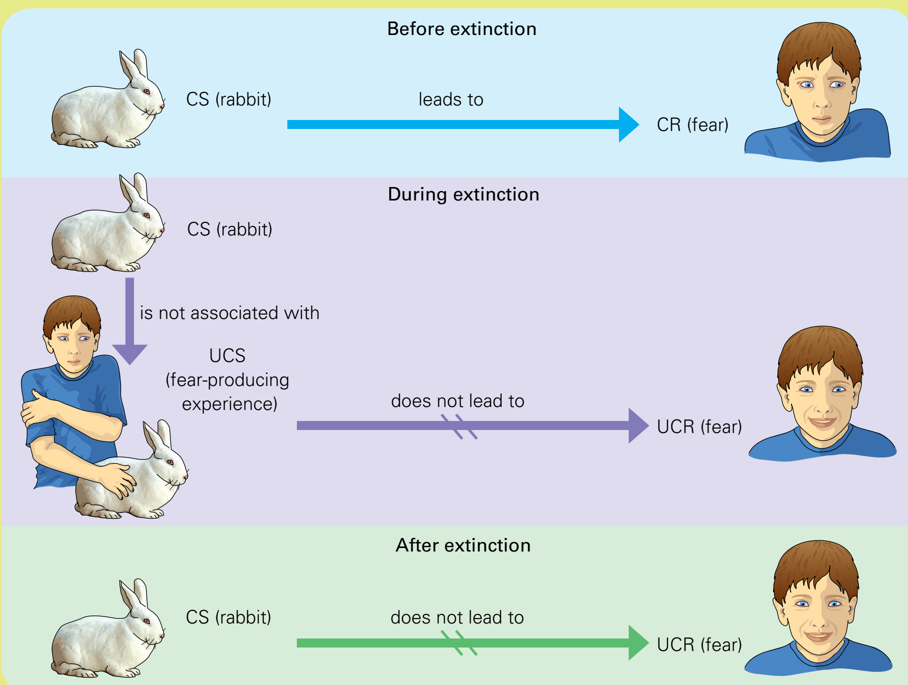


Figure 13.23 Extinction of Peter's specific phobia using counter-conditioning

Flooding

Flooding is similar to systematic desensitisation but does not have a relaxation component to help combat anxiety. When used for treating phobias, *flooding* involves bringing the client into direct contact with their most feared object or situation straight away and keeping them in contact with it until their fear and associated anxiety disappear. The principle underlying this technique is that anxiety will be experienced at a very high level and then gradually diminish, thereby enabling the client to experience their most prominent phobic stimulus in the absence of anxiety and come to learn that it is actually quite harmless.

Like systematic desensitisation, flooding can be conducted *in vivo*, through the use of visual imagery or by using a virtual reality device.

Throughout the flooding procedure, the client is asked to provide ratings of their anxiety level and they remain in the presence of the phobic stimulus until their self-reported anxiety level drops to a low level. Despite the intense distress it can cause, flooding is an effective technique when correctly used; however, it needs to be conducted by a skilled mental health professional.

Unlike systematic desensitisation, which involves minimising or preventing a fear or anxiety response by the client, flooding is used to deliberately produce a massive amount of fear or anxiety in the client. One well-known example of the use of flooding was that of an adolescent girl with a phobia of travelling in cars. She was driven around for four hours until her initial hysterical response subsided and her fear completely disappeared (Wolpe, 1973).

Box 13.12

Applied tension technique for treating blood, injury or injection phobias

Blood, injection or injury phobias are specific phobias involving extreme fear of exposure to blood, injuries or injections in one form or another. In contrast to other specific phobias, four out of five people with a blood, injury or injection phobia faint when exposed to their phobic stimulus. The fainting response is related to an extreme drop in blood pressure. Consequently, the person's fainting prevents the use of systematic desensitisation as part of their therapy.

In such cases, a technique called applied tension may be used. The *applied tension technique* involves learning to tense major muscle groups at the first sign of feeling faint. This has the effect of increasing heart rate, boosting blood pressure and raising cerebral blood flow, thereby physiologically preventing fainting. After being taught the technique, people with a blood, injection or injury phobia are encouraged to practise it several times a day for at least a week before they move on to the 'behavioural' part of their therapy.

Figure 13.24 People with a blood, injection or injury phobia typically faint upon exposure to their phobic stimulus. Consequently, systematic desensitisation cannot be used unless they are taught a strategy that prevents fainting.

Box 13.13

Comparing systematic desensitisation and modelling in the treatment of water phobia

Australian psychologists Ross Menzies and Christopher Clarke (1993) conducted a research study to compare the effectiveness of two treatment methods for children with a phobia of water (aquaphobia). The treatment methods involved systematic desensitisation and observation of a model (a therapist) successfully engaging in progressively closer interactions with water, thereby demonstrating that there is no cause to be fearful or anxious of water.

Forty-eight children aged between three to eight years (mean age five-and-a-half years) with a diagnosed phobia of water were randomly assigned to one of three experimental groups or the control group. Group 1 received systematic desensitisation, group 2 received systematic desensitisation and observed the modelling, group 3 observed the modelling and group 4 received no treatment. All participants in the experimental groups received three individually administered treatment sessions.

Menzies and Clarke hypothesised that children given either treatment alone (systematic desensitisation *or* modelling) would show greater improvement after treatment than children in the control group, but less improvement than children receiving both treatments (systematic desensitisation *and* modelling).

At the conclusion of the treatment conditions, it was found that children in group 1 and group 2 no longer had a phobia of water and continued to be free of their phobia over a period of three months after the three treatment sessions. In contrast, children in group 3 showed about as much improvement as children in group 4.

Figure 13.25 Either systematic desensitisation or modelling can be effective in the 'treatment' of a water phobia, but are less so when used in combination.

Learning Activity 13.11

Review questions

1 What is systematic desensitisation?

2 Explain what a fear hierarchy is and how it is used with reference to the management of a phobia of dogs.

3 Construct a simple flow chart to summarise the three steps in systematic desensitisation.

4 In what way does systematic desensitisation apply classical conditioning principles and processes?

5 Helena has a fear of flying. Together with her therapist, she has constructed a fear hierarchy. Put the steps of her fear hierarchy in the most likely order that she would approach them using systematic desensitisation.
- the plane doors closing
- checking in
- boarding the plane
- the plane taxiing to the runway
- thinking about travelling by plane
- taking off
- arriving at the airport
- travelling to the airport in a taxi
- being asked to fasten her seatbelt
- packing her luggage
- booking her plane ticket on the internet
- going to the departure lounge
- watching the flight attendants demonstrate the safety drill

6 a What is flooding?
b What is the underlying principle of this technique?

7 In what way does flooding apply classical conditioning principles and processes?

8 In what three ways can systematic desensitisation and flooding be carried out?

9 a How are systematic desensitisation and flooding similar when used in management of a specific phobia?
b How do systematic desensitisation and flooding differ when used in management of a specific phobia?
c Is flooding more or less ethically acceptable than systematic desensitisation? Explain your answer.

10 Sebastian has a phobia of cats.
a How could systematic desensitisation be used to assist Sebastian to overcome his phobia?
b How could flooding be used to assist Sebastian to overcome his phobia?

Learning Activity 13.12

Evaluation of research by Menzies and Clarke (1993)

Read the research study conducted by Menzies and Clarke (1993) described in box 13.13 and answer the following questions.

1 What was the aim of the research?

2 What was the hypothesis?

3 Who were the participants in the research?

4 Identify the IV(s) and DV(s).

5 Identify the experimental and control groups.

6 Did the results of the research support the hypothesis? Explain your answer.

7 With reference to Bandura's observational learning (modelling) theory (see chapter 10), what is a possible explanation for the finding that the group 3 condition did not lead to greater treatment benefits than the group 4 condition?

8 What particular ethical guidelines are relevant to the research?

Learning Activity 13.13

Media response

Read the article 'Scare tactics' on pages 634–5 and answer the following questions with reference to information in the article and the text.

1 How accurately does the article explain the meaning of phobia?
2 According to the article, why do people with 'obscure' phobias tend to not seek treatment? How accurate do you think this statement is?
3 In what ways did John's specific phobia impair his everyday life? Why?
4 Explain how John's thunderstorm phobia or Eyvonne's bird phobia may have developed in terms of a
   a behavioural model
   b cognitive model
   c socio-cultural model.
5 What biological explanation of phobias is proposed in the article?
6 Suggest how GABA may be contributing to Edan's jewellery phobia.

Learning Activity 13.14

Essay on factors that contribute to the development of a specific phobia

Write an essay of about 550–600 words in which you explain biological, psychological and social factors that may contribute to the development of a specific phobia and may be relevant to its management. References may be used in obtaining information for your essay.

In your essay ensure that you:

- explain the meaning of specific phobia
- describe a range of biological, psychological and social factors
- discuss how these factors may contribute to the development and management of specific phobia
- give an example of how different factors may interact during phobia development and anxiety management
- refer to relevant research findings
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms and ideas
- express your ideas in a clear and concise way
- accurately cite and reference all material.

Learning Activity 13.15

Visual presentation on a specific phobia

Prepare a visual presentation in which you use a biopsychosocial framework to explain the causes and management of a specific phobia of your choice.

You may select from a range of formats to present your information; for example, PowerPoint, a poster, a concept map, a flow chart, or a combination of formats. Photographs and other visual or art media may be used.

In your presentation, ensure you:

- explain the meaning of specific phobia
- outline a range of biological, psychological and social factors
- indicate how these factors may contribute to the development and management of specific phobia, including possible relationships between different factors during phobia development and anxiety management.

Written information may be in a dot-point format but you should ensure that all relevant information is accurately and adequately explained, using appropriate examples to clarify your understanding of key concepts.

Chapter 13 true/false quiz

Indicate whether each item is true or false by writing ‘T’ or ‘F’ in the blank space next to each statement.

1 ______ Anxiety is usually an adaptive response.

2 ______ A key feature of any anxiety disorder is the experience of some kind of phobia.

3 ______ Benzodiazepines are neurotransmitters.

4 ______ Behavioural models explaining phobias emphasise the role of learning processes.

5 ______ Some people experience phobic anxiety because they have a dysfunctional GABA system.

6 ______ According to Sigmund Freud, Little Hans developed a phobia of horses because the horses were actually a symbol representing his mother.

7 ______ According to the cognitive model, the development of a phobia is best explained in terms of mental activity involving unconscious processes.

8 ______ CBT focuses on changing behaviour that may lead to the development of a phobia.

9 ______ Systematic desensitisation involves bringing the person into contact with the most-feared object or situation straight away and keeping them in contact with it until their fear disappears.

10 ______ Children are vulnerable to developing specific phobias through parental modelling.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 13 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the following statements is the best description of anxiety?

A Anxiety is a mental disorder.
B Anxiety is a state of arousal associated with apprehension or concern.
C Anxiety is a state of arousal associated with loss of contact with reality.
D Anxiety is a state of arousal associated with socially unacceptable behaviour.

Q2 When using cognitive behavioural therapy (CBT) in the treatment and management of a specific phobia, the mental health professional will focus on

A specific environmental triggers.
B unconscious conflicts.
C cognitive biases.
D medications that alleviate anxiety.

Q3 Jake has a specific phobia of injections and experiences phobic anxiety whenever he sees a syringe. His phobia developed after he witnessed his mother have an injection and then faint. Jake, who was five years old at the time, had never seen anyone faint before and, for a few moments, he thought his mother was dead.

Jake's phobia is best described as developing due to

A parental modelling.
B a specific environmental trigger.
C cognitive bias.
D the stress response.

Q4 A specific phobia is said to be acquired through classical conditioning when

A the three-phase model occurs; for example, S (mouse) → C (anxiety) → R (fear).
B a conditioned stimulus (e.g. mouse) is generalised to similar stimuli (e.g. rats, rabbits).
C a neutral stimulus (e.g. mouse) becomes a conditioned stimulus through paired association with a conditioned response (fear).
D a neutral stimulus (e.g. mouse) becomes a conditioned stimulus that produces a conditioned response (fear) following paired association with an unconditioned response (fear).

Q5 Most people diagnosed with a specific phobia

A realise that their fear is grossly in excess of any real danger posed by the phobic stimulus.

B fear that their response to a phobic stimulus may become a specific environmental trigger for children.

C experience a gradual reduction in anxiety level as they contemplate being exposed to a phobic stimulus.

D manage their phobic anxiety and can therefore function effectively in everyday life.

Q6 The first step in systematic desensitisation usually involves

A teaching the client relaxation strategies that can be used to manage their anxiety.

B breaking down the fear-arousing event or situation into a logical sequence of steps and creating a 'stepladder' or fear hierarchy.

C systematic, graduated pairing of items in a fear hierarchy with relaxation by going up the steps on the ladder, one at a time.

D identifying cognitive biases or distortions underlying feelings and/or behaviour associated with the phobic stimulus.

Q7 If a person develops a specific phobia by watching another person's fearful behaviour towards a particular object or situation, they are said to have developed their phobia through

A transmission of threat information.

B classical conditioning.

C operant conditioning.

D observational learning.

Q8 The tendency for people with a specific phobia to focus on threatening stimuli, in preference to neutral stimuli, is called ______ bias.

A selective

B hypervigilant

C attentional

D interpretive

Q9 According to Freud's psychodynamic model, specific phobias develop through

A use of symbolic thinking.

B use of cognitive distortions.

C use of the defence mechanism called displacement.

D successful resolution of the Oedipal complex.

Q10 The stress response contributes to a phobic reaction by

A increasing physiological arousal.

B transmitting threat information.

C deactivating the fight–flight response.

D managing the fight–flight response.

The answers to the Chapter 13 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

The technique that involves bringing the client into direct contact with their most-feared object or situation and keeping them in contact with it until their phobic anxiety reaches a very low level is called ______________________________.

1 mark

Question 2

Define the meaning of the term phobia.

____

____

____

2 marks

Question 3

Explain the meaning of the phrase 'transmission of threat information' in relation to a specific phobia and give one example of a potential source of threat information.

____

____

____

____

2 marks

Question 4

Explain how operant conditioning may contribute to the maintenance or persistence of a specific phobia, with reference to an example of an operant conditioning process.

____

____

____

____

____

2 marks

Question 5

a Explain the role that gamma-amino butyric acid (GABA) is believed to play in phobic anxiety.

2 marks

b Explain how an understanding of the role of GABA can be applied to the management of phobic anxiety.

1 mark

The answers to the Chapter 13 short-answer questions are available at www.OneStopScience.com.au.

14 Mood disorder: major depression

Louise is 17 years old. She has had a lot to deal with in her life so far, such as the death of her father two years ago due to cancer and then losing all of her possessions in a house fire. Louise has been feeling very 'down' for the last few months. Most days it is a huge struggle just to get to school. Each day when she gets home from school she just lies on the couch and watches TV or goes to bed. She has lost weight too because she is not eating properly. She often wakes up at 5 am and can't get back to sleep. Louise is also finding it really hard to concentrate on her schoolwork and finds making decisions difficult. She can't seem to enjoy anything either. She is normally very close to her friends, but now she finds that she can't talk to them about how hopeless and meaningless her life feels. She doesn't feel like going out with them anymore. She no longer wants to play tennis, even though it used to be one of her favourite activities. Louise desperately wants to stop feeling down, but she is starting to think that she will feel like this forever and things will never improve. She doesn't know what is wrong or how to make things better.

Mood and mood disorders

Everyone experiences fluctuations in their mood, such as feeling 'high' when things are going well and we get an A+ for a SAC, or feeling 'low' when events take a negative turn and we get involved in conflict with friends or at home. Experiencing 'highs' and 'lows' is quite normal, as the intensity and duration of these feelings is usually in proportion to the events that produced them. However, experiencing moods, or fluctuations in moods, that are severe for no apparent reason, persist much longer than the normal ups and downs that most people experience, and impair the ability to function in everyday life can indicate the presence of a mood disorder.

The term **mood disorder** is used to describe a group of mental disorders that are characterised by a severe persistent disturbance in a person's mood that causes psychological discomfort or impairs the ability to function, or both. **Mood** is a mental state or overall feeling that colours our perception of the world and influences how we go about daily life. Since mood involves emotions, such as happiness, sadness and anger, it is often described as an 'emotional state'. Mood, however, can also involve feelings that we may not be able to easily label or experience for no apparent reason, such as anxiety or tension. Consequently, mood is sometimes referred to as a *non-specific* emotional state, meaning that we may have no idea what has caused a mood (Schacter, Gilbert & Wegner, 2009).

Depression and/or mania are central in all mood disorders. Generally, depression is a 'low' mood state and mania is 'high' mood state. More specifically, **depression** is characterised by intense sadness, feeling 'down' and worthless, and difficulties in functioning effectively in everyday life for a period of two weeks or more due to thoughts, feelings, behaviours and physical health symptoms such as those described in box 14.2 on page 677.

When depressive symptoms are less extreme, this is referred to as *dysthymia*. In contrast, episodes of *mania*, called *manic episodes*, are characterised by high levels of confidence, optimism, above-normal elevation of mood, talkativeness, being drawn to pleasurable activities, a decreased need for sleep, increased energy and irritability. When

Figure 14.1 A young woman is affected by an image of sadness—*Tears*, 1930–32, by photographer Man Ray (1890–1976)

mood elevation is less extreme, this is referred to as *hypomania*. Periods of hypomania, called *hypomanic episodes*, are characterised by symptoms that are similar to mania, but are not as extreme. Both manic and hypomanic episodes can also be accompanied by psychotic symptoms, such as delusions and hallucinations, meaning that the

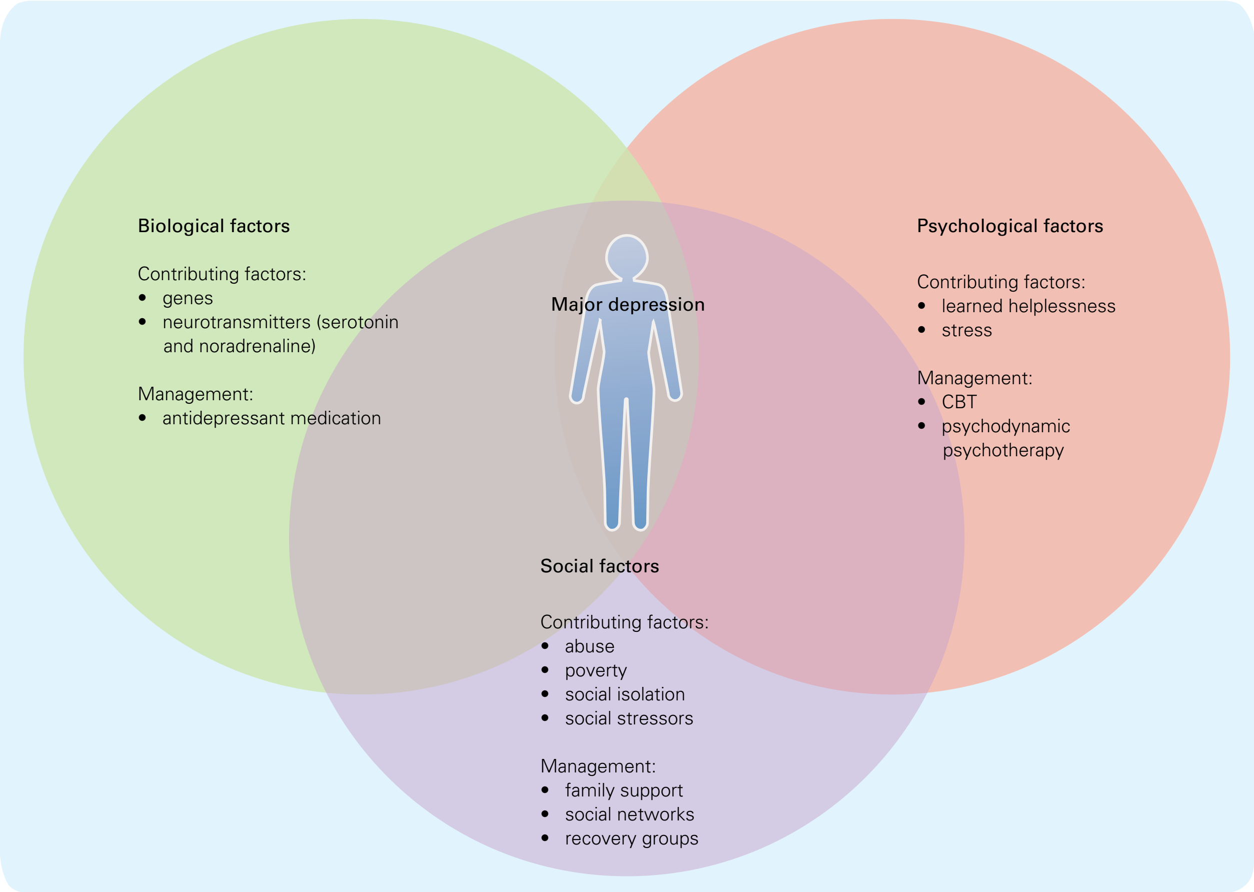


Figure 14.2 The biopsychosocial framework applied to understanding major depression and its management

person is seriously out of contact with reality. When mood fluctuates, or 'swings', between depression and mania, this is called *bipolar disorder* (formerly called *manic-depressive disorder)*. Mood changes between the two extremes of bipolar disorder are often unrelated to the individual's current circumstances and frequently disrupt their everyday functioning.

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM) describes a number of different mood disorders, some of which are shown in box 14.1. In this chapter we examine how biological, psychological and social factors (the *biopsychosocial framework*) interact to influence major depression (*major depressive disorder*) and its management (see figure 14.2).

Box 14.1
DSM-IV-TR mood disorders

Disorder	Description
Major depressive disorder	Disorder characterised by one or more major depressive episodes. Symptoms are depressed mood; anhedonia (loss of interest and enjoyment); changes in appetite or weight, sleep patterns and psychomotor activity; decreased energy; feelings of worthlessness or guilt; difficulty thinking, concentrating or making decisions; or recurrent thoughts of death or suicide.
Dysthymic disorder	Disorder characterised by depressed mood more often than not over a period of two years, but the symptoms are not severe enough to qualify as major depressive disorder.
Bipolar I disorder	Disorder characterised by episodes of major depression and mania.
Bipolar II disorder	Disorder characterised by fluctuations between episodes of major depression and hypomania.
Cyclothymic disorder	Disorder characterised by at least two years of numerous periods of hypomanic symptoms and numerous periods of mild depressive symptoms.

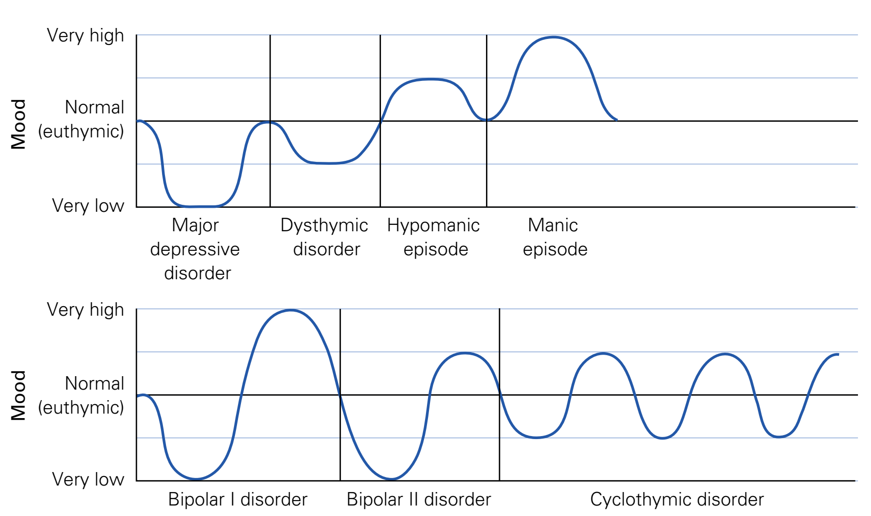


Figure 14.3 Visual representation of various types of moods and mood disorders described in the DSM

Learning Activity 14.1

Review questions

1 Explain the meaning of the term mood with reference to an example.
2 Explain the meaning of the term mood disorder.
3 When is a mood or fluctuations in mood considered to suggest the possible presence of a mood disorder?
4 a List three experiences that elevate your mood.
   b List three experiences that lower your mood.

Major depression

We all feel unhappy, sad, moody or low from time to time and this is a normal part of life. However, at these times, the support of family and friends, and being kind to ourselves, can usually lift our mood. We can also carry on and go to school or work, and socialise with friends, even though we might not feel like it. But people with major depression, like Louise described at the beginning of the chapter, experience feelings of intense sadness for long periods of time and often without reason. They also find it hard to function each day and may be reluctant to participate in activities they have enjoyed, and no amount of support from family or friends is able to lift their mood.

Major depression, or major depressive disorder, is a type of mood disorder characterised by one or more major depressive episodes involving symptoms such as intense sadness, loss of interest in everyday activities and a range of 'negative' thoughts, feelings and behaviours (see box 14.2). Both the DSM and *International Classification of Diseases and Related Health Problems* (ICD-10) describe major depression as varying in degree of severity, ranging from mild through moderate to severe.

Major depression is very common in Australia. On average, one in five people will experience major depression in their lifetime—one in four females and one in six males (beyondblue, 2010). It is the fourth most common problem managed in Australian general medical practices and is more likely to be associated with an anxiety disorder than any other type of disorder (Britt & others, 2005). The majority of people who experience a major depressive episode will have one or more recurrences within 15 years. For instance, approximately 50 to 60% of individuals who have a major depressive episode can be expected to have a second episode. Individuals who have had two episodes have a 70% chance of having a third, and individuals who have had three episodes have a 90% change of having a fourth (American Psychiatric Association, 2000). These statistics are for major depression. The number of people affected by less severe depression at some stage in their life is estimated to be much higher.

Box 14.2

How do you know if a person has major depression and is not just sad?

People may have depressive symptoms but may not meet the DSM diagnostic criteria for major depression. So how do you know if a person has major depression and is not just sad?

Major depression is more than just sadness—it's a serious mental disorder. People with major depression find it hard to function every day. Major depression has serious effects on *physical* and *mental* health.

A person may be depressed, if *for more than two weeks* they have:

- felt sad, down or miserable most of the time *or*
- lost interest or pleasure in most of their usual activities *and*
- experienced a number of the following symptoms.

Behaviour

- stopping going out
- not getting things done at work
- withdrawing from close family and friends
- relying on alcohol and sedatives
- no longer doing things they enjoyed
- unable to concentrate

Thoughts

- 'I'm a failure.'
- 'It's my fault.'
- 'Nothing good ever happens to me.'
- 'I'm worthless.'
- 'Life's not worth living.'

Feelings

- overwhelmed
- guilty
- irritable
- frustrated
- no confidence
- unhappy
- indecisive
- disappointed
- miserable
- sad

Physical

- tired all the time
- sick and run down
- headaches and muscle pains
- churning gut
- sleep problems
- loss or change of appetite
- significant weight loss or gain

Source: Beyondblue (2010). *Understanding depression—information for adults*. Fact sheet. www.beyondblue.org.au/index.aspx?link_id=7.980.

Figure 14.4 Australian tennis player and former Wimbledon champion Pat Cash has suffered from major depression. Following therapy and learning to avoid the 'triggers' for his depressive episodes, such as stress and drug use, Cash is able to get on with his life, largely free of depression. He talks openly about his experience in order to encourage others to seek help.

The diagnosis of a major depressive episode is made on the basis of the existence of a collection of symptoms. According to the DSM-IV-TR, in order to be diagnosed with having a **major depressive episode**, a person must experience five (or more) of a possible nine symptoms of major depression. It is essential, however, that at least one of the person's five symptoms includes a period of at least two weeks during which they experience *either* (1) depressed mood (that is, feeling very sad, 'low', 'down in the dumps', 'empty', 'hopeless') *or* (2) anhedonia. **Anhedonia** is the loss of interest in nearly all activities that the individual would normally engage or participate in, or not feeling any enjoyment in activities that they previously enjoyed. It is a feeling of 'not caring anymore'. A person must then also be experiencing at least *four* of the following seven symptoms: changes in appetite or weight; changes in sleep and psychomotor activity; decreased energy; feelings of worthlessness or guilt; difficulty thinking, concentrating, or making decisions; or recurrent thoughts of death or suicide, plans or attempts.

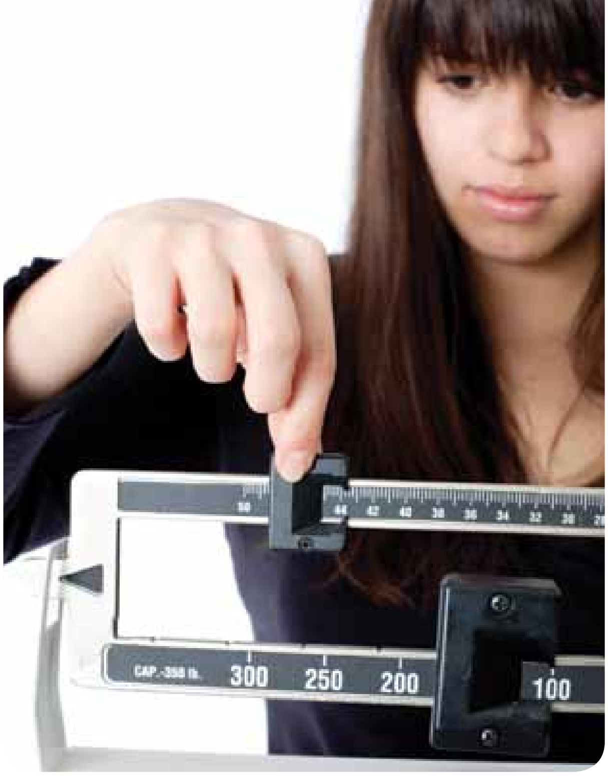


Figure 14.5 Major depression may involve either a loss of appetite and possible weight loss or an increase in appetite and possible weight gain.

Symptoms of major depression

Change in appetite or weight

A major depressive episode is often accompanied by a change in appetite. In some cases, the person will never feel very hungry. They can go long periods of time without wanting to eat anything. They may also forget to eat or, if they do eat, just a few bites will make them feel full. They may even feel that they have to force themselves to eat. For some people, the thought of eating is unpleasant, and having to prepare a meal seems to require too much energy. When this happens, a person may lose a significant amount of weight.

In other cases, the opposite may happen and the person will have an increase in their appetite and may gain significant amounts of weight (more than 5% of their normal body weight in a month). They may even find that they crave certain types of food such as sweets or carbohydrates.

Change in sleep pattern

A major depressive episode may also be accompanied by a change in sleep pattern that significantly affects a person's ability to function effectively in everyday life. In some cases, the person may experience *insomnia* and have difficulty falling asleep or staying asleep at night.

In other cases, the person may experience *hypersomnia* and require excessive amounts of sleep. People with hypersomnia sleep much longer than they normally would at night. However, despite this excess sleep, they have difficulty waking up in the morning and feel tired and sluggish during the day. This is called *excessive daytime sleepiness*. Another consequence of having excessive daytime sleepiness is that people usually feel compelled to have a daytime nap, which can impact on their availability to participate in everyday activities.

Figure 14.6 People experiencing a major depressive episode may experience excessive daytime sleepiness, which compels them to nap during the day, even though they have slept longer than usual overnight.

Change in psychomotor activity

A major depressive episode may also be accompanied by a change in the level of *psychomotor activity*; that is, how often or quickly one moves, thinks and/or speaks. In some cases, the person may experience psychomotor agitation. *Psychomotor agitation* is a state of increased activity of movement, thoughts and/or speech. For example, a person may become restless and unable to relax. They may engage in behaviours such as pacing around a room, tapping their feet or fingers, wringing their hands, twirling their hair, abruptly starting and stopping tasks, meaninglessly moving objects around, or fidgeting with objects or clothing. Their thoughts may also 'speed up', which is reflected in their speech. For example, they may speak quickly and jump from one topic to another.

In other cases, the person may experience psychomotor retardation, which is the opposite of psychomotor agitation. *Psychomotor retardation* is the slowing down of movement, thoughts and/or speech. The person may walk more slowly than usual, and their thoughts may be slowed, which is often reflected in their speech. For example, there may be a long delay before questions are answered and there may be long pauses in conversations.

Decreased energy

It is also common during a major depressive episode for a person to experience an overwhelming loss of energy or increase in fatigue. This can cause them to stay home and avoid social interaction, and prevent them from starting or finishing projects, maintaining previous interests and hobbies, or exercising. Even such things as getting washed and dressed in the morning can seem overwhelming and may even take twice as long to accomplish than usual.

Feelings of worthlessness or guilt

A major depressive episode often involves feelings of worthlessness. When feelings of *worthlessness* become prominent, the person believes that they are not good at anything, not important to anyone and deserving of nothing. It becomes impossible for them to accept compliments or to recognise what they have achieved.

The person may also experience excessive or inappropriate *guilt*, which means that they may have an unrealistic sense of personal responsibility and see many things as being their fault, even though they are not. For example, a person diagnosed with major depression might think that 'if only' they had gone and visited their sick family member in hospital more often, they might not have died.

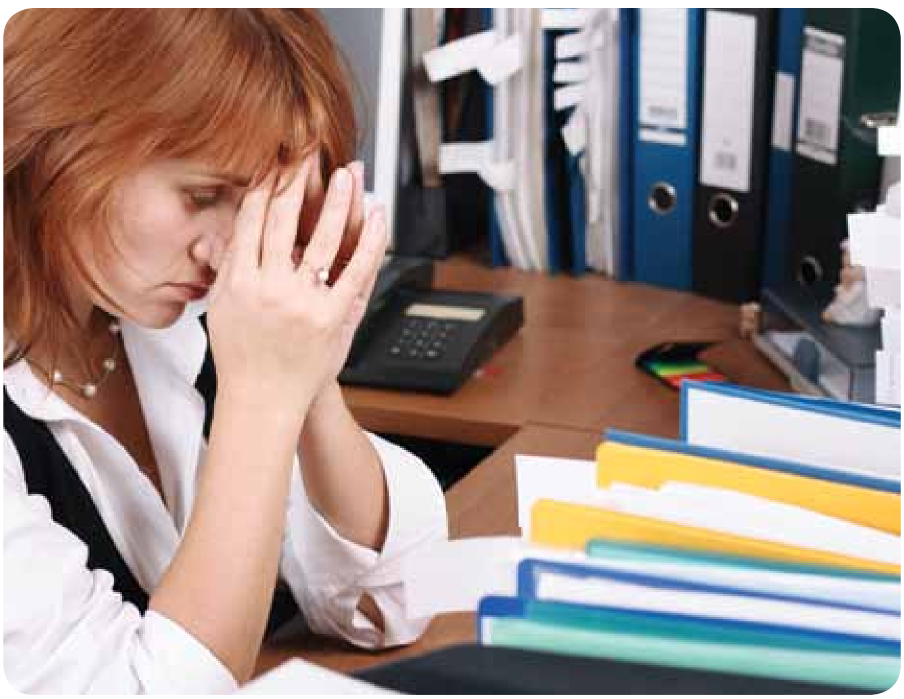


Figure 14.7 During a major depressive episode, a person may experience an overwhelming loss of energy or increase in fatigue.

Difficulty thinking, concentrating or making decisions

People experiencing a major depressive episode often find that they their ability to think, concentrate or make decisions becomes impaired. A person may report having problems with their memory, or that they are easily distracted. Errors in judgment during a major depressive episode can have devastating effects on the lives of those who suffer from the disorder, as well as on their family and friends.

Recurrent thoughts of death, suicidal ideation, plans or attempts

Thoughts of death, suicide or even suicide attempts may also occur when experiencing a major depressive episode. The frequency and intensity of thoughts about suicide can range from believing that friends and family would be better off if they were dead, to frequent thoughts about committing suicide or detailed plans about how they would actually carry out the act of suicide. People who are less severely suicidal may have brief but regular thoughts of suicide, such as several times a week. A person who is more severely suicidal may have made specific plans and decided upon a day and location for the suicide attempt (see box 14.3).

Some people believe that suicide should not be reported in the media because it may 'put the idea in people's heads'. However, responsible reporting of suicide may actually reduce the incidence of suicide. *Responsible reporting* excludes details about the method and location of suicide and does not represent it in a sensational or glamorised way. The issue of suicide should also be discussed respectfully, with consideration of the known contributory factors. It is also desirable that helpline contacts should be given. For example, a research study conducted by Australian psychologists Graham Martin & Lisa Koo (1997) on the media's reporting of the suicide of Kurt Cobain, the lead singer of rock band Nirvana, found that the rate of suicide among 15- to 24-year-old Australians *decreased* during the month following widespread reporting of Cobain's death. Significantly, the media coverage of Cobain's death tended to be highly critical of his decision to suicide.

Figure 14.8 Kurt Cobain regularly experienced major depressive episodes. Some of the lyrics he wrote reflected his negative thoughts. Cobain withdrew the song 'I hate myself and I want to die' from the album *In Utero* just before its release. He committed suicide not long after its release, describing himself in his suicide note as a 'miserable, self-destructive death rocker'.

Because of the relatively high incidence of major depression in the general population, the profound effects of this disorder and the risk of suicide, a great deal of research has focused on understanding the causes of and treatment and management strategies for major depression. Research findings indicate that major depression is usually caused by the interaction of a combination of biological, psychological and social factors, rather than any specific factor associated with each of these domains. Generally, the more of the known contributory factors people have, the more likely they are to experience major depression. For the purposes of VCE Psychology, we consider some of the more widely researched contributory factors in isolation, but keep in mind that that they can interact in both subtle and more obvious ways.

Box 14.3

Suicide—knowing when to get help

Young people with depression can have feelings of great despair and distress. These feelings can be so intense that they lead to thoughts of suicide. This doesn't necessarily mean that the person will act on these feelings—it's important, however, that any thoughts of suicide are taken very seriously by the person and their family and friends.

What makes people want to end their lives?

Sometimes life can become very painful and problems can seem overwhelming. At some point many young people think about suicide, but most don't plan or act on it. However, for others the thought of suicide might begin to seem like a real alternative to intolerable emotional or physical pain, or to a problem or situation that appears hopeless. Situations that might contribute to a feeling of hopelessness include relationship break-ups; family problems; sexual, physical or mental abuse; drug or alcohol problems; mental illness (including depression, anxiety, bipolar disorder and schizophrenia); major loss and grief such as a death; and any serious problem that is difficult to solve and won't go away. The problems may not be obvious to you. Mental illnesses such as depression change the way people think, making it difficult for the person to see a way out of their problems, causing them to feel pessimistic about the future.

How do people feel when they are at risk?

People at risk of taking their own life often feel very isolated and alone. They may feel like nobody can help them or understand their pain. If someone you know is not their usual self, or if they are showing some warning signs, you should not ignore it. You need to talk to the person about how they are feeling. Sometimes people become calm after being distressed and openly suicidal for a while. While this can be a sign of recovery, it can also mean that they have decided to complete their suicide plan. People with depression and/or anxiety disorders are more likely to have such thoughts.

How to help someone at risk of suicide

It's distressing to realise that someone close to you may be thinking about taking their own life. It's often difficult to know what to say and do, and how to make sure the person is safe. Most people who feel suicidal recover from these intense feelings. Family, friends and health professionals can make a big difference in helping people stay safe and to find positive reasons for living. ACT STRAIGHT AWAY, take warning signs seriously and ask the person if they are considering suicide and if they have any plans. This won't put the idea into their head but will encourage them to talk about their feelings. The person's safety is your main concern and you need to do whatever it takes to get them the help and support they need. Encourage the person to get support from a health professional. Try to give them hope. Ask them to promise that they will reach out and tell someone if suicidal thoughts return. And remember to look after yourself in this difficult and emotionally draining time. It's not always possible to intervene. In some people the warning signs of suicide are not obvious and even the most skilled health professionals may miss them.

More information and support

You can speak to trained counsellors by phoning these 24-hour telephone counselling services:

- Lifeline 13 11 14 (cost of a local call)
- Kids Help Line 1800 55 1800 (freecall)

Information and support is also available from:

- www.youthbeyondblue.com or www.beyondblue.org.au
- info line 1300 22 4636.

Source: Youth beyondblue (2010). *Suicide—knowing when to get help*, Fact Sheet 14. www.youthbeyondblue.com/factsheets-and-info/fact-sheet-14-suicide-know-when-to-get-help/.

Learning Activity 14.2

Review questions

1 Explain what major depression is with reference to the relevance of a major depressive episode, the key symptoms of a depressive episode and an example of each symptom.

2 What period of time is relevant to the diagnosis of a major depressive episode?

3 What is anhedonia and what is its relevance to the diagnosis of major depression?

4 Out of the nine possible symptoms, how many must a person be experiencing, according to the DSM, before they can be diagnosed as having a major depressive episode?

5 Explain how a major depressive episode may affect a person's energy levels.

6 a What key argument and/or research evidence has been proposed to support and oppose responsible reporting of suicide in the media?

b What other argument(s) for and against media reporting of suicide can you suggest? Give a reason for each argument.

c Locate an example of irresponsible reporting of suicide and explain why it is irresponsible.

7 Suggest a possible explanation for why females have a greater risk of developing major depression than do males.

8 Consider the descriptions of major depressive disorder, dysthymic disorder and cyclothymic disorder in box 14.1.

a In what way might the distinction between these specific disorders be unclear?

b In your opinion, are they best viewed as points along a depression continuum rather than distinct disorders? Explain your answer.

Biological contributing factors

Biological factors that have been found to be risk factors in major depression and other mood disorders include genes and disturbances in brain chemistry involving the functioning of specific neurotransmitters. In this section, we examine the roles of genes and neurotransmitters in contributing to the risk of developing major depression with reference to research evidence.

Role of genes

Research studies of families, twins and adopted children living with non-biological parents provide evidence that major depression has a genetic component. These studies have consistently found that major depression tends to run in families, which puts some people at an increased risk. For instance, major depression is about 1.5 to three times more common among biologically related people than among non-biologically related people in the general population (American Psychiatric Association, 2000). If one parent has major depression, the risk to one of their offspring of developing major depression at some time in their life has been found to be about a 25 to 30% chance. When both parents have major depression, the risk rises to about a 70% chance (Ainsworth, 2000).

The results of twin studies provide strong support for the role of genetic factors in the development of major depression. Twin studies typically compare the incidence of major depression among identical and fraternal twins. Though the results vary, research evidence indicates that major depression is more likely to occur in both members of identical twins, compared with non-identical twins. For example, in one study of 214 pairs of twins, at least one of whom was being treated for major depression, it was found that in the identical twin pairs, there was a 46% chance that the other twin would also have major depression. By contrast, when a non-identical twin had major depression, the other twin only had a 20% chance of developing the disorder (McGuffin & others, 1996). Similar results have been obtained by many other twin studies (see figure 14.9).

Although the existence of a genetic component suggests that biological factors are involved in depression, there is no widespread agreement on *how* genes actually influence the development

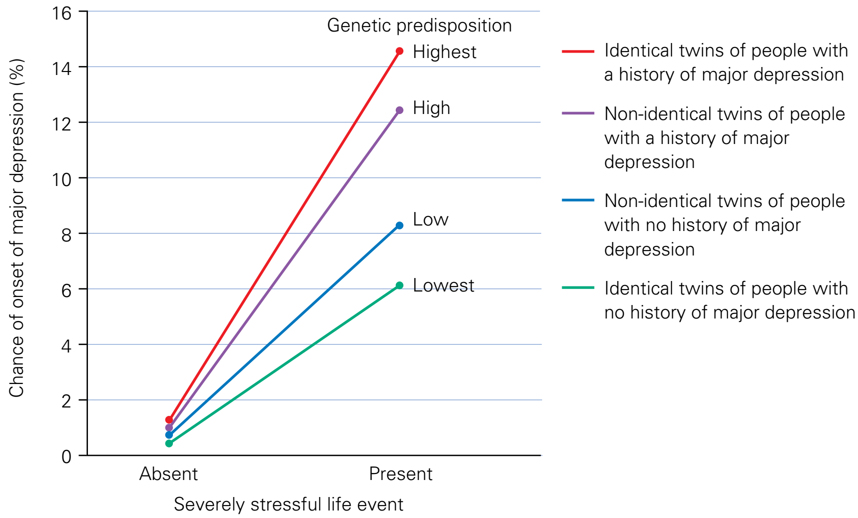


Figure 14.9 The results of twin studies provide evidence for the role of genetic factors in the development of major depression. The researchers in this study monitored a sample of female twin pairs including 2164 individuals for an average of 17 months.

Source: Kendler, K.S. & others (1995). Stressful life events, genetic liability, and the onset of an episode of major depression in women. *American Journal of Psychiatry, 152*, 837.

of depression. Nor does the existence of genetic component mean that an individual will automatically become depressed if a biological parent or close relative has had the disorder (beyondblue, 2010). Psychological factors and social factors are still likely to have an important influence on your chances of developing depression. Furthermore, psychological and social factors may also influence the role of genes.

Role of neurotransmitters

Another biological factor that can contribute to major depression is depleted amounts of certain neurotransmitters that transmit information between neurons in the brain. In particular, the neurotransmitters *serotonin* and *noradrenaline* have been found to be involved in mood and therefore major depression. Serotonin and noradrenaline (along with epinephrine/adrenaline and dopamine) belong to a class of neurotransmitters called *monoamines.* According to the **monoamine hypothesis**, major depression is assumed to be a consequence of depleted levels in the brain of either or both serotonin and noradrenaline (whereas mania is assumed to be caused by an oversupply of these substances). However, the precise role that a deficiency in serotonin and/or noradrenaline may play in depression is still not fully understood.

Serotonin

Serotonin (also called *5-HT*) is a neurotransmitter believed to be involved in a wide range of psychological activity, including states such as sleep and wakefulness, dreaming, eating, sexual behaviour and aggressive behaviour. Low levels

Learning Activity 14.3

Data analysis

Consider the data in figure 14.9 and complete the following tasks and questions.

1. Construct a suitable title for the graph.
2. Briefly describe the sample used and its composition.
3. How were major depression and stress operationalised?
4. On the basis of the results shown, write a tentative conclusion on the role of both the following factors in major depression, ensuring that you refer to relevant data:
   - genes
   - stressful life events.

of serotonin are associated with sad and anxious moods, hunger, food cravings and disruptions to the sleep cycle, all of which are symptoms of depression. The effectiveness of medications for managing depression by increasing the level of serotonin, or the activity of serotonin, provided the earliest evidence of serotonin as a contributory factor in major depression (Schacter, Gilbert & Wegner, 2009; Gazzaniga & Heatherton, 2006).

Noradrenaline

Noradrenaline (also called *norepinephrine*) is a neurotransmitter believed to be involved in attention, alertness, states of arousal and the stress response. Each of these activities may contribute to the symptoms of major depression. Noradrenaline is especially important for vigilance; that is, a heightened sensitivity to what is going on around you. As with serotonin, the effectiveness of medications for managing depression by increasing the level or activity of noradrenaline provided the earliest evidence of noradrenaline as a contributory factor in major depression (Schacter, Gilbert & Wegner, 2009; Gazzaniga & Heatherton, 2006).

Antidepressant medication and management of major depression

In the 1950s, researchers noticed that drugs that increased levels of serotonin and noradrenaline could sometimes reduce major depression. This observation suggested that major depression might be caused by low levels or the absence of these neurotransmitters in the brain. It also led to the development and widespread use of medications in the management of depression, commonly referred to as antidepressants.

Antidepressants are medications designed to relieve the symptoms of major depression. These medications can only be prescribed by medical practitioners and psychiatrists. They are commonly prescribed alongside the use of psychotherapies. They are also prescribed when other management strategies have not been helpful or psychotherapy is not possible due to the severity of the disorder or the lack of access to psychotherapy. Antidepressants are not generally recommended for the management of depression in children and young people, but they may be prescribed in certain circumstances (beyondblue, 2010; see box 14.4).

While antidepressants can relieve symptoms of major depression, they have a delayed onset of action of between two and six weeks. The delay may indicate that other factors associated with neurotransmission may also be important in alleviating symptoms, rather than simply the direct effects of increased levels of these neurotransmitters. For example, it is possible that serotonin and noradrenaline may alleviate symptoms of major depression indirectly by regulating the activity of *other* neurotransmitters that are also believed to be involved in major depression, such as dopamine and acetylcholine (ACTH).

Antidepressants can relieve symptoms and make people feel better, but taking them does not change a person's personality or make them feel endlessly or artificially happy. As with any other medication, some people who take antidepressants also experience side effects. Many of these side effects are short-term and well tolerated. Common side effects can include nausea, headaches, anxiety, sweating, dizziness, agitation, weight gain, difficulties sleeping and loss of appetite. The actual side effects that are experienced vary according to such factors as the specific type of antidepressant, the prescribed dosage, the individual's medical history and their current medical condition, and the individual's age. Antidepressants are considered to not be addictive but suddenly stopping their use can result in the experience of withdrawal symptoms, such as anxiety, headaches and a 'flu-like' feeling (beyondblue, 2010).

Like any medication, the length of time a person takes antidepressants depends on the severity of the disorder and how the person responds to treatment. For some people, antidepressants are only needed for a short time (generally six to 12 months) with psychological methods and self-help techniques being sufficient to prevent recurrence of symptoms. For others, antidepressants are needed on an ongoing basis—in the same way that someone with asthma would use respiratory medication (beyondblue, 2010).

Types of antidepressant medication

There are many different types of antidepressant medication. The medications are organised into 'classes', depending on whether they are used to manage major depression by increasing the levels of *both* serotonin and noradrenaline in the brain, or the level of either serotonin or noradrenaline *only*. The most commonly prescribed antidepressants in Australia use serotonin only. These types of medication 'belong' to the class called **selective serotonin re-uptake inhibitors (SSRIs)**. This class includes the medications called sertraline (brand name Zoloft), fluoxetine (for example, Prozac, Erocap, Lovan, Zactin, Auscap), citalopram (for example, Cipramil, Ciazil, Talohexal), paroxetine (for example, Aropax, Paxtine) and fluvoxamine (for example, Luvox, Faverin). The medications in this class are called re-uptake inhibitors because their main effect is to reduce or block ('inhibit') the reabsorption ('re-uptake') of serotonin by the presynaptic neurons that release the neurotransmitter. As a consequence of this action, a relatively normal or high level of serotonin (depending on the dosage) is allowed to accumulate at the synapse and influence the activity of the postsynaptic neurons.

SSRIs are the first choice for management of major depression by medication, followed by *serotonin and noradrenaline re-uptake inhibitors* (*SNRIs*). SSRIs have many advantages over the other or older types of antidepressants as they generally are very effective and have relatively few side effects. They tend to be non-sedating and are generally safe in the event of accidental or deliberate overdose. However, there may be side effects, and these most often include nausea, headaches, agitation, sleep disturbance or sexual dysfunction. Stopping SSRIs suddenly can cause unpleasant withdrawal symptoms, so cessation should first be discussed with the person prescribing the medication.

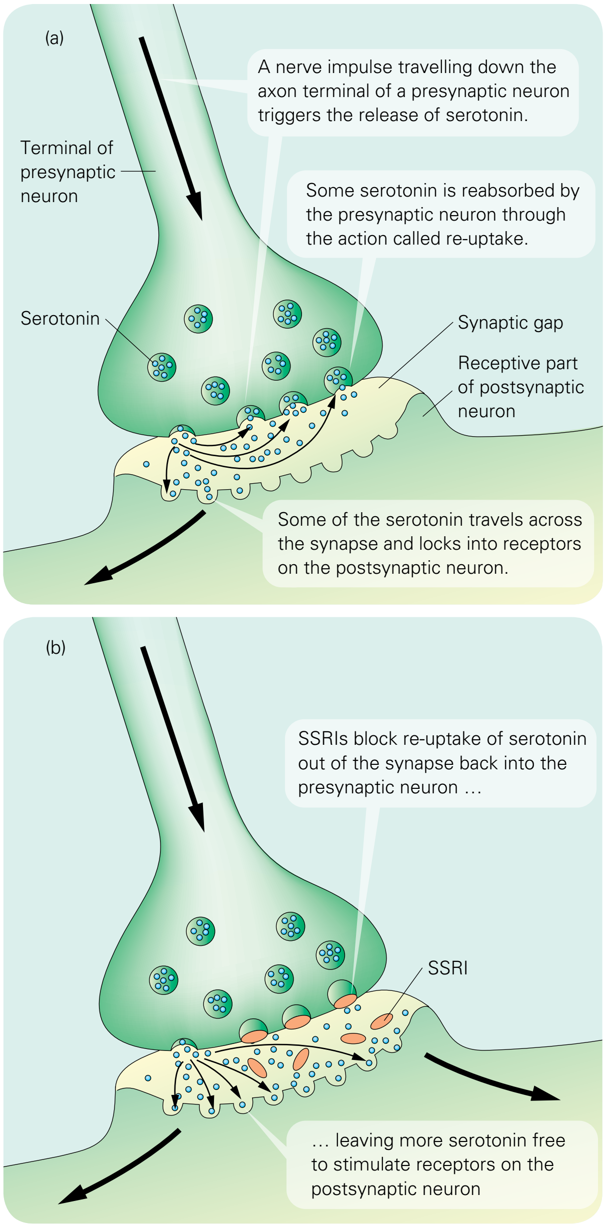


Figure 14.10 How selective serotonin re-uptake inhibitors (SSRIs) and similar antidepressants work. (a) When serotonin is released into a synapse, its action is normally inhibited by re-uptake back into the presynaptic neuron; (b) SSRIs block this re-uptake, thereby increasing the action of the serotonin on the postsynaptic neuron.

Figure 14.11 There are many types of antidepressants that can be used in the management of major depression.

Table 14.1 Classes of antidepressants

Serotonin and noradrenaline	Serotonin only	Noradrenaline only
Serotonin and noradrenaline re-uptake inhibitors (SNRIs) • venlafaxine (e.g. Efexor, Efexor-XR) *Reversible inhibitors of monoamine oxidase A (RIMAs)* • moclobemide *Monoamine oxidase inhibitors (MAO-Is)* • tranylcipramine • phenlzine (special diet required—rarely prescribed in Australia) *Noradrenaline–serotonin specific antidepressants (NaSSAs)* • mirtazapine (e.g. Avanza, Remeron)	*Selective serotonin re-uptake inhibitors (SSRIs)* • sertraline (e.g. Zoloft) • citalopram (e.g. Cipramil, Ciazil, Talohexal) • paroxetine (e.g. Aropax, Paxtine) • fluoxetine (e.g. Prozac, Erocap, Lovan, Zactin, Auscap) • fluvoxamine (e.g. Luvox, Faverin)	*Tricyclic antidepressants (TCAs)* • nortriptyline (e.g. Allegron) • clomipramine (e.g. Anafranil) • dothiepin (e.g. Prothiaden, Dothep) • imipramine (e.g. Tofranil) • amitriptyline (e.g. Tryptanol, Endep) *Noradrenaline re-uptake inhibitors (NARIs)* • reboxetine (e.g. Edronax)

Box 14.4

Are antidepressant medications effective for young people?

While antidepressant medicines have been used to treat young people under 18 years with more severe depression (including children), there is much debate among doctors as to the benefits of these medicines for young people. One of the main reasons why doctors have found it difficult to give clear recommendations is because of the lack of research on the impact of antidepressants on young people. The *Therapeutic Goods Administration,* Australia's regulatory agency for medical drugs, and manufacturers of antidepressants do not recommend antidepressant use for depression in young people under the age of 18. This is because:

- in trials, there were concerns about increased suicidal behaviour in young people taking antidepressants compared to those taking a pill that contained no drugs (placebo). The difference was roughly 4% compared to 2%. The risk was greatest in the first two months.
- of the lack of scientific evidence for the effectiveness of antidepressants in this age group. The increased risk of suicidal behaviour seen with antidepressants includes young adults up to the age of 24 years. There are, however, no Australian Government (i.e. Pharmaceutical Benefits Scheme) restrictions placed on the prescription of antidepressants and doctors are not prevented from prescribing them.

Of the various antidepressants available, selective serotonin re-uptake inhibitors (SSRIs) have been the most widely researched with young people. When the results of research are put together, the findings show that SSRIs can increase suicidal thoughts and behaviour in people under 18 years as well as those under 24 years. It is a matter of weighing up the benefits against the risks.

Depression itself poses risks of suicide, particularly during the early stages of treatment.

Among other adverse effects, children very commonly (up to 15%) experience hyperkinesia (abnormal increase in activity, or hyperactivity) and adverse effects commonly lead to antidepressants being stopped (approximately 10%). It is likely that the risks are greatest in younger children. There is much debate among doctors about the benefits of antidepressants for young people. One of the main reasons is because not enough is known about how effective and safe antidepressants are in adolescents and young adults. It is understood that:

- Psychological therapies are the main treatment for depression in young people (aged 13-24 years).
- Two psychological therapies have been found to be especially helpful – Cognitive Behaviour Therapy (CBT) and Interpersonal Psychotherapy (IPT). Other types of 'talking therapy' may also be useful.
- Getting information about depression and how best to recover is an important part of treating depression. Eating well, exercising, managing stress and following tips to improve sleep patterns can also be helpful.
- In young people with moderate to severe depression, antidepressant medication may be considered to reduce depression symptoms in the short-term, especially where psychological therapies alone have not worked or are not available.

What does this mean for a young person with depression?

- Everyone is different, so the treatment for depression needs to be worked out to suit the individual. This means the young person will need to see their local doctor and discuss their treatment with their family.
- If already taking one of these medicines, it's important not to stop taking them suddenly as this may cause an unpleasant 'withdrawal' reaction.
- If worried, the young person should speak with their doctor and ask for advice.
- If the young person decides to stop these medicines, it's best to do so slowly, with regular check-ups with their doctor.
- The young person's doctor may have decided to consider an antidepressant if their depression is severe or other treatments haven't worked. Their doctor will provide them with information about the medicine and its possible side effects.

Source: beyondblue (2011). *Antidepressants for the treatment of depression in adolescents and young adults* www.youthbeyondblue.com/factsheets-and-info.

Box 14.5

Electroconvulsive therapy (ECT)

Several hundred thousand prescriptions are written for antidepressant medications in Australia every year. In contrast, a small number of individuals with severe depression receive electroconvulsive therapy, or ECT, as a medical treatment. Electroconvulsive therapy, also called electroshock therapy or shock therapy, involves administering one or more brief bursts of a moderate electric current (65–140 volts) to the temporal lobe area of the patient's skull to induce a seizure (convulsion) in the brain.

First used with humans in 1938 by two Italian psychiatrists, Ugo Cerletti and Lucio Bini, ECT is a relatively simple and quick medical procedure. As shown in figure 14.12, the patient lies on a padded bed and electrodes are placed on one or both of their temples, depending on whether the left, right or both hemispheres are to be shocked. The patient is then given a short-term anaesthetic and injected with a powerful muscle relaxant to eliminate motor convulsions and confine the seizures to the brain, thereby minimising the chance of self-injury during a seizure. A soft object is placed between the teeth to prevent swallowing of the tongue.

When unconscious, a burst of electricity, for 0.1–0.5 seconds, is administered to induce a seizure. The seizure lasts for about 30 to 40 seconds. Outwardly, the seizure produces barely noticeable muscle tremors, depending on the strength of the muscle relaxant used. On regaining consciousness, the patient often reports a headache and is usually confused and disoriented for up to a few hours. In most cases, the patient experiences a permanent memory loss for events immediately before and after the ECT, with memory loss usually limited to events on the day of the treatment. Some patients, however, experience substantial memory loss that can be permanent. Research evidence indicates that applying shock to only one hemisphere (usually the hemisphere not dominant for language), causes less confusion and memory loss, and can be just as effective as shock to both hemispheres. The use of ECT for severe depression is usually not a once-only treatment. A patient is often required to undergo a series of six to ten ECT treatments over a period of several weeks.

About 80% of patients with severe depression usually show at least a temporary improvement after about four ECT treatments. After a few more treatments, improvement is longer lasting. Overall, however, there tends to be a high relapse rate, regardless of the number of treatments. About half the patients treated for severe depression experience a relapse within six months, unless they are also treated with antidepressants.

The major advantage of ECT is that it relieves the symptoms of depression relatively quickly, typically within days, whereas antidepressant medication can take weeks to alleviate symptoms. Because of its rapid therapeutic effects, ECT can be a lifesaving procedure for a severely depressed individual who is suicidal. In this case, waiting several weeks for relief can actually be deadly. ECT may also be an effective 'last resort' treatment for individuals who would otherwise continue to be debilitated by the symptoms of depression; for example, for people who are not helped by antidepressant medications or psychotherapy or cannot tolerate the side effects of antidepressants.

Although ECT frequently alleviates the symptoms of major depression, how this occurs remains unknown. Neuroimaging studies suggest that ECT reduces activity in brain areas involved in depression. Other studies have found that it may influence the activity of neurotransmitters at the synapse—as do antidepressants.

Despite controversy surrounding its use and that some critics have urged that it be banned

Figure 14.12 During ECT, electrodes on the forehead apply an electric current to the brain, creating a brief cortical seizure. Although ECT is controversial, for some severely depressed people it can be effective in alleviating their symptoms.

as a form of treatment, ECT can work in cases of severe depression. However, its potential benefits need to be weighed up against its potential serious side effects. Although there is no evidence that ECT causes permanent brain damage, inducing a brain seizure is not a matter to be taken lightly. Nor are the potential serious side effects of substantial and permanent memory loss and associated cognitive impairments.

ECT's biggest drawback is that its antidepressive effects can be short-lived. Relapses within four months are relatively common. About half the patients experience a relapse within six months. Today, patients are often prescribed long-term antidepressant medication following ECT, which reduces the relapse rate. In cases of severe, recurrent depression, ECT may also be periodically readministered to prevent the return of depressive symptoms.

Why is ECT not in wider use? The main reason is that ECT is the most controversial medical 'treatment' for mental disorders. Not everyone agrees that ECT is either safe or effective. For example, ECT has been banned in some countries, such as Japan, because of concerns about its safety. Furthermore, patients report mixed feelings about their ECT experiences.

How does ECT work? Despite more than 50 years of research, it's still not known why electrically inducing a convulsion relieves the symptoms of depression. Neuroimaging studies suggest that ECT reduces activity in brain areas involved in depression. Other studies suggest that it helps replenish levels of serotonin and noradrenaline, the neurotransmitters involved in major depression.

Learning Activity 14.4

Review questions

1. In what way can genes contribute to the development of major depression?
2. **a** What is the risk of a person developing major depression if one of their biological parents has, or has had, the disorder?
   b What is the risk of a person developing major depression if both of their biological parents has, or has had, the disorder?
3. Why do researchers use twin studies to investigate the possible role of genes in major depression?
4. Does the existence of a genetic component automatically mean that a person will become depressed if a biological parent or relative has or has had the disorder? Explain your answer.
5. What roles are seratonin and noradrenaline believed to play in behaviour and mental processes?
6. One prominent psychologist has suggested that it is 'not surprising that seratonin and noradrenaline can contribute to depression'. What justification is there for this statement on the basis of the roles of these neurotransmitters and symptoms of major depression?
7. What is the monoamine hypothesis?
8. Explain the possible role of neurotransmitters in the development of major depression, with reference to seratonin and noradrenaline.
9. **a** What are antidepressants?
   b About how long do antidepressants take to relieve the symptoms of major depression?
   c Explain how selective serotonin re-uptake inhibitors (SSRIs) act to alleviate symptoms of major depression.
   d List three common side effects of SSRIs.

Psychological contributing factors

Numerous psychological factors have been proposed as contributing to major depression. These include learning processes, psychological responses to internal and external stressors, low self-esteem, and cognitive processes such as dysfunctional patterns of thinking. Many theories have also been devised to explain the onset and/or maintenance of a depressed mood in terms of a combination of learning and cognitive processes. One of these theories is called *learned helplessness*. We examine the best-known theory of how 'helplessness' can be 'learned' and the connection between helplessness and major depression.

We also examine the relationship between *stress* and depression and how stressors and psychological responses to stressors can increase the risk of developing major depression.

Learned helplessness

More often than not, potentially negative events can be foreseen and avoided. When they can't be avoided, most of us expect that our actions will have some kind of negative outcome. While we may not always successfully deal with these negative events, we do not expect that our attempts will be met with complete failure. And we certainly do not expect that all our efforts will be futile and useless. When this does happen, when nothing we do seems to have any effect, and particularly when this happens repeatedly, we may learn to feel helpless.

American psychologist Martin Seligman (1975) called this response learned helplessness. **Learned helplessness** is a learned feeling or belief by an individual that they are helpless and unable to have any effect on events in their lives, so they give up trying. The theory of learned helplessness developed as a result from Seligman's studies on avoidance learning by dogs during laboratory experiments.

In his best-known experiment on learned helplessness, Seligman and his colleague Steven Maier (1967) used 24 'experimentally naive mongrel dogs'. The dogs were randomly assigned to either of three conditions, with eight in each condition. One at a time, each dog in groups 1 and 2 was individually strapped in a 'hammock' with four holes for its legs, suspended in the air and given 64 electric shocks at random time intervals that varied between 60 seconds and 120 seconds (with a mean interval of 90 seconds). The shocks were delivered through electrodes that were attached to its hind legs. Each shock counted as one trial. The dogs in group 1 (called the 'escape condition') had some control over their situation. Their head was held in position by a panel on either side. If the dog pressed either panel with its head the shock was terminated. If the dog failed to press a panel during any given shock, that shock would be terminated after 30 seconds. The dogs in group 2 (called the 'yoked control condition') did not have this opportunity. For them, the shocks were inescapable. However, the number and duration of these shocks was exactly the same for dogs in both groups. For each dog in group 1 there was an 'associate' in group 2. Whenever

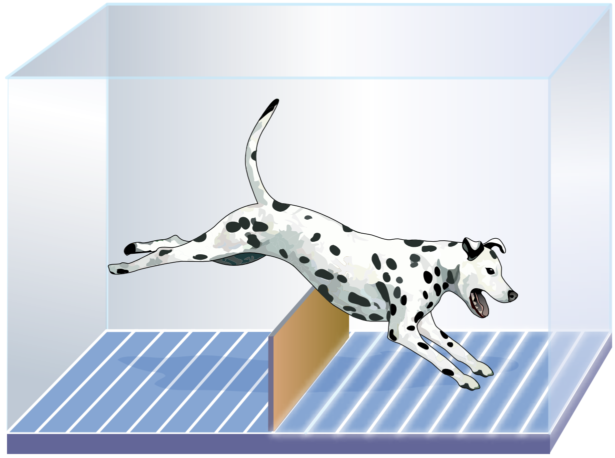


Figure 14.13 In Seligman and Maier's (1967) experiment on learned helplessness, dogs learned to escape electric shocks that were administered on one side of a shuttle box by jumping to the other (safe) side.

a group 1 dog was shocked, so was its group 2 'associate' dog. Whenever a group 1 dog turned off the shock, the shock was turned off for its 'associate' group 2 dog. Since the dogs in group 1 learned to turn off the shocks more and more rapidly as the trials progressed, the organisation of the groups 1 and 2 dogs into associate pairs ensured that the shocks administered to the dogs in both groups were identical. The difference was that one group had some control over the administration of shocks while the other group had no control.

After 24 hours, the dogs in both groups were placed individually in an apparatus called a 'shuttle box', like that shown in figure 14.13. This was divided into two compartments by a low barrier over which the dog could easily jump. Each dog was then given electric shocks through a grill forming the floor of the shuttle box, but now it had an option to escape by jumping over the barrier into the adjoining compartment where there were no shocks administered through the floor. In all, there were ten trials in the shuttle box. The responses of dogs in group 1 and group 2 were compared with those of dogs in group 3, which was made up of dogs that had not been used in the experiment in any way up until this stage.

The dogs in group 1 (prior experience of escapable shock) learned to escape in the new situation about as quickly as the dogs in group 3. The dogs in both these conditions took just under 27 seconds on average to escape to the 'safe' side.

During the first few trials, they waited until the shocks began and then scampered over the wall. Later, they jumped as soon as they were placed in the box, and thus avoided shock entirely. On average, the dogs in group 2 (prior experience of inescapable shock) took 48.22 seconds to escape from the shocks. But the dogs in group 2 also behaved very differently. Within little time of receiving shocks, many become very passive. Three-quarters of the dogs failed to escape on nine out of ten trials. They lay down, whined quietly and 'passively' accepted whatever shocks were delivered. They neither avoided nor escaped; they just gave up trying. In the harness set-up these dogs had been helpless—there really was nothing they could do to escape or avoid the shock. But in the shuttle box, they were not helpless. They could escape, but their prior experience, when they had no control over what happened to them, seemed to influence their ability to learn what appeared to be a fairly straightforward escape response. They had learnt to be helpless. According to Seligman (1975), in their life outside the shuttle box during and after the experiement, the group 2 helpless dogs also behaved differently from non-helpless group 1 and 3 dogs—they had a low energy level (were 'listless'), ate poorly, lost weight, interacted little with other dogs and showed little interest in sexual activity.

As a result of this research, Seligman made a link between learned helplessness and major depression. He proposed that people with major depression tend to share particular characteristics with dogs that have been rendered helpless. For example, both people with major depression and dogs that have experienced learned helplessness tend to be sad, anxious and passive (that is, fail to initiate actions); behave as if they have no control over their circumstances; have sleep problems; lose their appetite; and show little interest in others. Like the helpless dogs, people with major depression come to feel that their actions are pointless and useless. Like the dogs that received inescapable shocks while strapped in a harness, people with major depression may find themselves powerless when confronted with loss, business failure, serious illness and other problems or stressors.

To further illustrate the link between learned helplessness and major depression, Seligman (1972) described the case of a 15-year-old boy called Archie. For Archie, school was an unending series of shocks and failures. Other students treated him as if he was stupid and in class he rarely answered questions because he didn't know some of the answers. He felt 'knocked down' everywhere he turned. These may not be electric shocks, but they were psychological 'shocks' and Seligman reported that Archie felt powerless to prevent them. Archie had learned to passively endure whatever 'shocks' life was giving him. Seligman hypothesised that Archie might also not do well when he left school because of his expectation of future helplessness.

Learning Activity 14.5

Evaluation of research by Seligman and Maier (1967)

1. Prepare a flow-chart summary of the key features of Seligman and Maier's research (1967) on learned helplessness. Your flow chart should include brief descriptions of:
   - an operational hypothesis that could have been tested in the experiment
   - the IV(s) and DV(s)
   - the experimental and control conditions
   - results
   - conclusion
   - relevant ethical issues.
2. Name the experimental design.
3. What generalisation(s) was/were made from the results of the experiment?
4. Is/are the generalisation(s) valid? Explain your answer.
5. Give an example of a situation in which people might learn to be helpless.
6. What ethical issues may be relevant to the research? Explain your answer.

Although Seligman's original learned helplessness theory provided a useful way to describe and explain a contributory factor to the development of major depression, it had a number of limitations. One major limitation is that the theory did not adequately take account of cognitive processes that may be involved in learned helplessness in people and, therefore, in depression. Consequently, Seligman collaborated with two other American psychologists and revised his learned helplessness theory (Abramson, Seligman & Teasdale, 1978). The revised learned helplessness theory included aspects of attribution theory that had been developed by social psychologists. *Attribution theory* explains how we interpret observed behaviour or events then draw on our experiences to understand and then explain what causes those behaviours or events. The process of explaining behaviour or events in terms of a particular cause is called *attribution*.

Like the original learned helplessness theory, Seligman's revised theory focuses on the importance of the individual feeling or believing that they are not in control of their circumstances. However, the revised theory also proposes that when people experience failure, they usually try and attribute a cause to that failure. A person's attribution of an unfavourable event will primarily depend on their *interpretation* of the origin, meaning and consequences of that event. Those who generally interpret events in a negative and pessimistic way are likely to become depressed. Therefore, an individual's *attributional* or *explanatory style* is a psychological risk factor in developing major depression.

According to Seligman's revised theory, when explaining the cause of an event, we may make three types of *causal judgments* that influence the psychological impact of the event. We judge whether the event has an *internal* or *external* cause (that is, within the individual or outside the individual), whether the event is *stable* or *unstable* (unlikely to change or likely to change), and whether the event is *global* or *specific* (widespread or here and now).

For example, a person may judge that an unfavourable event has an 'internal' cause (e.g. it was my fault that my brother went out the night he died), or an 'external' cause (e.g. my brother died after being hit by a drunk driver). They may also judge that an event reflects a 'stable' cause (e.g. I failed my maths exam because I have poor mathematical abilities) or 'unstable' cause (e.g. I failed my maths exam because I was not feeling well that day). Finally, they may also make a causal attribution that is either 'global' (e.g. my wife wants a divorce because I am useless at doing most things) or 'specific' (e.g. my wife wants a divorce because she found out I was having an affair). If the attributed cause is judged as internal ('it's me') rather than external, then helplessness will be accompanied by a loss of self-esteem. If the attributed cause is judged as stable ('it's going to last forever') rather than unstable, then helplessness will be longlasting. And if it is judged as global ('it's going to affect everything') rather than specific, then helplessness will be general.

The revised helplessness theory proposes that people who attribute unfavourable or negative events to internal (their own fault), stable (unlikely to change) and global (occurring in a lot of settings) causes are at a *high* risk of developing major depression. This attributional or explanatory style leads people to feel helpless about making possible changes in their lives. Conversely, people who tend to make internal, stable, global attributions about favourable or positive events are generally at a *low* risk of developing major depression. An example is thinking that you won an athletics event through your own efforts and you are likely to continue winning many events because you have developed into a good 'all-round' athlete. Some psychologists believe that a negative attributional style is remarkably consistent across an individual's lifespan and begins in childhood with experiences that foster the development of pessimism and low self-worth (Schacter, Gilbert & Wegner, 2009).

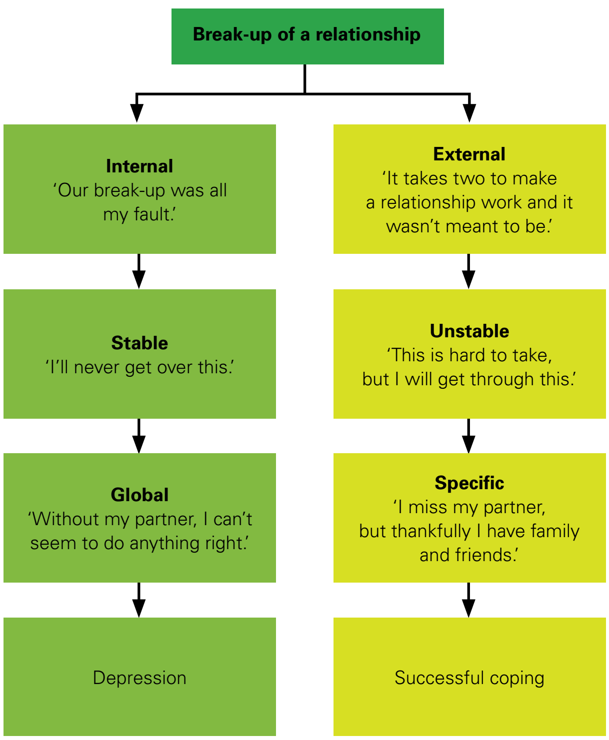


Figure 14.14 An example of attributional judgments leading to either to major depression or successful coping

Box 14.6

Assessing attributional style

Imagine that the following situations really happened to you. In each case, what do you think would be the most likely cause? Will the cause change in the future? Is the cause unique? Respond to each question by circling the number that most closely describes how you would feel in this same situation.

Situation 1

You are introduced to a new person at a party and are left alone to talk. After a few minutes, the person appears bored.

1 Is this outcome caused by you? Or is it something about the other person or the circumstances?

1 2 3 4 5 6 7

Other person or circumstances ... Me

2 Will the cause of this outcome also be present in the future?

1 2 3 4 5 6 7

No ... Yes

3 Is the cause of this outcome unique to this situation, or does it also affect other areas of your life?

1 2 3 4 5 6 7

Affects just this situation ... Affects other areas

Situation 2

You receive an award for a project that is highly praised.

4 Is this outcome caused by you or something about the circumstances?

1 2 3 4 5 6 7

Circumstances ... Me

5 Will the cause of this outcome also be present in the future?

1 2 3 4 5 6 7

No ... Yes

6 Is the cause of this outcome unique to this situation, or does it also affect other areas of your life?

1 2 3 4 5 6 7

Affects just this situation ... Affects other areas

You have just completed a modified version of the Attributional Style Questionnaire devised by Seligman and his colleagues. This inventory measures people's explanations of the causes of good and bad events. If you have a *depressive explanatory style,* you tend to explain bad events in terms of internal factors ('It's my fault'), a stable cause ('It will always be this way') and a global cause ('It's this way in many situations'). In contrast, if you have an *optimistic explanatory style*, you tend to make external ('It's someone else's fault'), unstable ('It won't happen again') and specific ('It's just in this one area') explanations.

When good things happen, however, the opposite occurs. People with a depressive explanatory style tend to make external, unstable, specific explanations. Those with an optimistic style tend to make internal, stable, global explanations.

	Depressive explanatory style	Optimistic explanatory style
Bad events	Internal, stable, global	External, unstable, specific
Good events	External, unstable, specific	Internal, stable, global

If you had mostly high scores (5–7) on questions 1, 2 and 3 and low scores (1–3) on questions 4, 5 and 6, then you have scored points towards a depressive explanatory style. If the reverse is true (low scores on the first three questions and high scores on the last three), you tend to have an optimistic explanatory style. Of course, these questions are sample items and the results can therefore not be used to reliably assess attributional style or to make valid inferences about predisposition to major depression.

Source: Huffman, K. (2007). *Psychology in Action* (8th ed.). New York: John Wiley & Sons, p. 516.

Learning Activity 14.6

Review questions

1 What is learned helplessness?

2 What behaviour did the dogs in the Seligman and Maier (1967) experiment have in common with people who have major depression?

3 Explain how learned helplessness may contribute to major depression with reference to Seligman and Maier's (1967) experiment.

4 **a** Explain the meaning of attributional (explanatory) style and how this may contribute to major depression.

b What pattern or combination of attributional judgments is most closely associated with major depression? Explain why this is the case.

c Construct two flow charts such as those in figure 14.14 to contrast patterns of favourable and unfavourable attributional judgments for a negative event *other than* failing a test or exam or the break-up of a relationship.

d Does a depressive explanatory style cause major depression or does major depression cause a depressive attributional style? Explain your answer.

Learning Activity 14.7

Research investigation on attributional style

Working in a small group, plan and conduct an investigation to assess attributional style using two situations and questions such as those in the modified version of the attributional style questionnaire in box 14.6. Your investigation should test a research hypothesis that takes into account gender differences in major depression.

The data collected will be combined to form the class results. The population, sample and sampling procedure should be determined through a small group or class discussion.

Each participant should receive a copy of the questionnaire and a briefing statement. The briefing statement should be completed as a small group or class exercise and should describe what the research investigation is about, what it requires of participants and how the results will be used.

The questionnaire should also record relevant participant variables, such as sex and age group.

All participants should be volunteers, give informed consent and complete the questionnaire anonymously. Ensure all other relevant ethical guidelines are followed.

Prepare a report on the research investigation. Your report should include:

1 a statement of the aim of the investigation

2 the research hypothesis

3 a summary of the results using appropriate descriptive statistics

4 a conclusion(s) based on the results and referring to the hypothesis

5 a potential limitation that may have affected the results in an unwanted way

6 other relevant information that may be requested by your teacher.

Stress

Numerous research studies have found that major depression may develop as a consequence of exposure to stressful life experiences. The types of stressful experiences that appear to be most often associated with major depression are those that involve a loss that can dramatically or permanently change the nature of a person's life; for example, those related to marriage and romantic relationships (for example, breaking up), work (for example, losing a job) and personal trauma (for example, being diagnosed with a life-threatening illness). Such experiences severely interrupt our everyday life and impact on our well-established 'routine' ways of satisfying our needs and desires. Many explanations have been proposed for the role of stress as a contributory factor to major depression. These include the *stress exposure model*, the *stress generation model* and the *reciprocal model*.

Stress exposure model

The **stress exposure model** proposes that individuals who have been exposed to a very significant stressor, or have many stressors in their lives and therefore have relatively little respite from stressors, will be more likely to develop major depression than those who have not (Brown & Harris, 1978). Therefore, according to this model, major depression is a *response* to stress and exposure to stressors *precedes* and increases the risk of developing major depression. A key assumption is that the stressors are independent of major depression; that is, the stressors do not occur as a result of depression. Research on the stress exposure model has focused on the influence of two broad types of stressors: discrete and continuous.

Discrete stressors are specific life experiences that are independent of major depression, are perceived as major stressors and impose significant demands for psychological, social and/or biological readjustment (as in the Holmes and Rahe social readjustment scale in chapter 12). Discrete stressors are often called *stressful life events* but they are perceived as significant and are negative and relatively rare events; for example, the death of a close relative (partner, child, parent); divorce, separation, broken engagement or break-up; job loss (retrenched or dismissed); assault (physical assault, rape, or mugging); or serious illness or injury. These types of experiences are negative life events that are unwanted, significant and disruptive and require readjustment to everyday life on the part of the individual, often over a considerable period of time. They are particularly stressful when they occur suddenly and are unexpected. Importantly, discrete stressors are *independent* life events that do not occur as a result of symptoms of depression, such as losing one's job as a result of major depression. Conversely, *dependent* life events may occur as a result of depression, such as losing one's job because of not working as efficiently due to deterioration in attention and concentration as a result of depression (Dobson, 2009).

Research studies have consistently found a strong relationship between the experience of discrete stressors and major depression. Major depressive episodes often follow a discrete stressor. For example, research studies have found that as many as 75% of people with major depression can identify a highly stressful negative life event that triggered their initial episode of major depression (Jenaway & Paykel, 1997; Post, 1992). In addition, people with major depression have been found to experience more stressful life events before the onset of a major depressive episode than at earlier points in their life when they did not have major depression (Paykel & Dowlatshahi, 1988). Other studies have found that discrete stressors may play a more significant role in triggering onset of the first major depressive episode and typically play less of a role in the onset of subsequent episodes (Monroe & Hadjiyannakis, 2002; American Psychiatric Association, 2000).

Research has also highlighted the role of continuous, or 'ongoing', stressors in the development of major depression. The two main types of continuous stressors are commonly referred to as *chronic stressors* and *daily hassles*, with a distinction between the two often made in terms of the extent and severity of specific stressors within each category. Specific chronic stressors tend to be more 'global' and severe in their impact, whereas specific daily hassles tend to be 'micro' and less severe but can combine and have a cumulative effect that imposes significant demands on the individual's coping resources.

Figure 14.15 Ongoing unresolved relationship problems can be chronic stressors that contribute to the development of major depression.

Chronic stressors are stressors that involve persistent or recurrent difficulties in life and therefore result in the presence of stress over a relatively long period of time. Chronic stressors include ongoing unresolved marital or relationship problems and long-term financial difficulties. Research studies have consistently found a strong relationship between the experience of chronic stressors and the development of major depression. Some studies have also found that the ongoing problems of life are more important predictors of major depression than major, but less frequent, life events. What makes chronic stressors particularly debilitating to the individual is the uncertainty associated with the resolution of the stressor. That is, it is often very difficult to know when the stressful event will end and if it will end at all (McGonagle & Kessler, 1990; Lazarus & Folkman, 1984).

The findings of many recent research studies on the effects of chronic stressors provide evidence for theories and models of stress previously described in this text, such as Selye's theory on the general adaptation syndrome, the Lazarus and Folkman transactional model of stress and coping, and Seligman's learned helplessness theory. For example, the GAS explains how exposure to chronic stressors can cause an organism to enter a stage of exhaustion. Because the organism has been trying to deal with the stressor(s) for some time, its resources have been depleted, its resistance to disease is very weak, and it becomes vulnerable to physical and psychological disorders. The stage of exhaustion can result in a variety of physiological and psychological effects including major depression. Furthermore, if a stressor has been ongoing for some time, coping efforts have probably been unsuccessful and this is likely to lead to an reappraisal of the stressor as more threatening than originally appraised (Lazarus & Folkman, 1984). This may then undermine a person's sense of control and mastery over their life, leading to a sense of helplessness that then acts as a precursor to major depression (Seligman, 1975).

Daily hassles are relatively minor events arising out of day-to-day living, such as the everyday concerns of work or school, caring for others and travelling between school and home (see table 12.1 on page 583). They can also refer to micro, or 'little', and more unexpected events that disrupt daily life, such as arguments with parents, a malfunctioning locker, and unexpected homework deadlines (Serido, Almeida & Wethington, 2004). Often, daily hassles are not readily identified as stressors because they are such a part of everyday life that they may be taken for granted. Some people can simply shrug off daily hassles as each one arises. For others, however, they can add up and take a toll on physical and mental health, thereby contributing to the development of major depression.

A limitation of the stress exposure model is that is does not account for the many people who experience significant life stressors or continuous daily hassles and do not develop depressive symptoms or major depression. In fact, most individuals under stress do not become depressed and sometimes depression develops without stress. Although it is well established that stress can be a contributory factor to major depression, it is overly simplistic to explain major depression (or any mental disorder) in terms of a single causal factor such as discrete life stressors. The sensitivity to developing major depression when stressed by a life event may also depend on other factors, such as whether someone can access appropriate social support (as compared with being socially isolated) and an individual's genetic make-up. For example, research studies have found that the risk of depression after a stressful event is elevated among people who are at high genetic risk and diminished among those at low genetic risk. The difficulty of isolating specific causal variables is one of the main reasons contemporary psychologists prefer to explain the development of major depression in terms of contributory factors rather than causal factors.

Stress generation model

The link between stress and major depression is not a 'one-way street' whereby stress triggers major depression. Based on her research with depressed women, American psychologist Constance Hammen (1991) proposed the stress generation model. The **stress generation model** refers to the pattern in which individuals with major depression seem to contribute to the occurrence of stressors in their lives and therefore actually 'generate' stress. Hammen based her model on research findings that people diagnosed with major depression experience higher levels of *dependent stressors*—stressors that occur as a result of their own behaviour—than do people who have been diagnosed as not having major depression (or any other mental disorder).

Hammen and many other researchers have consistently found that negative events involving relationships with others tend to be common among people diagnosed with major depression and are therefore risk factors. Some researchers have also proposed that stressors arising from close interpersonal relationships, or relationships in an individual's wider social networks, may be used as *predictors* of whether or not major depression will develop, especially for girls. For example, an Australian longitudinal study of adolescents found that the frequency of long-term or persistent interpersonal problems arising from peer, romantic and family relationships at the age of 15 was significantly higher among adolescents who had been diagnosed with major depression by age 15 (early onset), as well as among adolescents who experienced recurring episodes of major depression throughout adolescence. There was also a significant difference between the results for girls and boys. Girls reported more relationship problems than did boys and more girls experienced early onset and recurrence of major depression than did boys. The study also found that 74% of adolescent girls who had early-onset and recurrent major depression by age 20 had significantly worse-quality romantic relationships at 20 years. The researchers therefore found that more enduring or frequent depressive episodes in adolescent girls predicted subsequent poorer quality romantic relationships, which could help maintain a 'vicious cycle' of depression by influencing the onset of subsequent depressive episodes (Hammen, Brennan & Keenan-Miller, 2008).

Reciprocal model

The **reciprocal model** combines the stress exposure and stress generation models, and proposes a bidirectional ('two-way') relationship between stress and depressive symptoms. According to the reciprocal model, stress can 'trigger' major depression, but depressed individuals also create or seek stressful events. This means that stress can be both a *predictor* of the onset of major depression as well as a *consequence* of major depression. Depressive symptoms generate more stress, and stress can increase depressive symptoms (Hersen & Thomas, 2005).

Evidence supporting the reciprocal model has been obtained through a number of research studies, particularly studies of adolescents and children. For example, American psychologists Jocelyn Carter and Judy Garber (2005) investigated the relationship between stress and depressive symptoms among adolescents. Their results showed that the level of stress arising from peer relationships or academic studies could be used to predict the risk of experiencing symptoms of depression, and that experiencing depressive symptoms could be used to predict the level of stress likely to be experienced in peer relationships or academic studies over time. Essentially, depressive symptoms could generate more stress and stress could generate an increase in symptoms of depression. Consequently, the researchers concluded that the reciprocal model of the relationship between stress and major depression provided a more appropriate explanation than either the stress exposure model or the stress generation model.

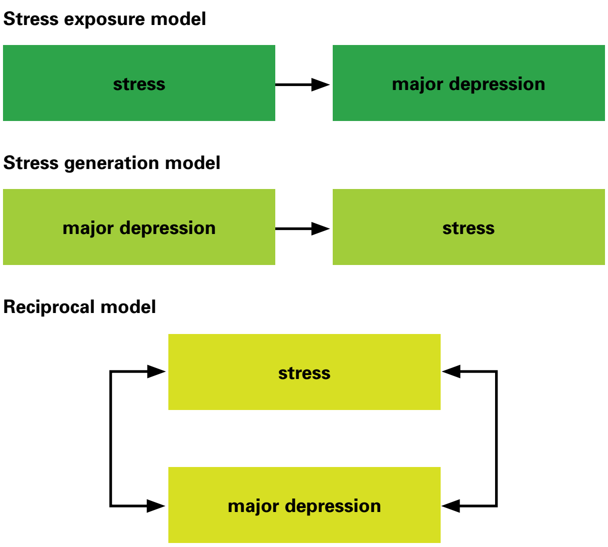


Figure 14.16 Three models of the relationship between stress and major depression

Learning Activity 14.8

Review questions

1. Name and briefly describe the three models that link stress and major depression.
2. Use a diagram and examples to explain how stressors and stress responses can interact and create a 'vicious cycle', resulting in the recurrence of major depressive episodes.
3. Explain how stress can contribute to the development of major depression with reference to different types of stressors and relevant examples.

Psychological management of major depression

Psychological management of major depression may take many forms and may or may not be accompanied by the use of medication. Two management methods are *cognitive behavioural therapy (CBT)*, which focuses on thought processes and behaviour, and *psychodynamic psychotherapy*, which focuses on underlying conflicts within the individual.

Cognitive behavioural therapy (CBT)

People with major depression have cognitive biases and unhelpful behaviours, so a commonly used psychological method involves assisting them to identify and change thoughts and behaviours responsible for maintaining their symptoms. As described in chapter 13, this approach is called cognitive behavioural therapy (see page 657).

According to cognitive behavioural theory, people with major depression think differently to people who do not have major depression. In particular, people who are depressed typically think in a biased, negative way and have a high number of negative automatic thoughts.

Automatic thoughts are habitual ways of thinking that involuntarily 'pop up' in a person's mind in response to a specific situation or event. Automatic thoughts can be positive, neutral or negative. *Negative automatic thoughts* immediately go through a person's mind when a situation or event triggers a negative emotional response (Foa & Olasov Rothbaum, 2002). They are similar to unwanted 'pop-ups' on a computer. For example, straight after finishing an exam, a person might think 'I bet I've failed that', 'I'm no good at exams' or 'I really am stupid'. These negative automatic thoughts will lower the person's *mood*, which, in turn, increases the probability of further negative automatic thoughts, thereby producing a vicious cycle that tends to maintain the major depression. The *behaviour* resulting from these negative automatic thoughts might include going home and not going out to celebrate with school friends after the exam. Other students may have thought they did well (a positive automatic thought) and others might not have been thinking about the possible outcome and are just happy to have the exam over with (neutral automatic thought).

Negative automatic thoughts have several characteristics. They are *automatic* (simply 'pop' into mind without any effort of the part of the individual); *involuntary* (people do not choose to have them and they are very difficult to avoid); *distorted* (do not fit all of the facts and are therefore inaccurate); *unhelpful* (they keep a person depressed, make it difficult to change and prevent them from getting what they want out of life); and *plausible* (accepted as facts and not questioned or challenged) (Fennell, 2001).

Psychologists have described a direct relationship between the amount and severity of someone's negative automatic thoughts and the severity of their depressive symptoms. This means that the more negative automatic thoughts a person has, and the more the person believes them, the more depressed they will become.

Once a person has major depression, cognitive biases exert a general influence over their day-to-day functioning. A *cognitive bias* is a predisposition, or tendency, to think in a certain way. There are many different types of cognitive biases; the five types that commonly occur in people with major depression are described in box 14.7.

In 1976, American psychiatrist Aaron Beck, who was very influential in the development and broad acceptance of the use of cognitive therapy in the management of major depression, proposed that cognitive biases of people with major depression become apparent in the form of a cognitive triad. As shown in figure 14.18, a *cognitive triad* consists of three major cognitive patterns, or ways of perceiving and thinking, that affect or influence each other. The first of these is the person's negative view of *themself*. They see themself as worthless, helpless, inadequate and 'not good enough'. For example, depending on the situation, they may think 'I'm a failure', 'no one loves me' or both. The second component is the depressed person's tendency to interpret *the world and their environment* in a negative way. For example, they may think 'there is nothing good out there'. The third component is the tendency to take a negative view of the *future*. For example,

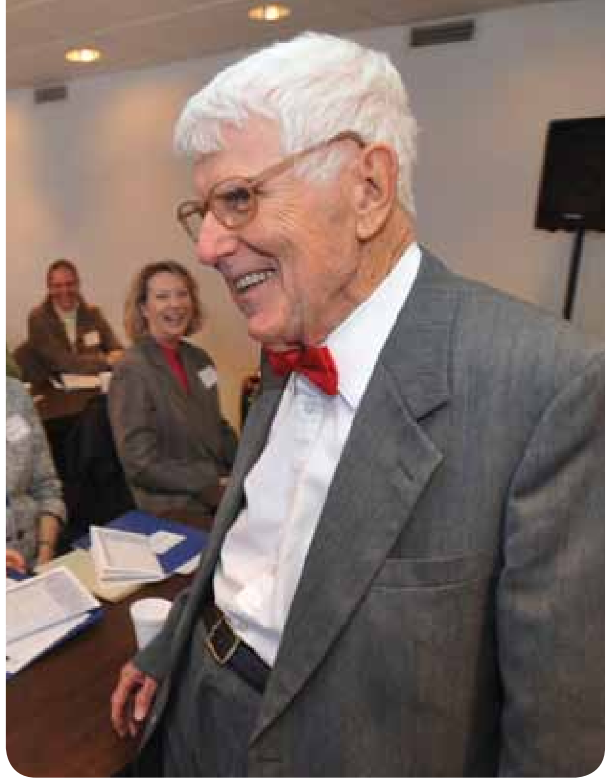


Figure 14.17 American psychiatrist Aaron Beck has been very influential in the development of cognitive therapy for major depression. He is also well known for developing the Beck Depression Inventory (BDI), which has been used by mental health professionals throughout the world for nearly two decades to support the diagnosis of major depression.

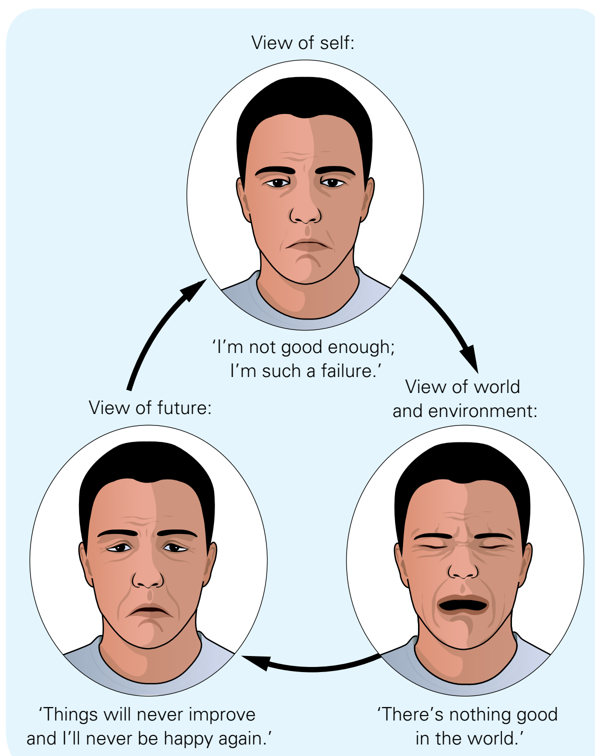


Figure 14.18 Beck's 1976 cognitive triad of major depression

when the person considers an important task they must perform, they expect to fail and they believe that their difficulties and suffering will continue forever. Thoughts such as 'things will never improve' and 'I will never be happy again' tend to be common.

In the management of major depression the *cognitive component* of CBT commonly involves helping the person to identify their negative automatic thoughts, carefully examine each negative automatic thought and evaluate how realistic it is. When this has been achieved, the goal is to replace negative automatic thoughts with more realistic, helpful and balanced thoughts.

Although this may seem quite straightforward, in practice it can be quite challenging. This is because negative automatic thoughts are *habitual* (so they may be difficult for people to isolate and pinpoint), they are *automatic* and *involuntary* (so they may be hard to control) and they are very *plausible* to the individual, especially when accompanying emotions are strong (so they may be difficult to challenge).

To help identify automatic thoughts, clients are often asked to keep a 'thought diary' in which they record what they think and how these thoughts make them feel (see figure 14.19). They are then encouraged to look for objective or 'factual' evidence that supports their negative automatic thoughts and evidence that does not support them. This involves encouraging them to directly examine and challenge any cognitive biases that may be occurring in their thinking. The final step involves helping the client develop alternative and more appropriate or balanced thoughts, which will then have a positive impact on their mood.

Box 14.7

Common cognitive biases in major depression

A *cognitive bias* is a tendency to think in a way that involves errors of judgment and faulty decision-making. Essentially, a cognitive bias is a 'mistake in thinking', which is why it is also sometimes referred to a *cognitive distortion* (Johnston, 2004). Common types of cognitive biases experienced by people with major depression include:

- *Over-generalisation*: drawing an 'exaggerated', unreasonable conclusion about one's ability, performance or worth on the basis of a single incident and then applying the conclusion across the board to related and unrelated situations; for example, thinking that 'everyone does not like me because Svetlana doesn't like me'.
- *Selective abstraction*: the process of focusing on a single detail taken out of context, while ignoring other important features of the situation, and considering the whole experience on the basis of the detail. An example is a woman attending a party and thinking afterward that no one liked her because she remembered the one awkward look someone gave her, but ignored the hours of smiles she received from other guests.
- *Dichotomous thinking*: sometimes called 'black or white thinking', occurs when someone is only able to see two options involving extremes and is unable to see the 'grey areas' or complexities of the situation. An example is thinking that you are a 'complete failure' for not achieving an A+ on a test.
- *Personalisation*: inappropriately relating external events to oneself. An example is thinking that someone cut a conversation short because of something you said or did.
- *Arbitrary inference*: making a judgment with no supporting information; for example, a businessman never takes his wife on any of his work trips. His wife is upset by this and concludes that her husband is concealing something from her, perhaps an extramarital affair, so she starts to feel depressed. She neglects other possible explanations.

20 November	Situation	Negative automatic thoughts	Emotions	Alternative thoughts	How I feel
	A group of my friends went out on Saturday afternoon and they didn't invite me to go.	Nobody likes me anymore.	Upset, lonely	Maybe they didn't invite me because they assumed I was working, as I usually do, on Saturdays. They didn't know that my boss had given me the day off. So, them going out without inviting me doesn't necessarily mean they don't like me anymore.	Relief, fine, alright
22 November	Situation	Negative automatic thoughts	Emotions	Alternative thoughts	Emotions
	I got 42% on my maths test.	I am so dumb. Everyone else did okay, except me. I'll never be good at anything.	Sad, anxious, embarrassed	My results were affected by the fact that I was sick for two weeks and couldn't study as much as I wanted to. Just because I didn't pass this maths test, it doesn't mean I'm stupid and won't ever be good at anything.	Positive, determined
23 November	Situation	Negative automatic thoughts	Emotions	Alternative thoughts	Emotions
	It's been 20 minutes since I sent a text to my friend and she hasn't texted me back.	My friend doesn't like me anymore or she's angry at me. I must have done or said something to upset her.	Sad, confused, upset	The reason my friend hasn't texted me back might have nothing to do with me at all. So could just be busy or maybe she has run out of credit or her mobile phone battery is flat or her mum has taken her phone from her. I will check with her tomorrow.	Fine, calm, untroubled

Figure 14.19 An example of a 'thought diary' of someone with major depression

Learning Activity 14.9

Developing more helpful and balanced automatic thoughts

For each of the negative automatic thoughts in the table below (which have led to the person experiencing a depressed mood), write an alternative, more helpful and balanced thought that is less likely to lead to a depressed mood.

Negative automatic thoughts	Alternative thoughts
When I met Harry in the street today he didn't smile at me. I must have done something to offend him.	
My girlfriend didn't eat that chocolate cake I baked for her. She thinks I am a terrible cook.	
This is hopeless. I should be able to do this by now. I'm never going to get the hang of roller-blading.	
I did that really badly. I might as well not bother at all.	
Matilda doesn't like me at all. She would never have shouted at me like that if she did.	

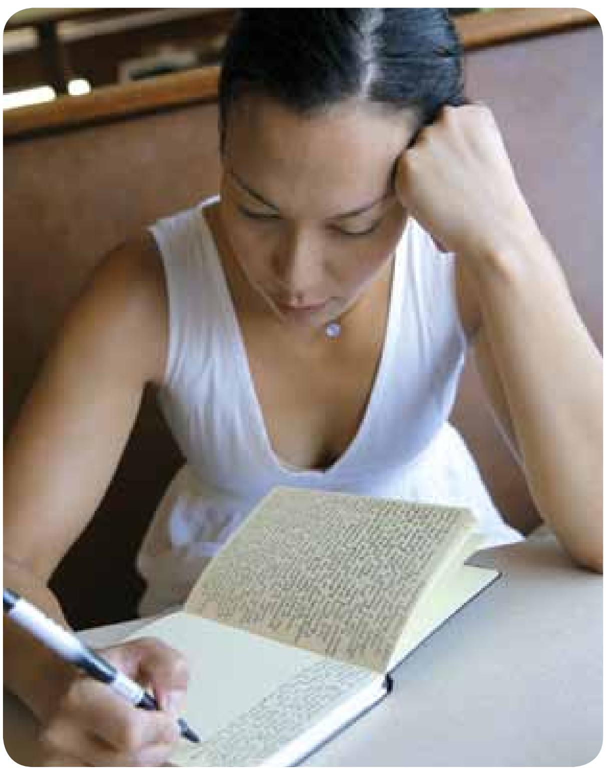


Figure 14.20 The cognitive component of CBT, using a strategy such as a thought diary, aims to help the person identify and challenge their negative automatic thoughts.

The *behavioural component* of CBT involves using behavioural techniques that are designed to maximise engagement in mood-elevating activities and overcome the behavioural inactivation symptoms that can frequently accompany major depression. *Behavioural inactivation symptoms* include anhedonia, fatigue, lethargy and lack of motivation. Generally, the greater the degree of the person's behavioural inactivation, the greater the need for using behavioural techniques.

A key assumption underlying the use of behavioural techniques is that people experiencing major depression are not engaging in enough pleasant and rewarding activities. Therefore, one of the most common behavioural techniques used in the management of major depression is activity scheduling. *Activity scheduling*, also called *reward planning* or *pleasant event scheduling*, is a technique designed to help a person with major depression gradually increase their activity levels and experiences of pleasure. The mental health professional and client will prepare an activity schedule, such as the one in table 14.2, with the goal of reintroducing the client to pleasurable events and activities. Activities as simple as watching TV and calling a friend are specified. There are five steps to implementing an activity schedule:

- *Monitoring current activities*: the person lists all activities they engage in during the day on an hour-by-hour basis. They then rate each hour's activity on two dimensions: pleasure (level of satisfaction experienced) and mastery (level of accomplishment). Each dimension is rated on a ten-point scale, with 0 equivalent to no pleasure and mastery and 10 equivalent to maximum pleasure and mastery. Monitoring activities in this way typically reveals that someone with major depression is engaging in very few rewarding activities. Often they spend hours in activities with a low level of satisfaction and accomplishment, such as watching television or sitting around mulling over negative thoughts.
- *Developing a list of rewarding activities:* the next step is to list activities the person can engage in that are likely to be rewarding. A goal is to include on the list activities the person currently enjoys, activities the person has enjoyed in the past when not depressed and activities the person has thought about trying but never has.
- *Planning rewarding activities:* next, the person is asked to schedule some activities from the rewarding activity list so that they can be undertaken. As part of this process, the person may be asked to predict in advance how much enjoyment and mastery they think they will experience from the activity, again using a 10-point scale.
- *Completing planned activities:* the person engages in the planned activities according to the schedule, and rates each activity for mastery and pleasure and records these ratings.
- *Evaluating the schedule:* after engaging in pleasurable activities for a week or so, the schedule is evaluated through discussion with the mental health professional to find out whether it is having its intended effect of lifting the person's mood. This requires the person to obtain a 'mood rating' for each day they followed their plan and a 'mood rating' for each day they did not follow their plan. If the schedule is not having any impact on the person's mood, it is possible that they have chosen activities that are too hard, that require too much planning, or that they don't really enjoy. Consequently, activities are reviewed with the mental health professional.

Table 14.2 Example of an activity schedule

	Thursday	Friday	Saturday	Sunday
9–10	School	School	Play tennis	Go for jog
10–11	School	School	Play tennis	Clean up room and do washing
11–12	School	School	Catch up and lunch with friends	Homework
12–1	Lunch	Lunch	Lunch with friends	Lunch with mum
1–2	School	School	Part-time job	Homework
2–3	School	School	Part-time job	Homework
3–4	School	School	Part-time job	Homework
4–5	Visit grandparents	Read book	Part-time job	Read book
5–6	Watch TV	Read book	Do chores at home	Help brother make dinner
6–7	Eat with family and clean up	Eat with family and clean up	Eat dinner at friend's house	Catch up with cousins
7–8	Homework	Watch TV	Go to movie	Catch up with cousins
8–10	Homework, read book, sleep	Call friends, watch TV, sleep	Go to movie, sleep	Organise the week, read book, sleep

Box 14.8

Cybertherapy: MoodGYM

Developed by the Centre for Mental Health Research at the Australian National University in Canberra, MoodGYM is a free internet-based computerised cognitive behavioural therapy (C-CBT) program designed to prevent depression in young people.

MoodGYM can be accessed at www.moodgym.anu.edu.au. It consists of five modules, a workbook and some interactive extras, including an interactive game. It includes options for assessing anxiety and depression, 'warpy' thinking, life-event stress, parental relationships and pleasant event scheduling.

MoodGYM has been evaluated by independent researchers and the results showed that users who accessed the program weekly ended up with markedly reduced depressive symptoms compared to a control group of non-users (Christensen, Griffiths & Jorm, 2004).

Figure 14.21 The behavioural component of CBT aims to counteract the anhedonia, lethargy and lack of motivation that frequently accompanies major depression.

Learning Activity 14.10

Review questions

1. **a** Suggest a suitable aim of cognitive behavioural therapy (CBT) in the treatment of a client with major depression.
   b What key assumption would underlie this aim?
   c Give two examples of roles required of the client during CBT.
2. **a** What are automatic thoughts?
   b Outline the key characteristics of negative automatic thoughts.
   c Give an example of how automatic thoughts can affect behaviour.
3. **a** Name and briefly describe the three components of the cognitive triad of depression, with reference to examples.
   b Explain the relevance of the cognitive triad to major depression.
   c Give an example of another cognitive bias common among people with major depression.
4. **a** What is the aim of the cognitive component of CBT in the treatment of major depression?
   b Outline a procedure that may be used to achieve this aim.
5. **a** What is the aim of the behavioural component of CBT in the treatment of major depression?
   b Outline a procedure that may be used to achieve this aim.

Learning Activity 14.11

Visual presentation on CBT

Construct a flow chart that summarises the possible management of major depression using CBT. Ensure your flow chart:

- starts with a list of commonly occurring thoughts, feelings and behaviour associated with major depression
- refers to the aim(s) of the therapy in relation to major depression
- outlines key assumptions of CBT when used for major depression
- identifies possible therapeutic techniques
- distinguishes between key roles of the mental health professional and the client during the therapy.

Psychodynamic psychotherapy

There are many psychodynamic explanations of why a person develops depressive symptoms. One of the most prominent explanations was proposed by Sigmund Freud. In 1917, Sigmund Freud wrote an essay in which he discussed his observations of the similarities between those suffering from depression (which he called *melancholy*) and the response to the death of a loved one. Both involve extreme sadness, loss of appetite, disturbed sleep and withdrawal from social life. Based on his observations, Freud proposed that major depression is caused by unconscious grief over real or imagined 'losses'. In reaction to the real or imagined loss, Freud believed the person then develops feelings of self-hatred (or *self-reproach*). The person then turns this self-hatred 'inwards' and consequently develops the symptoms of major depression.

Believing that major depression results from grief over real or imagined losses held or experienced at an unconscious level, psychodynamic psychotherapy seeks to help people bring these underlying issues to consciousness and work through them. Generally, **psychodynamic psychotherapy**, also called *psychoanalytic psychotherapy*, aims to help people understand the roots of emotional distress by exploring unconscious conflicts, motives, needs and defences. Psychodynamic psychotherapy is based on an assumption that all mental disorders are caused by unresolved psychological conflicts that occur in the unconscious part of the mind, beneath conscious awareness. These conflicts have their origins in early childhood experiences during which our instinctive impulses and society's view of what is 'acceptable' behaviour often clash.

When using psychodynamic psychotherapy for the management of major depression, therapists use a range of psychodynamic techniques, which may include free association, dream interpretation, identification of defence mechanisms and displays of transference.

Free association is a therapeutic technique in which the client is encouraged to say whatever comes to mind, regardless of how painful, embarrassing, illogical or irrelevant it might seem, without any interference by the psychotherapist. The psychotherapist listens carefully to identify and assess which 'themes' are the most involved in the development (and maintenance) of the person's major depression. For example, themes may include low self-evaluation, self-criticism, exaggeration of problems and difficulties, and unconsciously held wishes to escape or die.

The client may also be encouraged to share *dreams* they have as these may shed light on what is occurring unconsciously. Psychologists who adopt the psychodynamic perspective believe that dreams symbolically represent information stored in the unconscious mind. Partial evidence for the psychodynamic view has been obtained from research studies on the dream content of people with major depression. It has been found that the content of the dreams recalled by people with major depression typically reflect three common themes: loss, defeat and deprivation. For example, a woman might dream that she goes into a shoe shop, finds the perfect pair of shoes and then discovers they are both for the same foot. Or a man might dream that he would constantly lose money to a soft-drink machine without ever receiving a drink.

The psychotherapist may also examine the *defence mechanisms* that the client is likely to be using. Although defence mechanisms may block or temporarily ease painful feelings, in the long term they can worsen symptoms. Therefore, psychodynamic psychotherapists believe that it is important to help clients become more aware of the specific defence mechanisms they are using. It is believed that people with major depression typically use the defence mechanisms called denial, displacement and repression (Gabbard, 2007). **Denial** involves refusing to recognise or accept that something has occurred or is currently occurring. It is believed that someone with major depression uses denial to avoid acknowledging and expressing their unconscious feelings of anger. That is, this defence mechanism is primarily used to keep anger from entering the conscious level of the mind, thereby preventing its awareness. Psychodynamic psychotherapists therefore explore denied feelings with their clients who have depression and help them to more effectively express, tolerate and manage their anger (Busch, Rudden & Shapiro, 2004).

During therapy sessions, the psychotherapist would also be carefully observing the transference that is occurring. **Transference** occurs when a client unconsciously responds to the therapist as if they are a significant person in their life (often a parent), and shifts, or 'transfers', unresolved conflicts and fantasies to their therapist. Freud reported that many of his patients seemed at some point to begin to place certain feelings, like romantic love or parental love, onto the therapist. When this process occurs, the therapist can use this position to help the client regain or discover more 'normal' feelings by responding in ways unlike those of the person to whom the original feelings are relevant. For example, a child who has been psychologically abused or physically neglected by a parent may express transference by viewing the therapist as a parent. Because the child expects this role of parent to be negative and harmful, recovery of abuse may be possible when the therapist is neither abusive nor neglectful. Therefore, the psychotherapist can use this transference to provide what the parent did not provide; that is, a stable and accepting relationship in which the client is very important. It is thought that the way the person relates to the therapist, and the feelings the therapist develops for the person, provide clues about the nature of problems the person may have with their interpersonal relationships in everyday life.

Psychodynamic psychotherapists expect that in the course of psychotherapy, clients with depression will eventually gain an awareness of the losses in their lives, cope with losses more effectively and make corresponding changes in their functioning.

Figure 14.22 Believing that major depression results from unconscious grief over real or imagined losses, psychodynamic psychotherapy seeks to help clients bring these underlying issues to consciousness so that they can be understood and resolved by the client.

Despite reports of the success of psychodynamic psychotherapy with individual cases, research studies indicate that psychodynamic psychotherapy is only occasionally helpful in cases of major depression. Two features of the approach may limit its effectiveness. First, clients with depression may be too passive and feel too lethargic to fully engage in the detailed discussions that psychodynamic psychotherapy requires. Second, they may become discouraged and end therapy early when this long-term approach is unable to provide the quick relief that they so desperately need. Generally, psychodynamic psychotherapy seems to be of greatest help in cases of major depression that clearly involve a history of childhood loss or trauma, a longstanding sense of emptiness, feelings of perfectionism and extreme self-criticism (Comer, 2010).

Box 14.9

Grief and mourning

Each year, thousands of Australians experience the death of a close relative or friend. The grief and mourning that may result from such a painful loss can involve many symptoms of major depression. However, grief and mourning are natural responses to the death of a loved one and most people eventually come to terms with their loss and gradually resume their lives.

Although sometimes used interchangeably in relation to loss, grief and mourning are different. Grief is 'internal' and involves thoughts and feelings, whereas mourning is 'external' and involves behaviour. More specifically, *grief* refers to the private personal thoughts and feelings we have following loss, whereas *mourning* refers to our directly observable behaviour following loss. For example, grief involves the sadness, emptiness, anger, bewilderment, cognitive distortions and other thoughts and feelings that we may experience. Sometimes, we may hide our thoughts and feelings and other people remain unaware of how we are grieving. Conversely, mourning is the external things we do; for example, holding a funeral, the lighting of a candle and the observable signs of grief such as crying.

In her world-renowned book called *On Death and Dying* (1969), Swiss-born psychiatrist Elisabeth Kübler-Ross describes five stages of grief through which she believes we all progress following the death of a loved one. It is thought that people who do not progress through the five stages may need the help of a mental health professional. The five stages are:

- *Stage 1: Denial* (the 'this can't be real' stage: 'This is not happening to me', 'There must be a mistake')
- *Stage 2: Anger* (the 'why me?' stage: 'How dare you do this to me!', either referring to God, the deceased, or oneself)
- *Stage 3: Bargaining* (the 'if I do this, you'll do that' stage: 'Just let me live to see my son graduate')
- *Stage 4: Depression* (the 'defeated' stage: 'I can't bear to face going through this; putting my family through this')
- *Stage 5: Acceptance* (the 'this is going to happen' stage: 'I'm ready; I don't want to struggle anymore').

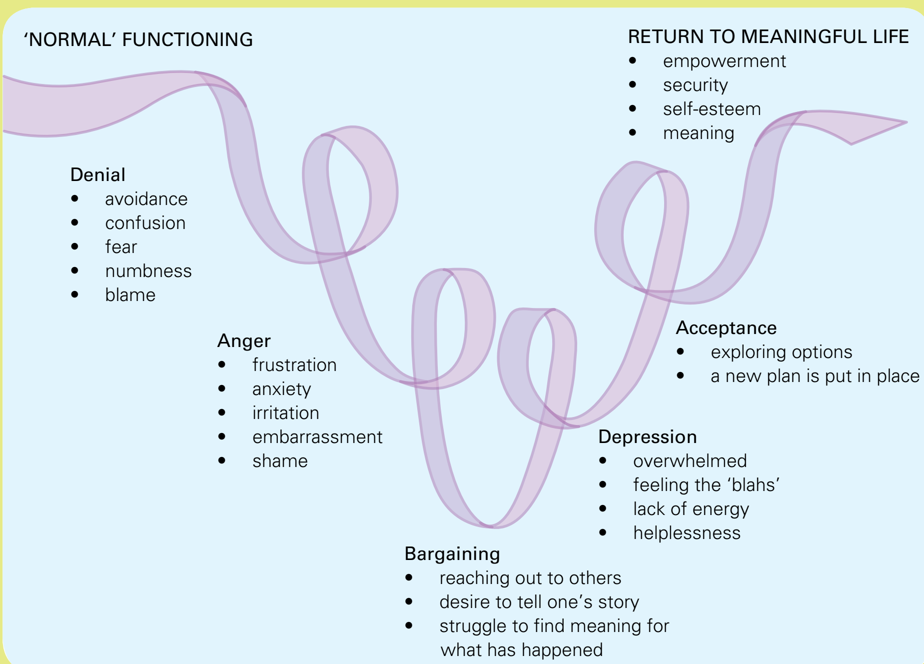


Figure 14.23 Kübler-Ross's five stages of grief in response to the death of a loved one

Learning Activity 14.12

Review questions

1 **a** What is psychodynamic psychotherapy?
  b What is its key assumption?
2 How did Freud explain major depression?
3 Briefly describe, with reference to examples, how each of the following may be used in the treatment of major depression by a psychodynamic psychotherapist:
  a free association
  b dream interpretation
  c identification of defence mechanisms
  d transference.
4 Give two examples of roles required of the person with depression during psychodynamic psychotherapy.

Learning Activity 14.13

Visual presentation on psychodynamic psychotherapy

Construct a flow chart that summarises the possible management of major depression using psychodynamic psychotherapy. Ensure that your flow chart:

- refers to the aim(s) of the therapy in relation to major depression
- outlines key assumptions of psychodynamic psychotherapy when used for major depression
- identifies possible therapeutic techniques
- distinguishes between key roles of the therapist and the client during the therapy.

Socio-cultural contributing factors

Socio-cultural factors that may contribute to the development and persistence of major depression can be divided into two categories. One category, called *risk factors*, includes those factors within an individual's environment that can *increase* the likelihood of their developing major depression. The other category, called *support*, or *protective factors*, includes those factors that can *decrease* the likelihood of, or 'protect' an individual from, developing the disorder.

Risk factors

Risk factors for major depression include *abuse* (experiencing maltreatment), *poverty* (having inadequate necessities of life), *social isolation* (having minimal social interaction) and *social stressors* (difficulties in relationships with others). All of these factors involve negative situations or events that can promote negative thoughts, feelings and behaviours.

Abuse

Psychologists have for a long time been aware that abuse can have disastrous effects on mental health and increase vulnerability to developing major depression. Generally, **abuse** involves psychological and/or physical maltreatment of a person by another, often to intimidate them and to get them to do what the abuser wants. This may occur in a number of different ways, as suggested by the names of the four types of abuse that are most commonly described: physical abuse, sexual abuse, emotional abuse and neglect.

Physical abuse occurs when someone suffers, or is likely to suffer, significant physical harm from an injury inflicted by someone else. The injury may be inflicted intentionally or may be the unintentional consequence of physical punishment or physically aggressive treatment. Injury may take the form of bruises, cuts, burns or fractures. *Sexual abuse* occurs when a person uses power or authority over someone else to involve them in sexual activity of some kind. Force, threat or manipulation may be used to get someone to do something against their will. *Emotional abuse* may involve passive or neglectful acts and/or the deliberate, cruel and active rejection of someone. It is sometimes described as 'mental cruelty' or 'psychological battering' with the intention of causing psychological harm. *Neglect* is abuse by omission; that is, a failure to take required action. For example, a child may experience abuse through neglect when a parent does not provide basic necessities such as food, clothing, medical attention or supervision to the extent that the child's health and development is, or is likely to be, significantly harmed.

There is considerable evidence that the early experience of abuse may predispose an individual to respond to stressors in adulthood by developing a major depressive episode. This is more likely to occur when the abuse that has been experienced is severe and chronic (Gabbard, 2007). Abuse has also been associated with an earlier age of onset of major depression. Furthermore, the depressive effects of abuse tend to be longer lasting for people who experience onset of major depression at an early age, as compared to people who experience onset of major depression at an early age but have no history of abuse. This often results in the management of depression being less effective and a higher risk for experiencing recurrent depression.

It is, however, difficult to isolate the effects of abuse during childhood from other negative aspects of parenting and the home environment, such as the effects of either or both parents suffering from a mood disorder or substance abuse disorder, low socioeconomic status of the family or marital problems experienced by the parents. For example, in an Australian study on links between the experience of child abuse and major depression, researchers investigated the short-term effects of sexual abuse on 84 sexually abused children, as well as various aspects of their family circumstances. The researchers found that sexually abused children were more likely to experience a major depressive episode. However, within families in which a child had been sexually abused, there was also more marital breakdown, unemployment and communication problems, and mothers tended to have poor mental health (Stern & others, 1995).

In another Australian study, researchers studied links between the experience of abuse by adult females and depression using a sample of 1257 women attending 30 general medical practices throughout Victoria. All participants completed the Composite Abuse Scale (which measures abuse in an adult intimate relationship), a depression inventory (either the Beck Depression Inventory or the Edinburgh Postnatal Depression Scale) and a measure of physical health (the SF-36). The results showed that 18% of women (218 out of 1213) were assessed by the researchers as 'probably' depressed and were significantly more likely to have experienced abuse in an intimate relationship than women who were not depressed. The researchers concluded that physical, emotional and sexual abuse are strongly associated with depression in women attending general practice (Hegarty & others, 2004).

Many psychologists believe that victims of abuse in a marital or de facto relationship can develop a feeling of helplessness over the course of their ordeal, which may explain why they stay with their abusive partners. When helplessness is learned by women in abusive relationships, they believe that nothing whatsoever can be done to stop the repeated episodes of abuse, that there are no alternatives to staying, and that the criminal justice system will not be able to protect them if they leave. In turn, they typically develop feelings of depression, low self-esteem and self-blame (Comer, 2010).

Poverty

Poverty is a concept used to describe the situation for people in a society who lack in the basic necessities of life. People in poverty usually suffer a level of deprivation to the extent that they are unable to meet minimum standards of wellbeing. Critical aspects of wellbeing include having adequate resources for attaining basic necessities such as food, water, shelter and clothing; access to acceptable levels of health and education; and freedom from excessive vulnerability to adverse situations and events that are stressors and often exacerbate stress already being experienced due to people's deprivation and inability to participate as they would like to in everyday life.

While it is obvious that poverty in Australia is not of the same scale or severity as in the developing world, poverty still exists according to contemporary definitions of poverty. One widely accepted definition describes **poverty** as an enforced lack of socially perceived necessities. This means poverty is a relative term, defined by a society, to describe people who cannot participate in the activities that most people take for granted. Some of the experiences of people living in poverty, such as juggling payments of bills, are widely shared by others in the community. Other aspects of their lives are almost unimaginable to most of us, such as the experience of seeking food parcels from emergency relief agencies or living on the streets (Australian Council of Social Services, 2010).

Figure 14.24 Poverty is an enforced lack of basic necessities of life. In Australian society, poverty is usually measured in terms of economic resources, particularly level of income.

For the purpose of research, poverty is usually measured in terms of economic resources, such as level of income, to investigate how continually having little or no money prevents people from obtaining a minimum standard of living and from fully participating in society. Since access to economic resources impacts on an individual's ability to access 'societal' resources, an economic variable such as level of income is often used to define an individual's socioeconomic status so that they can be compared with others who have the same and different levels of socioeconomic status. **Socioeconomic status** (SES) is a combined and total measure of an individual's or family's 'social' and 'economic' position (that is, 'status') in society, relative to ('compared with') others, based on income, education and employment (or occupation). SES is typically divided into three categories—*high SES*, *middle SES* and *low SES*—to describe the level of socieconomic wellbeing that an individual or family may have. Poverty is associated with low SES, so these two terms are often used interchangeably. Furthermore, low SES is often used to define poverty for the purposes of psychological research.

There is considerable research evidence that poverty is strongly associated with major depression. However, the specific nature of the relationship remains unclear. For example, psychologists continue to debate whether being in poverty can result in the development of major depression or whether having major depression can result in poverty due to an inability to fully participate in society.

Two hypotheses have been proposed to explain research findings of higher rates of mental disorders, including major depression, among people of low SES when compared with people with a higher SES. These are called the *social drift hypothesis* and the *social causation hypothesis*.

The **social drift hypothesis** proposes that having a mental disorder impairs psychological and social functioning and this leads to 'social drift' down the socioeconomic scale and ultimately into poverty. Therefore, according to this hypothesis, major depression can *cause* poverty. The individual's deteriorating mental condition occurs *first*, resulting in their downward social drift. When an individual develops a mental disorder, they become less able to maintain their economic resources, such as access to a regular income, as a result of their impaired functioning. For example, when suffering from major depression, people are unable to function as they normally do, and may therefore be unable to maintain full-time employment. This can leave them without any means of financially supporting themselves (and their family). In turn, the inability to financially support oneself (or others) can result in a gradual 'downward drift' into poverty as economic resources become increasingly scarce.

In contrast, the **social causation hypothesis** proposes that poverty itself is a major contributor to the development of a mental disorder such as major depression. This is said to occur because people living in poverty are exposed to more stressors and are more likely to be chronically stressed due to their life circumstances. These stressors act as triggers for the onset of symptoms and the loss of the individual psychological abilities necessary for effective everyday functioning. In addition, people of a low socioeconomic status have access to less social support and fewer 'social networks' (connections with other people) than people of a higher socioeconomic status. These factors can both contribute to the onset of major depression and also sustain it. Therefore, according to the social causation hypothesis, major depression is *caused* by the collective influence of different factors within the individual's social environment.

As shown in figure 14.25, the relationship between poverty and major depression is direct, with either leading to the other. However, the relationship is also more complex and multifaceted than this figure suggests. There is research evidence in support of both the social drift and social causation hypotheses. It seems that poverty is a significant risk factor for major depression or in accelerating its onset, and that major depression is a significant risk factor for poverty or further impoverishing one's socioeconomic circumstances. In addition, there is considerable research evidence that low parental socioeconomic status significantly increases the likelihood of children developing major depression at some point in their life.

Figure 14.26 demonstrates the complexity of the relationships between poverty and mental disorders.

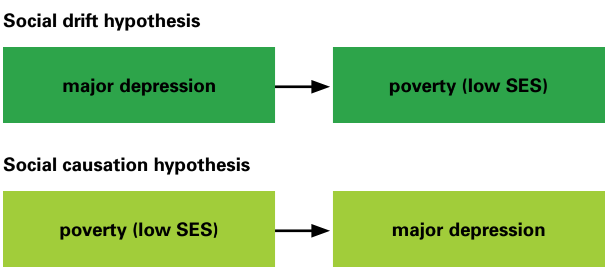


Figure 14.25 Two hypotheses on the relationship between poverty (defined by low SES) and major depression. The social causation hypothesis proposes that poverty causes a life situation that, in itself, increases the risk of developing major depression. The social drift hypothesis proposes that poverty is a consequence of a major depression.

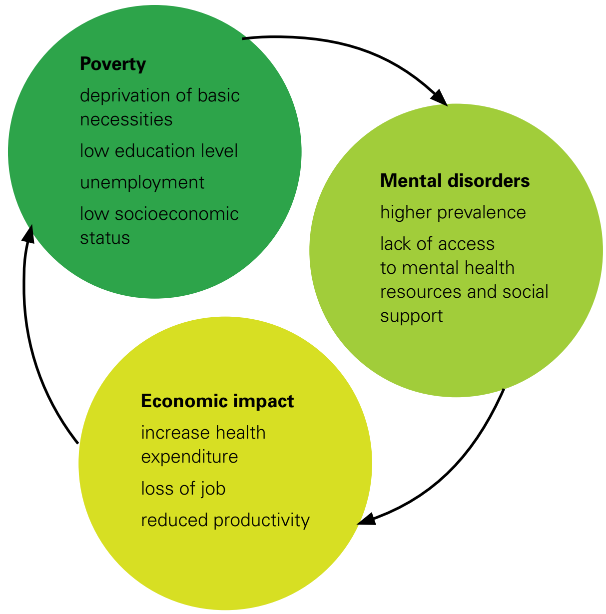


Figure 14.26 The relationship between poverty and mental health is complex and multidimensional. The World Health Organization describes the relationship as a 'vicious cycle of poverty and mental disorders' (2001, p. 14).

Learning Activity 14.14

Review questions

1 **a** Explain the meaning of abuse, with reference to different types of abuse.

b In what way is abuse a risk factor in major depression? Explain with reference to both child and adult victims of abuse.

2 Why is it difficult to isolate the potential effects of abuse in the development of major depression?

3 **a** Explain the meaning of poverty.

b How is poverty commonly measured? Suggest another way of measuring poverty for research purposes. Give a reason for your answer.

c Identify two groups in Australian society that you believe are likely to be in poverty or experience a higher incidence of poverty. Give a reason for each choice.

4 Does poverty lead to major depression or does depression lead to poverty? Explain with reference to the social drift and social causation hypotheses and relevant examples.

5 Would you expect a victim of abuse living in poverty to be more or less predisposed to the development of major depression? Explain your answer.

Social isolation

Although there are times when we prefer to be alone, we spend a great deal of our lifetime in the presence of or interacting with others as a member of one group or another and within the wider community in general. From the time we are born, we become members of groups; for example, our family, peer or friendship groups, sports teams, clubs and organisations. Group membership continues into adulthood to include the workplace, social groups and romantic relationships. We become members of some groups—such as our family, gender and nationality—because we had no choice. However, we also choose to belong to other groups. Almost everyone is voluntarily a member of many groups. A major reason group membership is attractive to individuals is because of the simple desire to be with others. Some psychologists have proposed that we all possess basic social needs to feel a sense of belonging and acceptance, and to have close interpersonal relationships with family, friends, intimate partners, and so on. Furthermore, these social needs are described as a motivating force that can drive, direct and sustain our behaviour until our needs are met. While individual differences exist in the strength of our needs, and how they are met, satisfying these needs involves frequent positive interactions with other people. When someone experiences a strong or persistent need or desire for contact or interaction with others, but is unable to meet this need, they are considered to be socially isolated.

Social isolation is the absence of social contacts, interactions and relationships with family, friends, neighbours, colleagues and acquaintances on an individual level, and with people in the wider community and society at large on a broader level. The term is specifically used in relation to contact with members of the same species. This means that someone may have a pet animal and enjoy contact and interaction with their pet but is socially isolated if there is no contact with other people when needed. Social isolation may also be perceived or actual. Perceived social isolation is subjectively determined, whereas actual social isolation can be objectively determined.

Perceived social isolation is the individual's personal interpretation of having little or no access to social contact, interaction and relationships with other people. The individual's perception of social isolation, and the feelings accompanying it, occur regardless of the actual number of people in the individual's social network. For example, an individual can have what others judge to be a relatively large number of people in their social network but still subjectively feel socially isolated if the quality or quantity of contacts who are available to them if needed is perceived to be low. In contrast, *actual social isolation* occurs when the individual actually is socially isolated. The person may have a social network but the number of people in it is usually limited and most or all people are likely to be difficult to access or inaccessible when needed. Actual social contact can be objectively determined by simply counting the number of potential contacts. For someone who is socially isolated, this is typically a low number of people, although having few contacts does not necessarily mean that someone is socially isolated; for example, a person may prefer one or two good quality relationships rather than a large number of superficial relationships. Actual social isolation is more likely to be experienced by people living in rural and remote areas of Australia (Hawthorne, 2007). However, actual social isolation is only thought to cause perceived social isolation when there is a difference between the 'desired' number of social contacts a person has and the 'actual' number of social contacts a person has (that is, desired is less than actual). There is considerable research evidence showing a relationship between social isolation and major depression. This has been obtained through studies with both animals and humans.

Animal studies in which monkeys are socially isolated during infancy by preventing any contact or interaction with the mother and/or other monkeys from the time of birth have found that infant monkeys subjected to such conditions develop behaviour patterns and symptoms similar to those experienced by people with major depression. The infant monkeys are observed to show signs of despair, withdrawal and agitation, as well as frequent crying, loss of appetite and disruption to normal sleep patterns. Similar findings have been observed in a wide range of other animals, including mice, rats, dogs, parrots and geese (Colotla, 1979). Like monkeys, rats that are

Figure 14.27 When monkeys are socially isolated from birth, they develop behaviour patterns and symptoms similar to those experienced by people with major depression.

Figure 14.28 Koko the chimpanzee in his cage at Skopje Zoo in Macedonia. Authorities firmly believe that Koko suffered from major depression after having lived alone for the entire ten years of his life since his birth at the zoo. Koko's father died shortly before his birth and his mother died when he was just nine months old. In late 2009, Koko was transferred to Apenheul Primate Park just outside Amsterdam where he now lives with other primates.

housed alone in cages and denied social interaction for prolonged periods (one to four months) tend to show isolation-induced depressive behaviours. When compared with a control group of non–socially isolated rats, socially isolated rats are also much less physically active, demonstrate greater loss of appetite and a decreased interest in sexual behaviour (Wallace & others, 2009).

Numerous studies with humans have also found a strong relationship between social isolation and major depression. For example, Australian psychologist Graeme Hawthorne (2008) conducted a study on the prevalence of perceived social isolation among a sample of 3015 adult Australians. A key finding of the study was that perceived social isolation was 'overwhelming' in its strong association with major depression. In addition, people who were living alone were twice as likely to have major depression when compared to those living with others.

Similar findings have been obtained from studies with adolescents; for example, adolescent perceptions of the quality and closeness of their peer relationships are consistently associated with major depression (Hall-Lande & others, 2007). Furthermore, research findings indicate that major depression is a particular issue for adolescents living in regional (rural) areas. For example, Australian psychologist Susan Quine and her colleagues (2003) conducted 81 small group meetings with adolescents (35 with boys and 46 with girls) in both regional and urban areas of New South Wales. The results indicated that certain health concerns were common to both regional and urban adolescents, such as use of alcohol and illegal drugs, bullying, diet and body image.

However, major depression and youth suicide (which was considered by participants to be linked to depression) were major issues raised more frequently by those adolescents living in regional areas. Quine and her colleagues concluded that the fact that depression and youth suicide were raised almost exclusively by young people in regional groups as opposed to urban groups emphasises the importance of these issues for adolescents living in regional areas who are likely to be experiencing more social isolation.

One explanation of the relationship between social isolation and major depression in humans is that social isolation results in a tendency to *overthink*, or ruminate. **Rumination** involves repeatedly thinking about or dwelling on undesirable thoughts and feelings, such as problems or moods, without acting to change them. American psychologist Susan Nolen-Hoeksama and her colleagues have studied rumination extensively and have found that rumination is a significant risk factor for the development of major depression. Rumination is a kind of negative thinking that not only prolongs an undesirable mood or worsens depression, but also impedes successful mood-changing strategies, such as distraction, that can blunt the emotional effects of problems, disappointments and setbacks (Nolen-Hoeksema, Parker & Larson, 1994).

Social stressors

Social stressors are stressors arising from social roles we perform in everyday life that are generally considered problematic or undesirable. Sometimes called *interpersonal stressors*, social stressors may be problems with friends, family, work colleagues or a partner; not 'getting on' with someone during groupwork at school because they aren't contributing; or being harassed or bullied by someone. Difficulties in interpersonal relationships, particularly those that are ongoing chronic problems, can lead to a sense of helplessness or hopelessness about one's ability to negotiate and resolve difficult interpersonal situations. This seems to be particularly the case for women, as interpersonal relationships are, on average, both more central to and more valued by women than by men (Hersen & Thomas, 2005; Kendler, Myers & Prescott, 2005).

In a longitudinal study involving 815 Australian adolescents, 15-year-old girls reported both higher rates of acute social stressors and chronic problems with romantic and close-friend relationships than did boys. Girls also tended to be more affected by these types of stressors. For example, among girls and boys who experienced similar levels of stress in response to problems with interpersonal relationships, girls showed significantly higher levels of major depression than boys (Shih & others, 2006).

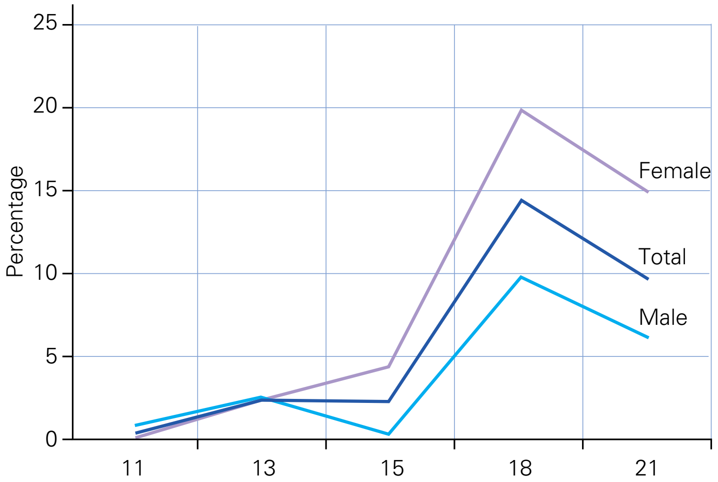
According to American psychologists Gerald Klerman and Myrna Weissman (1993), social stressors arising from interpersonal relationships that are risk factors for major depression include role disputes and role transitions.

A *role dispute* occurs when an individual and at least one other person of significance in their life have different or unequal expectations about the terms and/or guidelines for behaviour within the relationship. Some common examples of role disputes that adolescents experience include disagreements about levels of freedom and independence, arguments with parents about choice of a peer group, and disagreements with a romantic partner about the amount of time spent with friends.

A *role transition* involves adjustment to a life change that requires a change in behaviour associated with an old role to enable a new role to be performed. Examples of situations requiring role transition include the sudden loss of a loved one, changes in family structure due to a divorce or separation, and the ending of a romantic relationship or a significant friendship. These types of transitions have all been found to be risk factors in the development of major depression, possibly because they involve a loss of familiarity and comfort with the current role. A person may develop symptoms of major depression in response to a role transition if the role is placed upon them unexpectedly, the new role is unwanted, they are not psychologically or emotionally prepared for the new role, or the old role is missed (Strohschein, 2005; Grant & Compas, 1995; Monroe & others, 1999).

Adolescence is the stage in the human lifespan that is associated with a dramatic increase in the importance of peers and romantic relationships. It seems that, during adolescence, gender differences in the need to belong and to have close interpersonal relationships with other people become very important and make girls more

Figure 14.29 Adolescent girls are particularly vulnerable to major depression and this may be due to their use of co-rumination when dealing with social stressors.



Source: Hankin, B.L. & others (1998). Development of depression from preadolescence to young adulthood: Emerging gender differences in a 10-year longitudinal study. *Journal of Abnormal Psychology, 107*(1), 128–140.

Figure 14.30 Studies show that for females there is a progressive rise in depressive symptoms from age 15, and by age 18 females exhibit at least twice the prevalence of symptoms than do males.

emotionally vulnerable to pressures for popularity and acceptance by peers and potential romantic partners. Adolescent girls in particular often discuss problems associated with friendships, romantic desires, experiences and failures with their peers. It is possible that this may place adolescent girls at a higher risk of developing major depression than boys because they use *co-rumination* to deal with social stressors, especially those involving role disputes and transitions (Sheeber & others, 2007; Rudolph, 2002).

Co-rumination refers to repeatedly discussing and revisiting problems, speculating about them without acting to change them, and focusing on negative thoughts and feelings associated with them. Essentially, co-rumination involves rumination with someone else but with the negative thinking being verbalised. American psychologist Amanda Rose (2002) conducted research in which she found that co-rumination is a risk factor in the development of major depression. Her results showed that girls co-ruminate more than boys, and that this becomes more pronounced in adolescence, coinciding with the emergence of gender differences in major depression (see figure 14.30). Co-rumination may therefore help explain why adolescent girls are more likely than boys to develop major depression.

Why chatting too long on Facebook can get a girl down

As anyone who's shared a house with a teenage girl and a telephone will know, they certainly like to talk.

But too much chatting with their friends can make girls prone to anxiety and depression, a study has found.

The opportunity for youngsters to share their problems through texting, email and social networking sites such as Facebook has never been greater.

But excessive discussion—known to the experts as co-rumination—can be unhelpful.

Repeated conversations among adolescent girls, particularly about romantic disappointments, worsen their mood and create negative emotions, according to the study.

'There is a wealth of communication technology available to teens today that allows them to talk over and over again about the same emotional difficulties,' said Dr Joanne Davila, the psychology professor who led the research.

'Texting, instant messaging and social networking make it very easy for adolescents to become even more anxious, which can lead to depression.'

'Teenage friends have always chatted about their problems, asking each other why a boy didn't call or if they should break up with a boyfriend,' she added.

'But frequently discussing the same problem can intensify into an unhealthy activity for those who use Facebook and other electronic means to obsess about it,' she said.

Dr Davila and her colleague Lisa Starr, at Stony Brook University in New York, interviewed 83 girls aged around 13—the age when their risk of depression starts to increase.

The girls, who were accompanied by a parent, were asked how much time they spent talking to friends about their problems, how much they encouraged each other to do so, and their tendency to revisit the same problems.

They were contacted again a year later to follow them up.

The girls were tested for depressive symptoms on both occasions and asked about romantic experiences considered normal for early teenagers, such as having been asked on a date and having been kissed.

Higher levels of discussing problems with friends were 'significantly' linked with higher levels of depression, according to the report in *The Journal of Adolescence*.

More romantic experience was linked both to excessive talking and more depressive symptoms.

Dr Davila said: 'We wanted to start the process at the beginning and follow them over time to see what happens.'

'Lots of talking can help if those involved have strong problem-solving skills because it helps them reach a solution and it builds friendships.'

However, many teenagers have not developed effective ways of dealing with their troubles constructively. 'They often don't realise that excessive talking is actually making them feel worse,' Dr Davila said.

'Parents may need to be aware when they are obsessing about a setback and set limits on the discussion.

'They could change the subject, for example, after helping their daughter sum up how they feel about the problem, or think about more active ways to deal with it.'

Dr Davila said that although girls spend more time discussing their personal problems, the growth of electronic communications could lead to more co-rumination between teenage boys.

She added: 'It's most likely they are discussing the game last night or meeting up, but there's a possibility they could start discussing emotional problems more than in the past which would put them at risk.'

Source: Hope, J. (2009, January 30). Why chatting too long on Facebook can get a girl down. *The Daily Mail*, www.dailymail.co.uk/health/article-1132788/Why-chatting-long-Facebook-girl-down.html.

Box 14.10

A cross-cultural comparison of public beliefs about causes and risk factors for major depression

Mental health professionals and researchers view major depression as having complex causes involving an interplay of biological, psychological and social factors. However, the public's beliefs about causes are generally less sophisticated. Studies from Australia, Ireland, Germany, Switzerland, the UK and the USA have all found that social factors were most often seen as the causes of major depression, whereas genetic factors were much less frequently identified. Social factors covered in these studies included stressful life events, traumatic experiences, family problems and social disadvantage.

In one cross-cultural study, people in Australia and Japan were surveyed on the possible causes and risk factors in relation to two scenarios. One scenario described a person with major depression and the other scenario described a person with major depression *and* suicidal thoughts. In Japan, the survey involved 2000 adults aged between 20 and 69 from 25 regional areas. In Australia, the survey involved a national sample of 3998 adults aged 18 years or over.

Table 14.3 Percentage of Japanese and Australian populations to endorse proposed explanations as 'likely' or 'very likely'

Cause	Major depression	Major depression with suicidal thoughts
Virus or infection		
• Japan	6.2	6.6
• Australia	50.5	41.4
Allergy		
• Japan	10.2	11.4
• Australia	44.9	37.6
Day-to-day problems		
• Japan	93.6	91.8
• Australia	96.8	95.7
Death of someone close		
• Japan	79.8	81.4
• Australia	96.3	94.8
Traumatic events		
• Japan	82.6	79.6
• Australia	93.9	92.7
Problems from childhood		
• Japan	81.0	82.0
• Australia	91.3	95.0
Inherited or genetic		
• Japan	34.6	34.0
• Australia	68.0	68.4
Nervous person		
• Japan	81.4	77.4
• Australia	67.9	65.6
Weakness of character		
• Japan	73.6	69.2
• Australia	43.0	46.1

Source: Nakane, Y. & others (2005). Public beliefs about causes and risk factors for mental disorders: a comparison of Japan and Australia. *BMC Psychiatry*, *5*(33), 2–5.

Learning Activity 14.15

Review questions

1 a Explain the meaning of social isolation.
  b Give two examples of social or cultural groups in Australian society you believe may be vulnerable to social isolation. Give a reason for each answer.
  c Describe the circumstances under which someone with lots of pets would be considered socially isolated.
  d Distinguish between perceived and actual social isolation.
  e Explain how social isolation may contribute to the development of major depression with reference to research evidence.

2 a What is rumination?
  b Explain a possible relationship between social isolation, rumination and major depression.

3 a Explain the meaning of social stressor with reference to an example.
  b Explain how a role dispute and a role transition may function as social stressors and consequently contribute to the development of major depression.

4 a What is co-rumination and how might it contribute to the development of major depression?
  b What is your opinion of the hypothesis that adolescent girls tend to co-ruminate more than boys and that this may explain why adolescent girls are more likely to develop major depression?

5 Are socially isolated people more or less likely to experience social stressors? Explain your answer.

Learning Activity 14.16

Data analysis

Consider the data in table 14.3 and complete the following tasks and answer the questions.

1 a Which of the two depression scenarios is likely to be perceived by participants as the most severe case?
  b To what extent do differing perceptions appear to have influenced participant responses? Explain with reference to the data.
  c What cultural differences were there, if any, in relation to part (b)? Explain with reference to the data.

2 a Classify the causal factors into psychological, biological and social domains.
  b Suggest a suitable type of graph for representing the data for part (a).
  c What cultural differences in beliefs about contributory factors do the data suggest? Explain with reference to the data.

3 Which of the causal factor(s) do you believe are inaccurate? Explain your answer(s).

4 On the basis of the data, write a tentative conclusion about similarities and differences of Japanese and Australian opinions about causes of major depression (with or without suicidal thoughts).

5 a How might the beliefs individuals hold about the cause(s) of a mental disorder influence the type of assistance they seek to cope with it? Explain your answer.
  b Assuming perceived cause(s) influences choice of treatment, what type of treatment might Japanese people prefer? Australians? Explain with reference to the data.

Learning Activity 14.17

Media response

Read the newspaper article 'Why chatting too long on Facebook can get a girl down' on page 717 and then complete the following tasks and answer the questions.

1 Construct a simple flow chart to summarise the procedure (or research method) of the study reported in the article.

2 What cause–effect relationship is suggested by the article in relation to major depression?

3 To what extent is the suggested relationship consistent with theory described in the text? Explain your answer with reference to the article and the text.

4 According to the article, what is a possible contributory role that Facebook and similar social networking sites play in major depression?

5 Suggest a potential confounding variable of relevance to the reported research and its findings.

6 In what way might social networking sites *reduce* the incidence of major depression

a among adolescent girls?

b in the wider community?

Support factors

In addition to psychotherapy to assist management of major depression, support may be provided in a number of other ways. We consider how support may be provided through the individual's *family* and *social networks*, as well as through *recovery groups* that may be accessed in the local and wider community.

Family

Up until the 1960s, people with mental disorders were often admitted to a psychiatric hospital for 'the mentally ill' and sometimes remained there for the rest of their lives. Because of changes in our mental health care system, resulting from a better understanding of mental disorders and their management, most people with a serious mental disorder such as major depression now remain in the community with their families. However, in certain circumstances, people with major depression may still need care in a psychiatric hospital. For example, hospitalised care may be preferable during a severe major depressive episode when the person cannot look after themself and/or is having thoughts about harming themselves in some way. Nowadays, hospitalisation for major depression is usually short-term and temporary and the person will be discharged as soon as possible after being admitted, depending on the effectiveness of the management strategies.

Research findings indicate that major depression is significantly influenced by the family environment of the person with major depression. For example, in one study, researchers conducted assessments of interactions, interrelationships and overall functioning of the families of 45 people diagnosed with major depression at six and 12 months after their discharge from a psychiatric hospital. The results showed that people who lived in families with 'good' family functioning maintained their healthy recovery and were more likely to recover from major depression within 12 months when compared with depressed people living within families with 'poor' family functioning (Keitner & others, 1995).

It's not always easy to help someone who is experiencing major depression. Routines in the home can change. Relationships may become one-sided because people with major depression are sometimes so focused on their own problems that they may have nothing left to give a relationship. Family life is often disrupted, and supporting someone with depression can be demanding. Family members in a care and support role experience numerous feelings such as being overwhelmed by the nature of the role because it is often unrelenting. The high level of responsibility that comes with caring for and supporting a family member with major depression can be psychologically and physically exhausting. In response to this, many carers have found it helpful to enlist support

Figure 14.31 Research findings show that major depression is significantly influenced by the family environment of the person with the disorder and that family support can be an important factor in recovery.

from other family members as well as friends (beyondblue, 2010).

The families of people with major depression can provide support in a number of ways. The very nature of major depression can impair a person's ability to seek help when needed and to believe that their disorder is treatable and/or manageable. Major depression reduces energy and self-esteem and makes a person feel tired, worthless, helpless and hopeless. Therefore, people with major depression may need encouragement from family members to 'stick with' treatment until the symptoms of depression begin to abate (several weeks). If they are prescribed antidepressants, it may also mean monitoring whether they are taking their medication.

A person with major depression is likely to want to isolate themself and withdraw from others. In response to this, family members may make themselves available to simply talk to the person about how they're feeling or just spend time with the person to let them know someone cares and understands them (beyondblue, 2010). If anhedonia is experienced, family members can provide support by making plans to do something with them; for example, inviting them to go for a walk, go to a coffee shop or to see a movie, or to work on a hobby or other activity they previously enjoyed.

Family members can also provide support by educating themselves about major depression. The more they understand about contributory factors to major depression, how it affects people and how it can be managed, the better equipped they will be to talk to and support a family member with the disorder. For example, it is important for family members to know that major depression is not something a sufferer can just 'snap out of', nor is it a weakness, personality trait or character flaw such as laziness.

Social networks

While social isolation may be a risk factor in the development and persistence of major depression, the social support provided by members of a person's social network can *reduce* the risk of developing major depression and can also assist in recovery from the disorder.

The term 'social network' was first used by Australian anthropologist J.A. Barnes in the 1950s to describe the complex social relationships among people living in a Norwegian fishing village. Barnes (1954) concluded that the whole of social life could be seen as 'a set of points, some of which are joined by lines' to form a 'total network' of relations. Social psychologists subsequently built on this idea and defined a social network in terms of a social structure that maps out the relationships between individuals. They also devised elaborate ways of constructing diagrams using points and lines to represent relations among individuals in the social network. In other specialist areas of psychology, the term **social network** is used more generally to refer to the various individuals or groups who maintain relationships with an individual in different aspects of their lives. The relationships usually have some kind of significance or importance to the individual, such as those with relatives, close and other friends, neighbours, work colleagues, teachers, acquaintances, and so on, who may be part of the network. Others who may be important in a person's life and therefore be part of their social network are the family doctor, mental health professional, priest, local milkbar owner or hairdresser. Which of these people are important and are part of a social network depends on the individual's lifestyle. Finally, another characteristic of a social network is that some people within the network know each other and therefore have some kind of connection with each other, as well as with the individual.

The main benefit of an individual's social network is that it gives access to *social support* (help or assistance from other people) when needed. This may take the form of *appraisal support* by having access to someone with whom to talk and obtain feedback about feelings; *tangible assistance*, such as help with routine chores at a time when energy and enthusiasm for such tasks is low; *information support*, such as the web address of a social network for people with depression, the location of a recovery group in the community, or information about the potential value of these sources of support; and *emotional support*, such as help in coping with problems or just having someone to spend time with in order to experience the feeling that someone cares and understands.

It is common for people with depression to fail to recognise they need help or support and it is often difficult for them to accept offers of help. Ongoing support will play a major role in the person's recovery and this support may come from many sources (beyondblue, 2010). For most individuals, a healthy social support network will help them to handle many symptoms of depression more easily. A proper support network consists of a reinforcing family and friends, who can help the person to work through problems. For individuals with an undeveloped social network, or those with a negatively reinforcing social network, these problems can cause greater harm because of a lack of support. An underdeveloped social network cannot handle the pressure of a person looking for support and a negatively framed social network can actually reinforce thoughts of hopelessness, failure and worthlessness (Wade & Kendler, 2000).

Box 14.11

Youth beyondblue

Youthbeyondblue is the youth arm of beyondblue, an Australian organisation that provides information about depression and anxiety. The aim of Youthbeyondblue is to educate young people about depression and anxiety and encourage them, and their family and friends to get help when it's needed.

One in five young Australians experience major depression each year, and more than half of those aren't getting the professional help they need to get through it.

Research shows that when young people are feeling depressed they're most likely to talk about it with their family and friends. Youth beyondblue aims to give advice on ways to recognise depression and how to talk about it, and to let young people know what services are out there to help.

Source: www.youthbeyondblue.com.

Figure 14.32 Youth beyondblue recognises that young people will often turn first to trusted friends and family members to talk about what they're going through.

Learning Activity 14.18

Media response

Select and view one of the television advertisements about major depression from the following website: www.youthbeyondblue.com/tv-ads/. These advertisements were produced by youth beyondblue.

Write a 200–250 word commentary about how a person's family and social network can play a role in preventing the development of major depression. Ensure you refer to examples in the advertisement you viewed and key symptoms of major depression described in the text.

Recovery groups

Not everyone experiencing major depression wants or needs support beyond that offered by their family and their wider social network. Some people, however, may find it helpful to use support that is provided in their local or wider community. This can include recovery groups, also known as *support groups*.

A **recovery group** is a not-for-profit support group run by and for people who interact in some way on the basis of common interests or experiences to support one another. Recovery groups are built on a foundation of mutual support for a specific mental or physical health condition, such as grief, major depression, bipolar depression, schizophrenia, breast cancer or diabetes. They are typically organised and/or facilitated ('run') by a person who has experienced or recovered from the situation or condition, or by someone affected by it, such as a close relative. A key assumption of most recovery groups is that recovery is possible. The concept that recovery is possible leads to active management of symptoms and of episodes of depression. The goal of recovery proposed by many groups is not necessarily the absence of major depression or its symptoms. Instead, the goal usually involves drawing on other group members' experiences to develop problem-solving skills for self-care and management of symptoms in the gradual step-by-step restoration of mental health (O'Brien, Kennedy & Ballard, 2007).

There are many different ways recovery groups can be conducted or accessed. For example, they may be conducted in a person's home or a community facility where participants meet, on the internet using blogs or instant messaging, or by telephone. Some recovery groups are ongoing and new members can join at any time (called an *open group*), whereas other groups run for a certain number of weeks (for example, ten weeks) and new members are not admitted to the group after the first couple of weeks (called a *closed group*). Some groups are very flexible in the way they are run. Some emphasise emotional support and shared experiences, so the groups discuss whatever members want to each week. Other groups can be more structured, with a set program; for example, the group leader may invite a doctor, psychologist, nurse or social worker to talk about a topic related to the group's interests or needs.

Although recovery groups do not suit all people, as not everyone is comfortable in a group setting, meeting with others, using the internet or exchanging messages about personal issues, and connecting with other people who have had similar experiences and are 'in the same boat' can have a number of benefits. A recovery group by its very nature can help people with major depression feel less lonely and isolated. The group provides a means of connecting and sharing with others who truly understand what each member is going through because virtually all members 'have been there' or 'are there'. The group also provides opportunities to talk openly and honestly about feelings, to share personal experiences (for example, what worked and what didn't) and gain a clearer understanding of what to expect in their situation. Members of a recovery group can also assist each other to develop problem-solving skills for self-care and management of symptoms, and to develop and maintain healthy lifestyle habits.

While recovery groups can be very beneficial, they are not a substitute for the support provided by a mental health professional, as they are typically led by individuals who lack formal training in mental health service delivery. Recovery groups should therefore only ever be one part of an overall management program for major depression.

Figure 14.33 Participation in a recovery group can be a valuable part of the overall management plan for an individual experiencing major depression.

Box 14.12

Examples of major depression recovery groups

There are many recovery groups that can be accessed by people with major depression. Specific types of groups and their activities include the following.

The Mood Disorder Support Group

Organised by the Mental Health Foundation of Australia (Victoria), this group regularly holds meetings throughout the year in Richmond, Melbourne. New members can join at any time and there is no participation fee.

The goals of the group and meetings are to provide friendship and support to those with a mood disorder, their family and friends; to educate sufferers, families and the general public about the management of the disorder; to improve the quality of health care and the general wellbeing of members; and to promote research into the causes and improved treatment of general anxiety and depressive illnesses (www.mentalhealthvic.org.au/index.php?id = 32).

Blueboard

Organised by the Australian National University Centre for Mental Health Research, this is an online support group for people affected by depression, bipolar disorder and anxiety disorders. The group is run as a moderated bulletin board with strict protocols to enhance safety and privacy. Forums for carers are also available. The site aims to reduce stigma, and to provide support, hope and opportunities for sharing successful coping strategies (www.blueboard.anu.edu.au).

GROW Australia

GROW is a community of persons providing support groups based on a 12-step self-help program for people suffering anxiety, depression or other mental or emotional distress. Small groups of people who have experienced depression, anxiety or other mental or emotional distress meet together on a weekly basis to help each other deal with the challenges of life (www.grow.net.au).

Soft Pathway

Soft Pathway involves recovery groups facilitated by trained volunteers experienced in depression and anxieties and are held in Brighton and Bentleigh East, Melbourne, to help people who have been diagnosed with and treated for depression and/or anxiety or related problems. The group provides a safe and relaxed environment for people to share their journey and offers support and encouragement. There is no cost to participants (www.softpathway.com.au).

Learning Activity 14.19

Review questions

1. Outline three ways in which a family can support someone with major depression.
2. a. What is a social network?
   b. What are two key characteristics of a social network?
   c. Construct a diagram that shows several individuals and groups in your social network, and identifies connections between people in your network and a different social network.
   d. Give three examples of how the social network of someone with major depression can provide support.
3. a. What is a recovery group?
   b. What is a common goal of recovery groups for major depression?
   c. Give three examples of how a recovery group can provide support for someone with major depression.

Learning Activity 14.20

Essay on causes and management of major depression

Write an essay of about 550–600 words in which you explain biological, psychological and social factors that may contribute to the development of major depression and may be relevant to its management. References may be used in obtaining information for your essay.

In your essay ensure that you:

- explain what major depression is, with reference to key symptoms
- describe a range of relevant biological, psychological and social factors
- discuss how these factors may contribute to the development and management of major depression
- give an example of how different factors may interact
- refer to relevant research findings
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms and ideas
- express your ideas in a clear and concise way
- accurately cite and reference all material.

Learning Activity 14.21

Visual presentation on causes and management of major depression

Prepare a visual presentation in which you use a biopsychosocial framework to explain the causes and management of major depression.

You may select from a range of formats to present your information; for example, PowerPoint, a poster, a concept map, a flow chart, or a combination of formats. Photographs and other visual or art media may be used.

In your presentation, ensure that you:

- explain what major depression is with reference to key symptoms
- outline a range of relevant biological, psychological and social factors
- indicate how these factors may contribute to the development and management of major depression, including possible relationships between different factors.

Written information may be in a dot-point format but you should ensure that all relevant information is accurately and adequately explained, using appropriate examples to clarify your understanding of key concepts.

Chapter 14 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Mood is a mental state.

2 ______ Deficiencies in GABA and adrenaline are a risk factor for major depression.

3 ______ Mood disorders involve psychological discomfort.

4 ______ When using CBT in the management of major depression, the mental health professional will identify flawed cognitive triads that have caused the depression.

5 ______ Seligman and Maier (1967) demonstrated how major depression can cause learned helplessness.

6 ______ Major depression can vary in degree of severity, ranging from mild to severe.

7 ______ The contribution of genetic inheritance to major depression is demonstrated by the results of research showing how genes influence its onset.

8 ______ Talking about major depression in recovery groups only makes it worse.

9 ______ If a person experiences two major depressive episodes, it is highly likely they will experience a third episode.

10 ______ Only suicidal people need antidepressant medication.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 14 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the following is the best example of a recovery group for someone with major depression?

A members of a 'well-functioning' family who provide support to another family member recovering from major depression

B a group of people who have been touched by major depression in a significant way and meet to support each other

C a group of mental health professionals who monitor the recovery of the individual they are treating

D the beyondblue organisation

Q2 An essential feature of a major depressive episode is

A the experience of a depressed mood for a period of at least two weeks.

B one or more mood swings from 'high' (mania) to 'low' (sadness).

C a noticeable change in appetite or weight.

D one or more thoughts of death or suicide.

Q3 The biopsychosocial framework explains the development, onset or persistence of major depression by emphasising

A how biological factors influence psychological factors, which in turn influence social factors.

B the relative contribution of biological, psychological and social factors.

C the interaction of biological, psychological and social factors.

D the impact of underlying biological factors on psychological and social factors.

Q4 Which of the following statements about the action of selective serotonin re-uptake inhibitors (SSRIs) is correct?

A SSRIs block re-uptake of both serotonin and noradrenaline out of the synapse back into the presynaptic neuron.

B SSRIs ensure re-uptake of serotonin out of the synapse back into the presynaptic neuron.

C SSRIs ensure re-uptake of both serotonin and noradrenaline out of the synapse back into the presynaptic neuron.

D SSRIs block re-uptake of serotonin out of the synapse back into the presynaptic neuron.

Q5 The role of genes as a contributory factor in major depression is primarily based on research evidence showing

A a genetic predisposition to high levels of serotonin or glutamate in the brain.

B the significantly higher incidence of major depression among identical twins when compared with non-identical twins.

C the significant link between daily hassles and onset of major depression.

D the effectiveness of antidepressants in treating and/or managing major depression.

Q6 According to Martin Seligman's revised theory of learned helplessness, depression is more likely to occur when someone attributes their failure to an ___________________________ cause.

A external, stable, global

B internal, stable, global

C external, unstable, specific

D internal, unstable, global

Q7 The loss of interest or enjoyment in activities by a person with major depression is called

A hypersomnia.

B psychomotor retardation.

C dysthymia.

D anhedonia.

Q8 The model that proposes that stressful significant life events and/or the cumulative effect of daily hassles can contribute to stress is called the __________________ model.

A stress exposure

B stressor causation

C reciprocal

D stress generation

Q9 Antidepressants have a delayed onset of action of about _______ week(s).

A 1

B 2–3

C 4–6

D 7–8

Q10 Rumination involves

A repeatedly dwelling on negative thoughts and feelings without acting to change them.

B developing a list of rewarding activities with the goal of changing behavioural symptoms of major depression.

C discussing setbacks with a social network member and devising self-help strategies.

D saying whatever comes to mind, regardless of how painful, embarrassing, illogical or irrelevant it might seem.

The answers to the Chapter 14 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the meaning of the term mood disorder.

1 mark

Question 2

Explain what major depression is, with reference to three key symptoms other than loss of interest in enjoyment of activities and feelings of helplessness.

2 marks

Question 3

a What is learned helplessness?

1 mark

b Describe the relationship of learned helplessness to major depression, as suggested by research evidence.

1 mark

Question 4

a Name a socio-cultural risk factor in major depression.

1 mark

b Explain how this factor may contribute to the development of major depression, with reference to an example.

2 marks

Question 5

Describe the key difference between the use of psychodynamic psychotherapy as compared with the use of cognitive behavioural therapy in the management of major depression.

2 marks

The answers to the Chapter 14 short-answer questions are available at www.OneStopScience.com.au.

15 Addictive disorder: gambling

In 1988, 28-year-old Jie arrived in Australia from China. A year later, in 1989, she married Benny, a waiter. Jie worked in full-time employment until the birth of her first child in 1993. Jie began to miss the company of other people during the day. Loneliness set in. In order to deal with her strong feelings of social isolation, Jie started going to the local hotel in the evenings after Benny got home from work to 'play' the gaming machines. Jie liked being around English-speaking people and her visits to the hotel and use of the pokies quickly escalated, as did the amount of money she spent on the machines. As this was making serious inroads on the family budget, Benny tried to deal with the problem by confiscating Jie's credit card, but it had little effect. The next day, Jie obtained a new credit card from the bank. Each evening, despite Benny's protests, Jie would head off in search of new venues with gaming machines, seeking a change of luck. By now, Jie was constantly preoccupied with thoughts of 'playing' the pokies. The birth of her second child in 1998 merely had the effect of temporarily stopping her from playing.

One hot February morning in 2000, Benny was fast asleep after having finished work at 2 am. Jie arose at about 7 am, fed the children and then put both children in the car to drop the older child at school. She returned home to get money to go shopping, taking $150. When she returned to the car, her younger child was asleep, so she decided that instead of going shopping she would go to a hotel with gaming machines. Jie intended to 'go in there for 20 to 30 minutes' while leaving her child to 'sleep peacefully in the car' in the hotel carpark. She thought that she would just play for a while and if she could 'win even $8 or $10' then she could 'shop for more things'. However, Jie became so engrossed in playing that she completely lost track of time. Her sleeping child was slowly developing heatstroke in the car.

A few hours later, Benny arrived at the hotel to find Jie playing the pokies, while the younger child was still in the car. When Benny and Jie returned to the car they found their child unconscious. They took the child straight to the local hospital, where the child was pronounced dead a few hours later. After a Supreme Court trial in 2001, the jury took only two hours to find Jie guilty of manslaughter. She was sentenced to four years in prison, but was paroled immediately.

This true story attracted much media attention and created a great deal of controversy and debate in the wider community.

Addiction

The term 'addiction' is most commonly used to describe the uncontrollable use of drugs and other chemical substances on which people can become dependent. Dependence on such substances is primarily physiological, marked by changes in bodily processes that make ingestion of a certain amount of the substance necessary for minimum daily functioning. This is called *physical dependence*, and it becomes apparent when the substance is withheld or unavailable and the user undergoes painful withdrawal reactions, such as physical pain and intense cravings. The cravings suggest a psychological component of addiction, so the term *psychological dependence* is used to refer the mental desire to experience the effects produced by the substance.

More recently, the use of the term 'addiction' has expanded to cover dependence on any type of substance, including alcohol, nicotine in cigarettes and caffeine in tea, coffee, Coca-cola and various 'energy' drinks. Common to these substances on which we can become dependent is a type of chemical that affects our central nervous system functioning, particularly the functioning of the brain. There has been increasing recognition among psychologists in more recent times that a diverse range of behaviours may also be addictive and result in dependence, involving a psychological component and possibly a physical component. For example, research findings indicate that behaviours such as Jie's gambling, as well as many other behaviours such as eating, shopping, physical exercise, work, watching TV, playing computer games and using the internet are potentially addictive (see box 15.1). Consequently, **addiction** is now used more broadly to refer to a condition in which an individual feels a recurring urge to use a specific type of substance or engage in a certain activity despite potentially harmful consequences. The condition is associated with impaired self-control and mental preoccupation or continued use of the substance or engagement in the activity, despite the potentially adverse effects. Although there is presently no category of mental disorder in the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) or *International Classification of Diseases and Related Health Problems* (ICD-10) called 'addictive disorder', it is recognised that addiction can have detrimental effects on mental (and physical) health and involve symptoms associated with most mental disorders, such as psychological dysfunction and distress.

Characteristics of addiction

British clinical psychologist and prominent researcher on behavioural addiction Mark Griffiths (2005) has proposed that *all* addictions—including behaviours that do not involve ingestion, injection or inhalation of some type of chemical—have six distinctive characteristics in addition to impaired self-control. Griffiths calls these salience, mood modification, tolerance, withdrawal, conflict and relapse.

Salience refers to the high level of importance of the activity in the person's life. Typically, the activity dominates their thinking (e.g. preoccupation and cognitive distortions), feelings (e.g. cravings) and behaviour (e.g. deterioration of socially acceptable behaviour). *Mood modification* refers to the change in subjective experience that people with an addiction report as a consequence of engaging in the activity. For example, they may experience feelings ranging from an arousing 'high' or 'buzz' to a tranquilising ('calming') and/or 'de-stressing' feeling of escape or numbing. **Tolerance** refers to the decreased sensitivity to the activity over time, whereby increasing amounts of the particular activity are required to achieve the original desired effects. A well-known example of tolerance is the need experienced by a person addicted to heroin to increase the size of their 'fix' (dose) to get the feeling (e.g. an intense 'rush') they once got from much smaller doses. Similarly, someone with a gambling addiction may bet larger and larger amounts of money over time to achieve the psychological 'high' previously experienced. **Withdrawal** refers to the unpleasant psychological and/or physical reactions that occur when the particular activity is suddenly reduced or discontinued. For example, psychological withdrawal symptoms may include sadness, excitability and/or irritability, and physical symptoms may include nausea, headaches, insomnia and/or reactions such as those associated with the fight–flight response to a stressor. *Conflict* refers to disagreements, clashes and other problems experienced by the person with the addiction and that arise as a consequence of their addiction. These may occur within the individual ('intrapersonal conflict') and/or with those around them, such as loved ones, friends and associates ('interpersonal conflict'). **Relapse** refers to the recurrence of earlier patterns of the activity (or 'symptoms') after a period of abstinence (e.g. voluntary non-engagement) or control (e.g. improvement or apparent 'cure').

Figure 15.1 The term 'addiction' is now used more broadly to refer to a condition in which an individual feels a recurring urge to use a specific substance or engage in a certain activity despite potentially harmful consequences.

Box 15.1

Internet addiction

Some people are so preoccupied with the internet and unable to control their use of it that it jeopardises their wellbeing, relationships, education or employment. This has led psychologists to propose the construct of *internet addiction* to describe and explain the uncontrollable, maladaptive use of this technology. Internet addiction is viewed as an impulse control disorder, and it shares many of the symptoms of pathological gambling that are described in the DSM-IV-TR.

Detecting and diagnosing internet addiction is often difficult because its legitimate use for personal and business reasons can mask addictive behaviour. It is estimated that 71 % of office workers abuse the internet during work hours, visiting social networking sites, shopping online, reading personal email, or visiting pornography, gaming or gambling sites. Furthermore, individuals who suffer from depression, anxiety disorders, social phobia and other compulsive disorders are more likely to develop an internet addiction (Young, 2009).

The Internet Addiction Diagnostic Questionnaire (IADQ) was developed by American psychologist Kimberley Young as an initial screening instrument for diagnostic purposes. The following questions are linked to key symptoms associated with internet addiction.

1 Do you feel preoccupied with the internet (think about previous online activity or anticipate next online session)?
2 Do you feel the need to use the internet for increasing amounts of time in order to achieve satisfaction?
3 Have you repeatedly made unsuccessful efforts to control, cut back or stop internet use?
4 Do you feel restless, moody, depressed or irritable when attempting to cut down or stop internet use?
5 Do you stay online longer than originally intended?
6 Have you jeopardised or risked the loss of a significant relationship, job, educational or career opportunity because of the internet?
7 Have you lied to family members, a therapist or others to conceal the extent of involvement with the internet?
8 Do you use the internet as a way of escaping from problems or of relieving a dysphoric mood (e.g. feelings of helplessness, guilt, anxiety, depression)?

According to Young (2009), if a person answers 'yes' to five or more questions about a six-month period, they may be suffering from an internet addiction. Other signs include a heightened sense of euphoria while involved in computer and internet activities, neglecting sleep to stay online, neglecting routine duties or life responsibilities, being socially isolated and secretive about online activities or suddenly demanding privacy when online.

Source: Young, K. (2010). *Signs of internet addiction*. The Center for Internet Addiction Recovery, www.netaddiction.com/.

Learning Activity 15.1

Review questions

1 Define the meaning of addiction, with reference to potentially addictive behaviours and substances.
2 Distinguish between psychological and physiological dependence, with reference to an example.
3 Under what circumstances would body building or aerobic exercising be considered addictive? Explain with reference to key distinctive characteristics of an addiction.
4 Explain why addiction is considered to be a 'maladaptive' or 'psychologically dysfunctional' condition.

Gambling

Gambling is any activity in which money (or anything of value) is put at risk on an event of uncertain outcome that relies, in part or entirely, on chance. The activity may be legal or illegal but the outcome is unknown and the gambler is usually risking something of value. The most popular gambling activities in Australia are purchasing lotto and instant lottery ('scratchy') tickets, while wagering ('betting') on horses or dogs, 'playing' electronic gaming machines ('poker machines' or 'pokies') and casino table games, such as blackjack and roulette, account for the overwhelming bulk of money gambled (see box 15.2).

Some types of speculative trading on the stock market may also be a considered a form of gambling; for example, purchasing shares following a sudden drop in their value with the view of selling shortly after when it is believed that their value may increase. Consequently, definitions of gambling sometimes refer to risking something of value for entertainment purposes to distinguish gambling from investment activities such as speculative share trading in which chance also plays a prominent role (Productivity Commission, 2009).

The various forms of gambling can be divided into two categories: continuous and non-continuous. *Continuous* forms of gambling are those in which the time between betting and knowing the outcome is short—which permits instant gratification. This includes electronic gaming machines, bingo, horse racing, casino betting and 'scratchies'. *Non-continuous* forms of gambling are those in which the time between wagering and knowing the outcome is long—thereby delaying gratification. The most common or popular non-continuous activity is lottery gambling, such as Tattslotto or Powerball.

The goal of all forms of gambling is to win more than is lost. However, the reality is that all popular forms of gambling provided by the various commercial operators are based on the absolute certainty that, ultimately, the gambler will lose more than they will win over time. Most gamblers know that the 'odds are in favour of the house' but they also believe that they can 'beat the odds' (Coombs, 2007; APS, 1997).

The gambling services legally available in Australia can be broadly classified as wagering, gaming and lotteries, as summarised in box 15.2. Most countries, including Australia, regulate gambling. Regulation places certain restrictions on gambling in terms of the opening times of gambling venues, the number of gaming machines in any one venue, minimum age limits and so on. In Victoria, regulation of the gambling industry and activities is the responsibility of the Victorian Commission for Gambling Regulation.

Box 15.2

Forms of legal gambling in Australia

Wagering is another name for betting—to stake something (usually money) on the outcome of a contest or any uncertain event or matter. The principal forms are racing and sports betting.

Gaming comprises all legal forms of gambling other than wagering—including lotteries, electronic gaming machines, casino table games and keno. *Minor gaming* is the collective name given to raffles, lucky envelopes, 'art unions' and the like.

Lotteries come in various forms, including lotto, pools and instant lotteries. Lotto is played by choosing numbers in anticipation that those numbers will be among the winning numbers selected randomly through various means.

Electronic gaming machines (EGMS) account for around three-quarters of instances of severe problem gambling. These machines come in two main types: ones where the player generally can make no strategic decisions after starting the game and ones where the player may make strategic decisions. An example of the latter is a machine with a drawcard game in which, after the game has started, the player must decide whether to hold or receive cards.

EGMs are based on random number generation and wins are generally represented by matched icons. Most games are non-strategic, although players may control the stakes. Less common are multi-terminal gaming machines, which accommodate several players and usually simulate games such as blackjack and roulette. Over one-fifth of the total number of EGMs in the world is located in Australia. They are widely accessible to the community in all states and territories, except Western Australia.

Australian EGMs are among the most sophisticated in the world. For example, Australian EGMs usually have the ability to play multiple games in rapid succession and to ramp up stakes from a tiny bet (1 cent) to a large bet ($10 bets every three seconds). The machines also have banknote acceptors and crediting of wins, and some have jackpots linked to other machines across different venues.

Source: Australian Government Productivity Commission (2010). *Gambling. Productivity Commission Inquiry Report, 50*, 2.4. Commonwealth of Australia, www.pc.gov.au/projects/inquiry/gambling-2009/report.

Gambling as an addiction

For many Australians, most forms of gambling are a source of recreation and pleasurable social activity. Participating in gambling can provide time away from the pressures of work, a temporary escape from boredom, fun, excitement, a chance to win money, the thrill of anticipation and an opportunity to get away from thoughts and feelings that may be 'depressing', to get out and meet people and socialise, and to 'dream' about winning a fortune. Gambling venues such as casinos and clubs can also provide an accessible, comfortable and safe social environment, which many people —particularly women, elderly people and ethnic communities—have found appealing (Productivity Commission, 2009).

For a number of people, however, gambling stops being pleasurable and becomes a serious problem that causes harm to themselves and/or to those around them, such as their partner, family, friends or others in the community. When gambling begins to consume more money and time than a person can afford, it can affect many parts of the individual's life, including their psychological and physical health, relationships, finances, work and study (see figure 15.4).

The terms *problem gambling* and *pathological gambling* are often used interchangeably to describe gambling behaviour that has become very 'problematic' or addictive. Legislative and regularity authorities in Australia tend to use the term problem gambling.

Problem gambling

Problem gambling is characterised by difficulties in limiting money and/or time spent on gambling, which leads to adverse consequences for the gambler, for others or for the community. This is the preferred definition in Australia as it includes the notion that problem gambling can be represented on a continuum as a behaviour

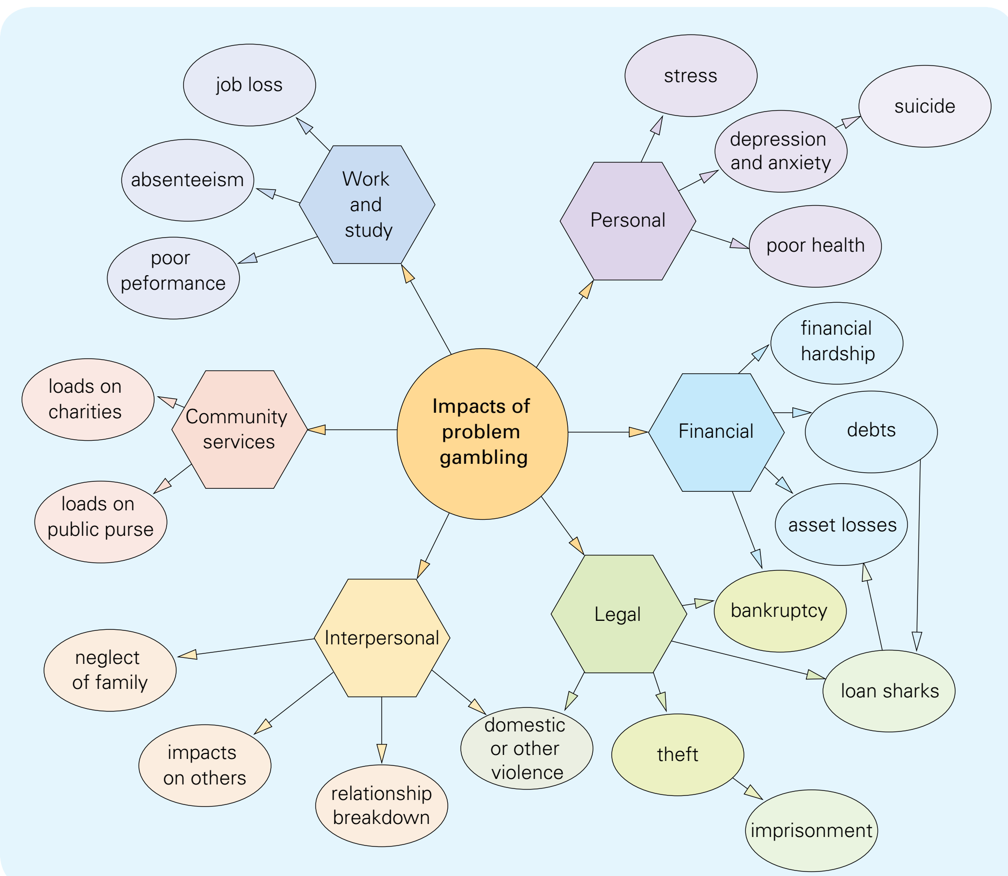


Figure 15.2 Impacts of problem gambling

Source: Australian Government Productivity Commission (2009). *Australia's Gambling Industries. Inquiry Report Volume 1: Report (Parts A–C), 10.* 25. Commonwealth of Australia, www.pc.gov.au/__data/assets/pdf_file/0004/82552/gambling1.pdf.

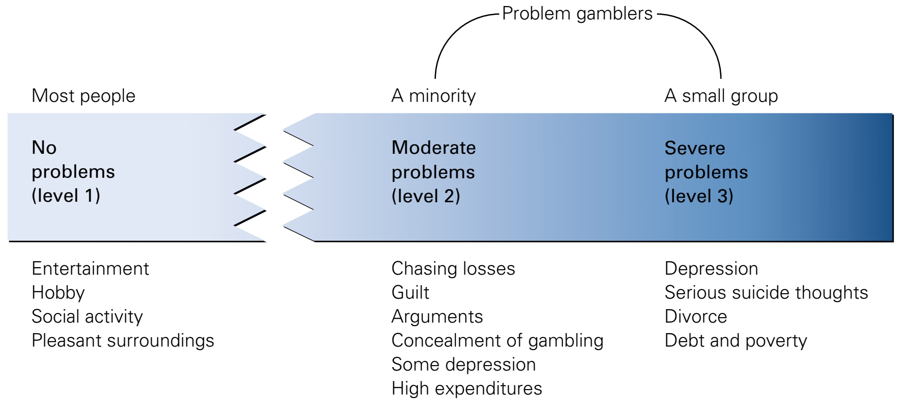


Figure 15.3
A gambling continuum

Source: Australian Government Productivity Commission (2009). *Australia's Gambling Industries. Inquiry Report Volume 1: Report (Parts A–C), 10.* 19. Commonwealth of Australia, www.pc.gov.au/__data/assets/pdf_file/0004/82552/gambling1.pdf.

that occurs in varying degrees. The description 'difficulties in limiting money and/or time spent on gambling' suggests a continuum of gambling behaviours by individuals who have *no difficulty* (including non-gamblers) to those who have *extreme difficulty*. Problem gambling can also be represented on a continuum as ranging from *occasional non-problematic use* (e.g. recreational gambling) when there are no adverse impacts through to *extreme over-involvement* (e.g. gambling accompanied by a sense of impaired self-control), with a range of more or less problematic behaviours in between. There is no clear point, however, at which a 'recreational gambler' becomes a 'problem gambler' (see figure 15.3) (Productivity Commission, 2009, 1999).

The term 'pathological gambling disorder' is used to refer to problematic gambling as a diagnosable mental disorder. According to the DSM, a **pathological gambling disorder** is characterised by persistent and recurrent gambling behaviour that disrupts personal, family and/or work-related relationships and activities. Defining problematic gambling in these terms draws attention to its 'maladaptive' nature; that is, the behaviour does not assist or promote adaptation to the demands of everyday life.

Gamblers' Anonymous in Australia considers problem or pathological gambling to be an addiction, and a number of people seeking help for their gambling problems support this view. When considering treatment and management plans for an addictive gambling disorder, it is important to take account of the fact that many people who perceive their gambling as an addiction and seek help tend to prefer support that aims to assist them to achieve abstinence; that is, stop all gambling. Those who believe they have problems controlling their impulses are more often interested in *controlling* their gambling rather than stopping it altogether. These are clearly different expectations (Government of South Australia, 2009).

Whether it is called problem gambling or pathological gambling, gambling *can* be addictive and can have devastating effects on the individuals concerned, their families and the wider community. The Productivity Commission (2009), the Australian Government's independent research and advisory body on social issues, has estimated that about 125 000 Australians are problem (or pathological) gamblers, and that about 290 000 gamblers are at moderate risk of developing the problem or disorder.

Currently, the DSM-IV-TR classifies pathological gambling disorder as a type of impulse control disorder. The term 'impulse control disorder' is used to describe a group of disorders that involve problems of impulse control. **Impulse control** is the psychological effort made to resist an urge ('impulse'), inner drive or temptation to do something that is potentially harmful to oneself or others. Gamblers often fail to limit the size of their bets, limit the total amount of money spent, stop after reaching their limit and control the amount of time spent gambling in the course of a day or the number of days spent gambling during a week or a month. The DSM-IV-TR identifies in total six different types of impulse control disorders, including kleptomania, pyromania and trichollomania (recurrent pulling out of one's hair for pleasure, gratification or relief of tension, resulting in noticeable hair loss). Although they have been grouped together in this diagnostic category, there are striking differences as well as similarities between these disorders.

The American Psychiatric Association, which publishes the DSM, is proposing to replace the term 'pathological gambling disorder' with the term *disordered gambling*. It has also proposed to reclassify the disorder into a new category called *addiction and related disorders* when the upcoming revision of the DSM (the DSM-V) is published. Furthermore, disordered gambling is likely to be the only disorder in a subcategory called *behavioural addictions*. Another potential behavioural addiction (internet addiction) is in the Appendix of the current DSM and will be considered as a potential addition to this category when there is sufficient research evidence to do so.

Pathological gambling disorder

In order to be diagnosed with pathological gambling disorder, according to the DSM-IV-TR, a person must experience at least five of the following ten symptoms.

- *Preoccupation with gambling*: long periods (e.g. two weeks or more) are spent thinking about past gambling experiences, planning future gambling episodes, or thinking of ways to get money with which to gamble.
- *Tolerance*: when the person gradually increases the size of the bet or takes greater risks to achieve and experience the desired excitement or 'rush' that was originally obtained by a much smaller bet. As well as wagering progressively larger amounts of money when gambling, tolerance may be evident when the person spends progressively longer periods gambling.
- *Loss of control*: the person has made repeated unsuccessful efforts to control, cut back or stop gambling but cannot control themself. Many pathological gamblers try different ways of achieving control. For example, some try to shift to a 'total cash lifestyle' in the hope that limiting access to bank accounts and credit cards will prevent them from gambling. Others try giving financial control to a family member.
- *Withdrawal*: the person experiences unpleasant psychological and/or physical reactions when their gambling is suddenly reduced or discontinued. Withdrawal symptoms experienced by pathological gamblers may include restlessness, irritability, insomnia, headaches, upset stomach, loss of appetite, heart palpitations (rapid heartbeat), muscle aches, breathing difficulty and/or chills.
- *Escape*: the person gambles as a way of escaping from personal problems, such as daily hassles and stressful life events, or negative emotions such as intense sadness, feelings of helplessness, guilt and anxiety. Often, their personal problems and negative emotions are interrelated. Escape behaviour can *initiate* gambling and can also *maintain* it once it begins. Some psychologists have proposed that everyone who gambles does so for escape, in the same way as weekend golfers play for escape or artists create artworks for escape. However, when the gambler can't resist their urge to gamble, gambling can become an escape from the problems that it generates, thus creating a 'vicious cycle' that maintains pathological gambling behaviour and is difficult to escape.
- *Chasing*: after losing money gambling, the pathological gambler often returns another day to pursue ('chase') recovery of their losses. This often involves their 'throwing good money after bad money'. Recreational gamblers typically 'cut their losses', which means that after losing money they accept their loss and walk away. When they gamble again, it is a new discrete event. They may have learned something from the previous 'losing' experience and take this into account when gambling again so that they can limit loss. But for pathological gamblers,

loss can generate a kind of 'personal vendetta'. Pathological gamblers who 'chase' often keep an informal tally of their losses. Their losses 'eat away' at them, and they cannot feel satisfied until they either 'break even' or, better yet, come out ahead.

- *Lying*: to conceal the extent of their gambling, the pathological gambler lies and deceives family members, friends, their therapist or others who disapprove of their gambling or may prevent them from gambling. Often pathological gamblers lie about behaviour that could lead to others learning about their gambling. Lying may be of two types. *Reactive lying* involves being dishonest in response to a question or suggestion that may expose one's gambling. For example, a gambler who reactively lies would answer 'at the movies' if asked the question 'where were you tonight?' by a loved one. Often pathological gamblers engage in another type of lying and develop a lifestyle based on deception. *Deceptive lying* involves dishonesty that is planned in advance. Therefore, it is a *proactive* type of lying rather than reactive. For example, a gambler addicted to betting on the outcomes of sport matches may use several bookmakers who require all bets to be placed in person. However, despite being hopelessly in debt, not having had a good meal in weeks and living off friends, whenever the pathological gambler meets one of their bookmakers, they wear a perfectly tailored suit and polished shoes, and speak with the optimism and bravado of a business tycoon. This deception is essential, because if one of their bookmakers discovers the truth about the gambler's actual financial situation, they are likely to refuse their bets and may even inform other bookmakers that the gambler is a 'bad risk'.
- *Illegal activity*: the person commits illegal acts such as forgery (e.g. using someone else's signature for a credit card), writing dud cheques, theft and embezzlement or 'misappropriation' of funds in order to finance their gambling. For example, a pathological gambler employed as an accountant might redirect money from a client's bank account to their own. In severe cases, a pathological gambler may even kill a family member to get payment from a life insurance policy.
- *Risked relationships*: the person has jeopardised or lost a significant relationship or job, or educational or career opportunity, because of their gambling. For example, this may occur when a man chooses to go to the horses races to gamble ahead of being present at the birth of his child, or a parent leaves a child unattended in a parked car while they gamble on the 'pokies'. Although pathological gambling causes job-related problems, job loss is usually only seen in the late stages. This is because a person cannot gamble without money, so many pathological gamblers try to hold on to their jobs for as long as possible.
- *Bailout*: the person relies on others, such as friends or family, to provide money to relieve a desperate financial situation caused by gambling. Gamblers are notoriously effective in manipulating or persuading other people, particularly loved ones, to 'bail them out' financially.

Because of the increasing number of problem or pathological gamblers in the general population, the potentially addictive nature of gambling and the significant harmful effects of uncontrollable gambling on the individual, on their family, friends and colleagues, and on the wider community, a growing number of psychologists are conducting research on causes and treatments of the behaviour. Most psychologists believe that it is caused by the interaction of a combination of biological, psychological and socio-cultural factors, rather than any single factor. Importantly, research evidence indicates that gambling *can* be addictive and that some people *do* in fact become addicted. In this chapter, we examine some of the more widely researched contributory factors to gambling as an addictive disorder. These are organised in isolation of one another, but they can interact in obvious as well as quite subtle ways.

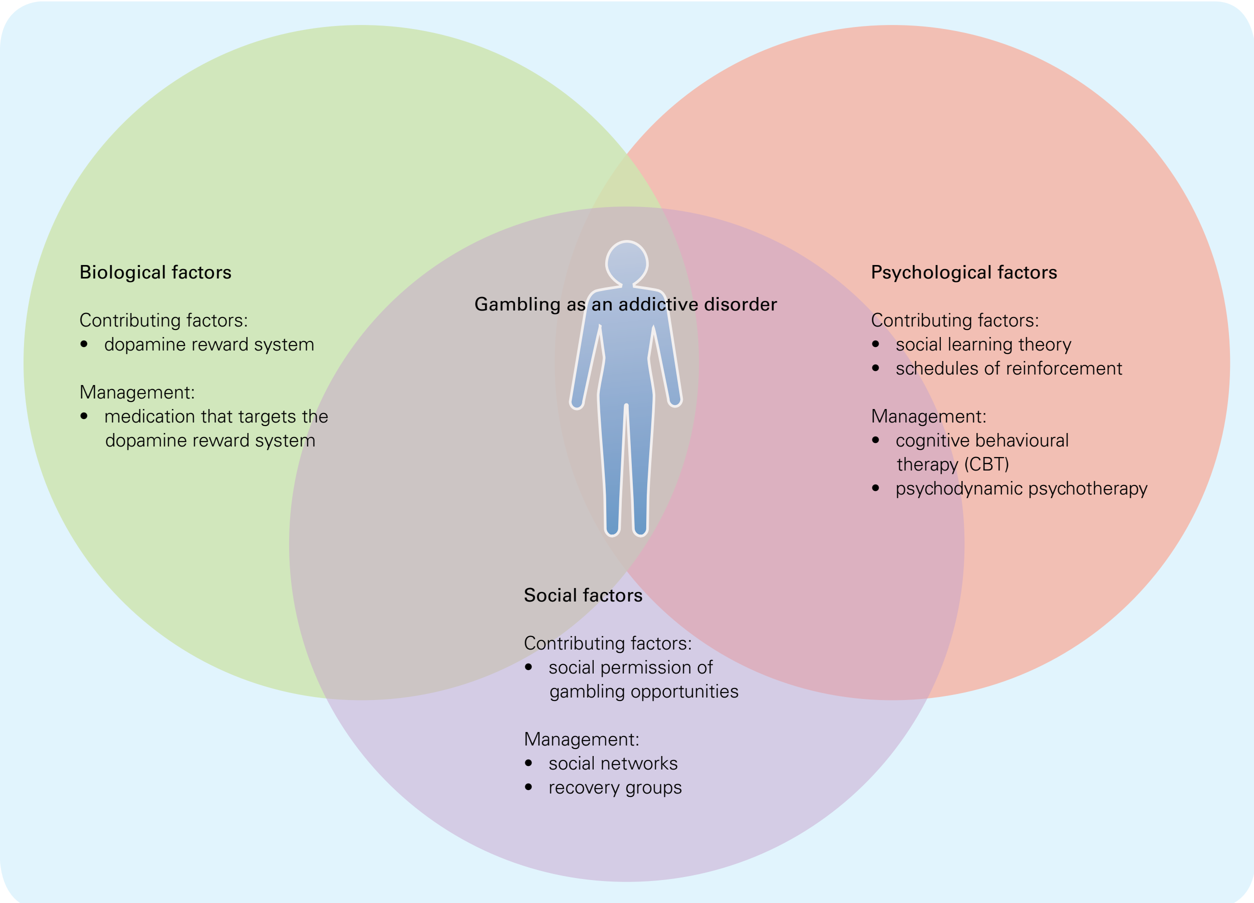


Figure 15.4 Biopsychosocial framework applied to understanding gambling as an addictive disorder and its treatment

Box 15.3

Gambling in Victoria

In 2008, the Department of Justice (Victoria) conducted the largest ever study of gambling in this state. A random stratified sample of 15 000 adults from metropolitan and regional areas throughout Victoria were surveyed using a computer-aided telephone interviewing system. The survey response rate was about 50%. The study examined the prevalence of gambling behaviour as well as health and wellbeing issues of gamblers in an effort to understand factors contributing to gambling and its effects on the individual.

All gamblers (defined as adults who had gambled in the past year) were asked nine questions that categorised them into one the following risk groups, based on their scored answers: problem gamblers, moderate-risk gamblers, low-risk gamblers and non-problem gamblers. This assessment was conducted using the Canadian Problem Gambling Index (see box 15.4). It is the most commonly used assessment device in Australia for research on the prevalence of gambling and problem gambling among adults in the general population. The study found that 73.07% of Victorian adults reported participating in some form of gambling in 2008. Other results are shown in figures 15.5 and 15.6.

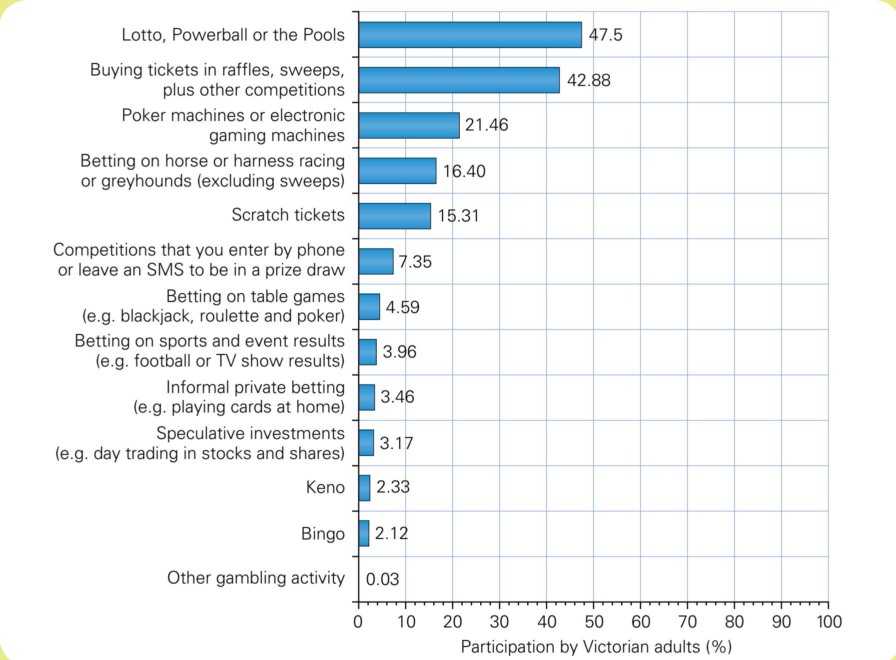


Figure 15.5 Participation in different gambling activities in Victoria in 2008

Source: Department of Justice (2009). Fact sheet 5 – Participation in gambling activities. *A study of gambling in Victoria: Problem gambling from a public health perspective.* State of Victoria, p. 1.

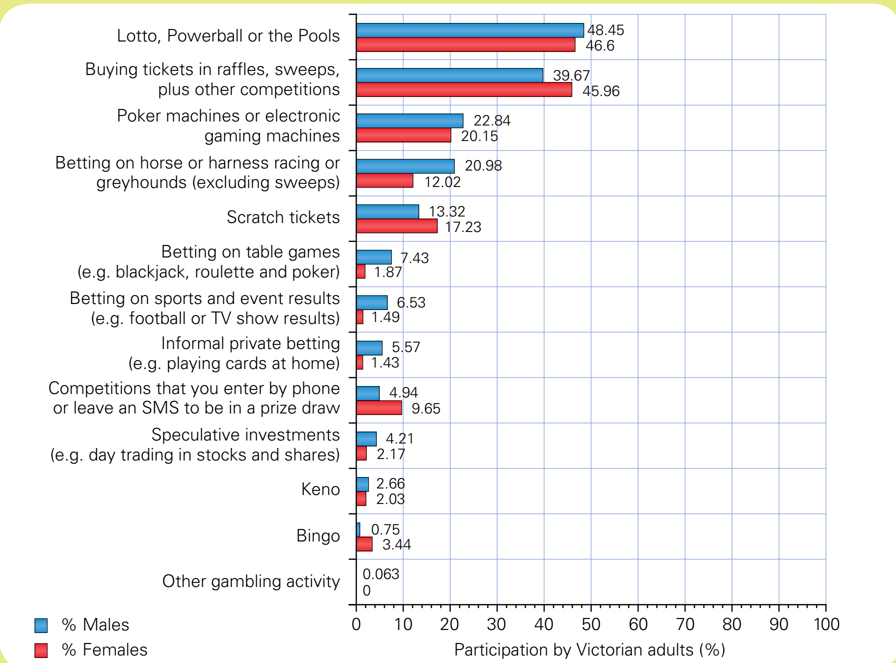


Figure 15.6 Victorian adult participation in gambling in 2008, by gender

Source: Department of Justice (2009). Fact sheet 5 – Participation in gambling activities. *A study of gambling in Victoria: Problem gambling from a public health perspective.* State of Victoria, p. 2.

Table 15.1 Prevalence of problem gambling in Victorian adults

Risk for problem gambling	% Victorian adults
Non-problem gamblers (score of 0)	64.31
Low-risk gamblers (score of 1–2)	5.70
Moderate-risk gamblers (score of 3–7)	2.36
Problem gamblers (score of 8–27)	0.70
Non-gamblers	26.93

Source: Department of Justice (2009). *A study of gambling in Victoria: Problem gambling from a public health perspective.* State of Victoria, p. 11, www.justice.vic.gov.au/wps/wcm/connect/DOJ+Internet/Home/Gambling+and+Racing/Research+and+Statistics/JUSTICE+-+A+Study+of+Gambling+in+Victoria+-+Problem+Gambling+from+a+Public+Health+Perspective+%28PDF%29.

Box 15.4

The Canadian Problem Gambling Index

The Canadian Problem Gambling Index (CPGI) is used to measure the prevalence of gambling and problem gambling among adults in the general population. It is a short questionnaire on which respondents are asked to rate the frequency of nine thoughts, feelings or behaviours associated with gambling and their consequences during the previous 12-month period. The answer options for each question are 'never', 'sometimes', 'most of the time' or 'almost always'. The questions are:

1 Have you bet more than you could really afford to lose?
2 Have you needed to gamble with larger amounts of money to get the same feeling of excitement?
3 When you gambled, did you go back another day to try to win back the money you lost?
4 Have you borrowed money or sold anything to get money to gamble?
5 Have you felt that you might have a problem with gambling?
6 Has gambling caused you any health problems, including stress or anxiety?
7 Have people criticised your betting or told you that you had a gambling problem, regardless of whether or not you thought it was true?
8 Has your gambling caused any financial problems for you or your household?
9 Have you felt guilty about the way you gamble or what happens when you gamble?

The answer to each question is scored on a 4-point scale: never = 0, sometimes = 1, most of the time = 2 and almost always = 3. The scores are then added up to derive a total score. Total scores are interpreted as shown below.

- **0** non-problem gambling
- **1–2** low level of problems with few or no identified negative consequences
- **3–7** moderate level of problems leading to some negative consequences
- **8+** problem gambling with negative consequences and a possible loss of control.

The higher the total score, the greater the risk that gambling is a problem.

Source: Centre for Addiction and Mental Health, Canadian Problem Gambling Index, www.problemgambling.ca.

Learning Activity 15.2

Review questions

1 Explain what gambling is with reference to an example.

2 a What is problem gambling?
  b What is pathological gambling?
  c List key characteristics of pathological gambling.
  d In what key ways are problem and pathological gambling similar and different?
  e Which term, problem gambling or pathological gambling, reflects the use of a categorical approach or a dimensional approach to classification of mental disorders?

3 a What is the main characteristic of an impulse control disorder?
  b In what way is problem or pathological gambling an impulse control disorder?

4 Under what circumstances is gambling an addictive disorder?

5 For each of the following people, identify which symptom(s) of pathological gambling disorder they are exhibiting:
  a Leon has a very stressful life. He works 15 hours a day, six days a week. However, when he is sitting in front of a poker machine, nothing else matters and he's able to forget about his stressful life for a while.
  b In order to continue gambling, Selina has stolen money from friends and borrowed money from family members under false pretences. She never tells anyone the truth about how much she has lost on gambling. She always tells everyone that she 'broke even'.
  c Samir has just lost $15 000 on gambling. He thinks, 'I've gotta get back my $15 000. If I win the money back everything will be alright', so he goes back to the roulette table. This time he tells himself that if he recovers the $15 000 he will stop for good. However, Samir loses another $1000.

Learning Activity 15.3

Data analysis

Consider the information in box 15.3, particularly the data in figures 15.5 and 15.6, and complete the following tasks and questions.

1. What was the Department of Justice survey about?
2. a Explain how a random stratified sample may have been obtained and why this type of sample was used.
   b Explain whether the sample was representative of Victorians.
   c Suggest a possible limitation of the sample and how this may have affected the results.
3. Explain whether the survey was standardised.
4. How was 'gambler' operationalised?
5. Can 'competitions that you enter by phone or leave an SMS to be in a prize draw' reasonably be considered a gambling activity?
6. What were the five most common gambling activities and their frequencies?
7. a Identify three gambling activities for which there appear to be significant gender differences.
   b Suggest a possible reason for the gender differences.
8. Refer to the Canadian Problem Gambling Index in box 15.4 and suggest a series of questions and answers that would contribute to an aggregate score indicating 'problem gambling with negative consequences and a possible loss of control'.
9. Following publication of the Department of Justice study, a newspaper published an article with the headline 'Victoria has a gambling problem'. On the basis of the results in figure 15.7, figure 15.8 and table 15.1, is this headline justifiable? Explain your answer.
10. Access a copy of the report on the Department of Justice study and identify a result or conclusion that you believe may be of community interest or relevance (and that has not been included in box 15.3).

Learning Activity 15.4

Research investigation on gambling

Working in a small group, plan and conduct an investigation to compare the prevalence of gambling in a sample of research interest; for example, male and female adolescents and/or adults.

The Canadian Problem Gambling Index described in box 15.4 may be used. Ensure all relevant ethical guidelines are followed when planning, conducting and reporting on your research.

Collate, tabulate and graph the data collected so that comparisons can be made. Draw relevant conclusions from the results and comment on the limitations of the investigation and its findings.

You should construct a hypothesis(es) before conducting the research and write a report on the investigation.

Biological contributing factors

The growth of the gambling industry has been accompanied by a large amount of research seeking to explain biological factors that may underlie and contribute to a gambling addiction. Of particular interest to psychologists have been reports of people treated with dopamine medications for Parkinson's disease who apparently developed a gambling addiction soon after treatment. Psychologists had not previously heard of other medication being linked with addictive gambling. However, the number of cases is not compelling evidence of a connection between dopamine and addictive gambling, especially as far more people with Parkinson's disease who take dopamine medications do not experience the desire to gamble excessively. However, this has not prevented psychologists and other researchers from seeking to understand and explain the potential role of dopamine as a contributing factor in gambling addiction.

The role of the dopamine reward system

The neurotransmitter dopamine is found in relatively few areas of the brain but appears to have a role in the development and maintenance of addictive gambling, as well other potentially addictive behaviours. **Dopamine** is a neurotransmitter that is believed to be involved

Figure 15.7 The release of dopamine in the brain can produce pleasurable experiences. An area of the brain, called the dopamine reward system, has been implicated in problem gambling and other addictive behaviours.

in pleasure, motivation, emotional arousal and the control of voluntary movements. Because of its role in basic motivated behaviours, such as seeking pleasure or associating actions with reward, dopamine is involved in regulating some critical human activities. For example, higher levels of dopamine in the brain are usually associated with positive emotions and may therefore be involved in the experience of pleasure that accompanies positive reinforcement. The release of dopamine also contributes to the planning and control of complex motor movements, thereby guiding behaviour towards objects and experiences that will lead to reward. However, dopamine can produce different effects in different neural pathways in the brain and not all of these are pleasurable or rewarding. For example, in some pathways, the presence of high levels of dopamine has been linked to schizophrenia. In other pathways, the presence of low levels of dopamine produces the tremors and decreased mobility of Parkinson's disease (Schacter, Gilbert & Wegner, 2009; Gazzaniga & Heatherton, 2006).

Researchers have identified a pathway in the brain where dopamine is concentrated and which is involved in the experience of a distinct sense of pleasure. This neural pathway, called the dopamine reward system, may therefore be an underlying brain mechanism in learning processes and behaviours involving positive reinforcement through pleasurable or rewarding consequences. The **dopamine reward system** is in a neural pathway that delivers rewards, or 'pleasurable experiences', when stimulated. This system is located in the medial forebrain bundle. As shown in figure 15.8, the **medial forebrain bundle** is a neural pathway that ascends from the midbrain through the hypothalamus into the nucleus accumbens. Neurons in the medial forebrain bundle are most susceptible to stimulation that produces pleasure and these neurons release dopamine. Stimulation of neurons in the medial forebrain bundle to activate the release of dopamine produces pleasurable experiences (Schacter, Gilbert & Wegner, 2009; Lancelot, 2007).

Studies with animals show that dopamine is released in the medial forebrain bundle when reward or pleasure is experienced. Dopamine is also released in *anticipation* of receiving a reward. For example, if food is presented to a hungry rat using a variable interval reinforcement schedule (i.e. at unpredictable times), the medial forebrain bundle is stimulated and dopamine is released each time the food is presented. If the situation is then changed so that a signal light comes on two seconds prior to each food presentation, the animal soon learns to anticipate food each time the light comes on. In this new situation, after several trials, no dopamine

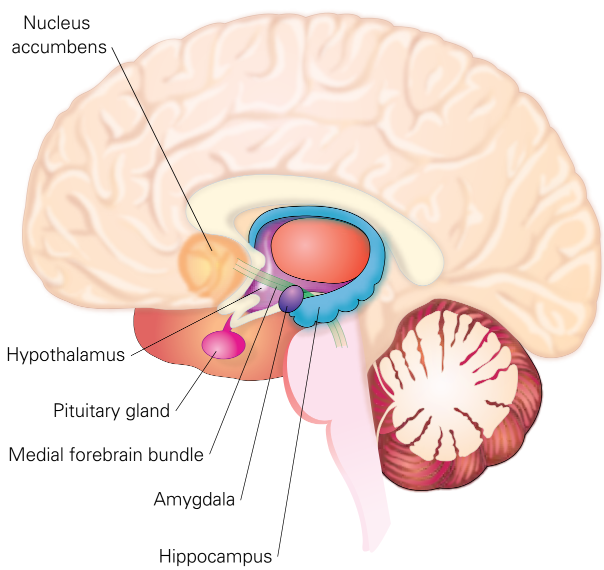


Figure 15.8 The dopamine reward system is a network of neurons in a part of the brain called the *medial forebrain bundle.* This neural pathway delivers pleasurable experiences when stimulated.

release occurs when the food is presented. Instead, dopamine is released only when the light comes on (Gray, 2007).

This pattern of dopamine release is consistent with the idea that dopamine is also involved in new learning. When a reward is unexpected, the release of dopamine immediately after the reward helps to reinforce the remembered association between the reward and any stimulus or response that has preceded it. When the cues and responses leading to a reward have already been well learned, however, there is no need for further reinforcement of that learning, and dopamine release in response to the reward ceases. Dopamine release now occurs in response to the signal preceding the reward, because the animal's interest seems to be focused on learning how to predict when the signal will appear and how to make it appear (Gray, 2007).

In relation to problem gambling, neuroimaging studies using *f*MRI have shown that games of chance with monetary rewards are powerful activators of the brain's dopamine reward system. Because the reward is never predictable, every instance of payoff results in a new burst of dopamine into the brain, no matter how many times the person plays. Consciously, the person may know that the game pays off in a way that is unpredictable and uninfluenced by anything that they do, but the dopamine reward system nevertheless responds as if it is constantly trying to learn how to predict and produce the reward. In addition, every cue in the environment that has previously been associated with gambling produces a strong, often irresistible urge to gamble. The repeated reinforcement by dopamine of associations between rewards and the cues and behaviours that precede each reward therefore results in the maintenance of an exceptionally strong response that is very resistant to extinction (Gray, 2007).

Research evidence also suggests that problem gambling may be partially attributable to *excessive* dopamine activity. Some of this evidence comes from the research on Parkinson's disease, which is associated with a deficiency of dopamine in the brain. Treatment therefore involves *increasing* dopamine levels in the brain using medications that are dopamine agonists. Dopamine *agonists* stimulate the release of dopamine or mimic dopamine to produce its effects. One of the most common dopamine agonists used in the treatment of Parkinson's disease is called *levodopa* (or *L-dopa*). It reduces the symptoms of Parkinson's disease by increasing the level of dopamine in the brain.

Several studies have reported a relationship between use of dopamine agonists in the treatment of Parkinson's disease and the development of an addictive gambling disorder and suggested that an excess of dopamine could be responsible. For example, a research team of American doctors reported a study of 11 people with Parkinson's disease who all developed 'pathological gambling' after starting treatment with medications containing high doses of a dopamine agonist. In one case, a 54-year-old married pastor started gambling daily at the local casino, hiding his losses from his wife. In another, a 41-year-old computer programmer who had never gambled in his life became 'consumed' by internet gambling. In a third, a 68-year-old man with no history of gambling lost more than $US200 000 at casinos over a six-month period. Also, after taking dopamine agonists, six of the participants felt a strong desire not just to gamble but also to engage to excess in other behaviours in which impulse control is involved, such as eating, drinking alcohol, having sex and making purchases. And once these participants stopped taking the drug or took less, their urges in all of these domains declined dramatically. The results also showed that gambling stopped in eight out of the 11 participants when the dopamine agonist was reduced or discontinued. One of these participants, referred to as George, stopped taking his dopamine agonist abruptly. Two days later, he felt his longings to engage in gambling and other 'excessive behaviours' rapidly resolve. It was 'like a light switch being turned off,' he said (Dodd & others, 2005).

Precisely how dopamine agonists lead some people with Parkinson's disease to develop a gambling addiction remains unclear. Tests of dopamine agonists in people with healthy brains have not resolved this question, because healthy brains do not respond like the brains of people with Parkinson's disease. The neurobiology of reward is complex and more is unknown than known. However, knowledge that the dopamine reward system may play a role in addictive disorders has led researchers to target the dopamine reward system for the treatment of the many people who do not have Parkinson's disease but have a gambling addiction.

Box 15.5

Electrical stimulation of the medial forebrain bundle

The discovery of 'pleasure centres' or a 'reward system' in the brain is often credited to Canadian neuroscientist James Olds and his student Peter Milner. Olds and Milner (1954) implanted tiny electrodes into the brains of rats and used them to electrically stimulate specific brain areas. They observed that some brain areas through which the *medial forebrain bundle* passes appeared to produce intensely positive experiences when stimulated. The rats behaved as if they were trying to get more of that stimulation. For example, a rat would show a strong inclination to return and remain in the spot in its cage where it received the stimulation. Olds and Milner concluded that the rat must be finding the stimulation pleasurable.

Olds and Milner then set up an experiment in which rats could electrically stimulate their own brain by pressing a lever in a Skinner box. With electrodes placed near an area of the hypothalamus through which the medial forebrain bundle also passes, the rats learned very quickly to press the lever repeatedly to receive stimulation. Olds (1956) observed that these rats would ignore food, water and other life-sustaining necessities for hours on end simply to receive stimulation directly on the brain. Some rats continued to press the lever for 24 hours without rest, as often as 5000 times per hour. Olds called these areas of the brain 'pleasure centres' (Olds, 1956).

Subsequent research showed that rats and other animals will work hardest and longest to stimulate the medial forebrain bundle. When Olds and Milner inserted electrodes into the medial forebrain bundle, they were tapping artificially into the brain's natural reward system. Subsequent research using an EEG to record electrical activity of the brain has shown that the medial forebrain bundle becomes active in all sorts of situations in which an individual receives a reward, whether the reward is food, novel objects to explore or (in humans) a prize received for winning a game (Gray, 2007). Furthermore, damage to areas of this neural pathway inhibits numerous types of basic motivated behaviours such as hunger and thirst. Without a functioning medial forebrain bundle, animals will not work to obtain rewards and will die unless they are given food and water artificially through tubes into their stomachs.

Figure 15.9 The rats in Olds and Milner's experiment quickly learned to repeatedly press a lever in a Skinner box to receive stimulation of their brain.

The dopamine reward system as a target for treatment

Increasing research evidence suggests that some medications can decrease the frequency of gambling behaviour. While there is no 'magic pill', one medication that has been studied in relation to gambling addiction is naltrexone. *Naltrexone* has traditionally been used to treat alcohol dependency and addiction to heroin and other opium-based drugs. Naltrexone does not cause physical dependence and it can be stopped at any time without withdrawal symptoms. Unlike an *agonist*, which stimulates a neurotransmitter's activity, an *antagonist* inhibits the activity of a neurotransmitter. In the dopamine reward system, inhibiting dopamine activity at the synapse with naltrexone can result in decreased subjective feelings of pleasure. People with a gambling addiction who are taking naltrexone are therefore possibly not compelled to seek reward system stimulation through further gambling because they do not feel as much pleasure as before they were on the medication (Peterson, 2007). That is, naltrexone dampens gambling-related excitement and cravings. Furthermore, ingesting naltrexone can result in a feeling of *satiety*, giving individuals the feeling that they have 'had enough' of a behaviour long before they would have normally.

In one study, American psychiatrist Suck Won Kim and his colleague John Grant (2001) tested the effectiveness of naltrexone in the treatment of participants with a gambling addiction. Kim and Grant hypothesised that naltrexone would reduce the urges and behaviours associated with addiction. Participants were recruited through newspaper advertisements. Of the 26 volunteers who were screened by the researchers in a telephone interview, seven males and ten females with a mean age of 44.6 years were assessed as eligible to participate in the study. All met the DSM-IV criteria for pathological gambling disorder and did not have any other disorder. All participants were prescribed naltrexone for six weeks and its use was monitored by the researchers to check for suitability of the dosage and potential side effects. Of the 17 participants, the involvement of three had to be terminated prematurely because of the drug's side effects (severe nausea and diarrhoea). The remaining 14 participants completed the study. As shown in table 15.2, use of the medication naltrexone appears to have been very effective in treating the participants' gambling addiction.

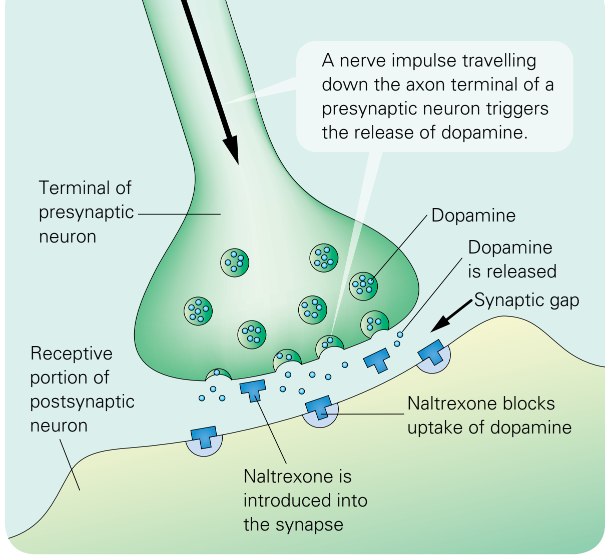


Figure 15.10 When naltrexone is released into the synapse, it blocks the uptake of dopamine by the postsynaptic neuron, thereby inhibiting the effects of dopamine.

In a follow-up study, Kim, Grant and other colleagues (2001) prescribed naltrexone for 11 weeks to 45 participants with a gambling addiction. Another 38 participants with a gambling addiction were given a placebo over the same period. At the end of the 11-week period, 75% of the participants, compared with 24% of those taking the placebo, experienced significant reductions in their gambling disorder symptoms. Naltrexone's use for treating gambling addiction (and substance abuse), however, is limited by its side effects, which predominantly involve nausea, but there is also the serious possibility that naltrexone can have toxic effects on the liver.

Table 15.2 Baseline and terminal visit gambling symptom data

Outcome measure	Baseline (beginning of treatment) (mean)	Terminal (end of treatment) (mean)
Total number of episodes of gambling during the past 7 days	7.56	1.69
Amount lost in the last 7 days ($US)	547.50	68.80
Gambling thought frequency[(a)]	3.94	1.24
Gambling urge frequency[(a)]	2.91	1.00
Gambling urge strength[(b)]	6.12	1.41

(a) 0 = none, 1 = once a day, 3 = three times a day, 5 = five times a day, 6 = more than five times a day; (b) 0 = none, 2 = mild, 4 = moderate, 6 = severe, 8 = extreme

Source: Kim, S.W., & Grant, J.E. (2001). An open naltrexone treatment study in pathological gambling disorder. *International Clinical Psychopharmacology, 16,* 287.

Learning Activity 15.5

Review questions

1 What is dopamine and what roles is it believed to play in behaviour and mental processes?
2 In what way is dopamine believed to be involved in learning through positive reinforcement?
3 Explain the meaning of dopamine agonists or dopamine antagonists, with reference to an example of each type of medication.
4 Explain the relationship between Parkinson's disease, dopamine and addictive gambling, with reference to key findings of a relevant research study.
5 a What is the dopamine reward system?
  b Where is it located?
  c Draw a simple diagram showing its location in relation to key brain structures and the four lobes.
  d Explain the possible role of the dopamine reward system in addictive gambling.
6 Explain the role of the dopamine reward system as a target of treatment for addictive gambling.
7 What conclusion can be drawn about the effectiveness of naltrexone in the treatment of addictive gambling?
8 How does an understanding of the brain's dopamine reward system contribute to an understanding of addictive gambling?

Learning Activity 15.6

Data analysis

Consider the description of the research study on naltrexone by Kim and Grant (2001) and the results in table 15.2, and then complete the following tasks and questions.

1 Describe the sample and the population of the study.
2 How were the participants selected?
3 Name the type of sample.
4 What was the hypothesis for the study?
5 Briefly outline the procedure for testing the hypothesis.
6 Construct another suitable title for the table.
7 With reference to data in the table, explain why the use of the medication naltrexone appears to have been very effective in treating the participants' gambling addiction.
8 Explain a possible limitation of the study.
9 Suggest a different research method to test the hypothesis and explain your choice of method.

Psychological contributing factors

Numerous psychological factors have been proposed as contributing to the development and maintenance of a gambling addiction. Two main types of explanations are based on learning theories and cognitive processes. Learning theories tend to emphasise modelling through observational learning and the role of intermittent schedules of reinforcement in the acquisition and maintenance of gambling behaviour. Cognitive theories tend to emphasise distorted patterns of thinking—such as misconceptions and erroneous beliefs about what determines success, luck and probabilities ('odds'), and the ability to control outcomes—and how cognitive biases, distorted reasoning and errors in judgment can lead to poor decision-making when placing a bet or chasing losses. Theories have also been developed to explain the onset and/or maintenance of addictive gambling in terms of a combination of learning and cognitive processes. One of these theories is called *social learning theory*. In this section we examine the role of social learning as a contributory factor to addictive gambling, then consider how reinforcement provided through specific types of gambling activities can contribute to the acquisition and/or maintenance of excessive and uncontrolled gambling.

Social learning theory

The term 'social learning theory' is often used interchangeably with the term 'observational learning theory', as it includes such concepts as observational learning, imitation and modelling. In addition, Albert Bandura, who developed the most widely described version of observational learning, is also considered to be the leading proponent of social learning theory.

According to Bandura, from the time we are born, we are surrounded by other people displaying a huge variety of behaviours, all of which we are able to observe. This provides us with a rich source of information about our environment. Through observation we learn many behaviours, not by actually carrying out the behaviour and experiencing the consequences, but simply by watching the behaviour and its consequences being experienced by someone else. Our thoughts, beliefs, attitudes, emotions and other mental processes may also be acquired through observational learning processes as these do not occur independently of observed behaviour.

In 1977, Bandura included these ideas in a theory that he initially called social learning theory. **Social learning theory** is a description and explanation of learning that combines operant conditioning and observational learning processes, taking account of the environment, or 'social context', in which they occur. According to social learning theory, we are more likely to model, learn and perform behaviours that are observed to be desirable and reinforcing. In 1986, Bandura revised his theory and now refers to it as *social cognitive theory* in order to emphasise the importance of cognition in the learning process. Both his initial and revised social learning theories are often described as 'a bridge' between the behaviourist theories of Watson and Skinner, and the cognitive learning theories of Köhler, Tolman and more contemporary cognitive learning theorists. This is because social learning theory encompasses cognitive processes such as attention, memory and motivation, as well as learning processes such conditioning, reinforcement and punishment.

According to Bandura, there are four conditions that need to be met before social learning will occur and is demonstrated. First, we must pay *attention* to and closely watch the model's behaviour. Second, having observed the model, we must be able to *retain* (remember) the model's behaviour. Third, when the model's behaviour has been closely attended to and retained in memory, we can attempt to *reproduce* (imitate), what has been observed and, fourth, we must be *motivated* to perform the behaviour.

An important variable that influences motivation to perform behaviour is whether the behaviour is observed as being reinforced or punished. This means that we do not have to directly or personally experience reinforcement or punishment in order for learning to occur. Rather, we can observe the consequences of someone else's behaviour. Bandura used the terms 'vicarious reinforcement' and 'vicarious punishment' to describe these learning processes. Like any other reinforcement, *vicarious reinforcement* increases the likelihood of the observer behaving in a similar way to a model whose behaviour is reinforced. In this way, we are conditioned through observing someone else being reinforced without personally experiencing the reinforcement or consequence directly.

Based on social learning theory, researchers have demonstrated that media portrayals (including advertising) of gambling can encourage the observer to engage in gambling by providing vicarious reinforcement. One of the main reasons this occurs is that the majority of 'models' used to promote gambling do so in a way that demonstrates positive consequences (positive reinforcement) without showing the adverse consequences (punishment). Media portrayals of gambling also tend to convey explicit (obvious) and implicit (subtle) messages that gambling is socially approved and desirable, thereby increasing the likelihood of imitation by the observer.

Australian research studies consistently find that recreational and problem gamblers report media portrayals as depicting gambling as a 'fun', 'thrilling', 'exciting' and 'pleasurable' activity, which leads them to view gambling as socially acceptable or desirable behaviour. Glamourised media portrayals also result in favourable attitudes toward gambling and this is linked to an early age onset of gambling. It is quite common for younger people to be targeted by gambling industries in advertising. For example, advertisements and promotion materials of casinos often feature 'young and beautiful' people having great fun.

Figure 15.11 The big draws in lotto attract much media attention. The public is bombarded with advertising that positively reinforces gambling behaviour and entices people to enter the draw.

Melbourne's Crown Casino has specifically targeted the age group of 18 to 28 years by establishing a 'young members club'. All 'young members' can receive free drinks and discounted nightclub entry fees, and sometimes free tokens to have 'fun' gambling. Although most younger people see through the glamour and glitz of the advertisements and promotions, some don't. For example, in one research study, it was found that about 50% of people diagnosed with a problem gambling disorder identified gambling promotion through advertising as one of the main reasons for taking up gambling. Essentially, it fostered the learning of misconceptions and erroneous beliefs about gambling (Grant & Kim, 2001).

In the Australian media and society in general, Tattslotto and big jackpot winners are given much attention. Even raffle winners are celebrated at school fetes, sports team functions and similar types of community or family events. The focus is on winning but rarely on loss—which is the real experience of most people when gambling. When we observe this biased representation of the gambling outcome, it influences our perceptions and impacts on what we learn.

Real-life models

Real-life models are people with whom we have direct contact, such as parents, siblings, teachers and friends. Many young Australians learn about gambling within their own families and often the message conveyed is a positive one that gambling is an acceptable recreational activity for a family. This is further reinforced by media portrayals of gambling as a form of family entertainment and opportunities created by gambling venues for family attendance. 'Family days' and free admission for children at horse-racing carnivals, and the child amusement facilities at hotels with poker machines, are designed to make it easier for parents to attend gaming venues and gamble. Parents who take advantage of these options not only model gambling as an acceptable 'family activity' but also directly expose children to the gambling, therefore also increasing the probability that their children will eventually become gamblers themselves at an earlier age than they would otherwise (Australian Psychological Society, 1997).

There is considerable research evidence indicating that many children are first exposed to gambling by their parents and that parental modelling of gambling as an acceptable activity can lead to the development of problem gambling later in life. For example, a study by Susan Moore and Keis Ohtsuka (1997) reported that about 70% of the 1017 Victorian 14- to 25-year-olds in their sample had experienced gambling within their family. Furthermore, Robyn Maddern (1997) found that parents introducing their children to gambling activities is more common among Australian-born adolescents than among adolescents born outside Australia. Problem gamblers are also more likely to view gambling as part of their family norms, and children of problem gamblers are at an increased risk of developing a serious gambling problem at some time in their own lives (ANU Centre for Gambling Research, 2004; Wynne, Smith & Jacobs, 1996). The vast majority of adult problem gamblers report commencing gambling in early adolescence, and some as early as 9 or 10 years old. In addition, if either parent has or both parents have a gambling problem, then there is also an increased risk that their children will ultimately have a gambling problem (Gupta & Derevensky, 1998; Maddern, 1996).

According to the Australian Psychological Society (1997), children should be given accurate information about gambling and the odds of winning to allow them to make an informed choice about participating in gambling. If they choose to gamble, it is important that appropriate role modelling teaches them responsible attitudes and behaviours that minimise their risk of developing a gambling problem.

Symbolic models

Symbolic models are presented to us in media such as television, movies and books. Research studies indicate that the higher the status of the model, the more the observer will imitate the behaviour, which is why many advertisements feature celebrities. Gambling industry sponsorship of current ‘public heroes’, such as prominent sports personalities or famous actors, is one of the clearest applications of social learning theory (Adams, 2007). Along with many large corporations, gambling providers spend large sums of money to encourage sports, arts and charity events to display their company identifiers. Common examples include a lottery’s logo being displayed as part of sponsoring a national sporting competition, a casino logo being displayed on the uniform of prominent sporting teams, and significant events being held at gambling venues (e.g. the AFL Brownlow Medal awards are held each year at Crown Casino). According to social learning theory, the young person keen on sports and identifying strongly with the success of sporting heroes will take in all these images, seeing them as an endorsement of gambling, and may begin to consider the prospect of similar rewards for themselves.

Consider the case of 19-year-old Jamie, an avid cricket player. He spends a considerable amount of time watching the Australian cricket team, thinking about the players, visualising how he would handle situations, and identifying with the struggles and triumphs of his favourite team heroes. Their wins are his wins, their losses are his losses and their choices are his choices. Being a bowler himself, Jamie’s favourite player of all time is Shane Warne. The sight of Shane Warne, wearing an ‘888.com’ polo shirt and enjoying himself playing poker with other celebrities at a luxury suite at Crown Casino sends a variety of compelling signals. If Jamie’s favourite cricketer is rewarded by an association with gambling, then so might he experience similar success. He decides to log on to 888.com to see what it is all about.

Figure 15.12 Often featuring attractive people enjoying themselves, depictions of gambling events in the media typically glamourise gambling and rarely show its negative consequences.

Box 15.6

The influence of social learning on gambling behaviour

Australian psychologists Matthew Rockloff and Victoria Dyer (2007) conducted an experiment on how learning about other people's wins influenced the gambling behaviour of a person playing an electronic gaming machine. They were particularly interested in the effects of the broadcasting of wins within a gaming venue. The wins of one gambler, who is often unseen, are usually announced to other gamblers by means of lights, bells and various tunes. According to Rockloff and Dyer, this information may influence gambling behaviour either by generating perceptions about the frequency of wins, or by energising the competitive instincts of the gambler. For example, problem gamblers may be motivated by the desire to appear 'lucky' or 'skilful' in the presence of others. In such cases, the fear of appearing to be a loser in the presence of others may also motivate problem gamblers to continue playing despite their mounting losses. This is consistent with Bandura's (1977) social learning theory, which suggests that the presence of other gamblers should promote gambling behaviour, particularly if they are winning.

One hundred and sixteen participants (50 male and 66 female, aged 18–67) were recruited from newspaper advertisements and posters in gaming venues in Rockhampton, Queensland. In a room on their own, the participants were required to play a computer-simulated gaming machine with a predetermined winning sequence, followed by an indefinite losing sequence. All participants were led to believe that other gamblers were also playing alone behind closed doors in two adjacent rooms.

At the beginning of the session, participants were given $5 as a payment for their attendance. They were then offered the opportunity to gamble with the money. All agreed to do so. To reinforce the perception that participants were gambling with their own money, the $5 payment was given back to the experimenter.

When gambling, participants received one of four types of false feedback designed to suggest that other gamblers in adjacent rooms were playing and sometimes winning at the same game. The four types of feedback were (1) 'sight and sound' information, (2) 'sight' only, (3) 'sound' only or (4) 'no sight and no sound'. 'Sight' information consisted of a banner across the top of the computer monitor that showed 'wins' made by the fictitious players (but not the amounts won). Banner messages included 'Room 1 wins!' or 'Room 3 wins!' at random intervals. 'Sound' information consisted of participants hearing winning bells when players in adjacent rooms presumably had won.

The results of the study indicated that participants in the sight-and-sound condition played significantly more trials (mean = 124.71) when compared to the other three conditions combined (mean = 108.43). These participants also lost more money. In the sight-and-sound condition, 71.4% of participants gambled away all their money, whereas 65.6%, 53.1% and 63.2% of participants in the sight-only, sound-only and no-sight and no-sound conditions, respectively, gambled away all their money. In contrast, the implied presence of others slowed play somewhat—which in itself would tend to decrease losses over a fixed period of time. This difference, however, was not statistically significant. There was no evidence for significantly higher average bet sizes in the sight-and-sound condition compared to the other conditions.

Learning Activity 15.7

Review questions

1 What is social learning theory?
2 According to Bandura, what four conditions need to be met for social learning to occur and be demonstrated?
3 What is vicarious reinforcement and what role does it play in social learning?
4 a Who or what are real-life models?
  b Explain how real-life models may influence the development of gambling behaviour, with reference to an example.
5 a Who or what are symbolic models?
  b Explain how symbolic models may influence the development of gambling behaviour, with reference to an example.
6 How does social learning theory account for the development and maintenance of gambling behaviour?

Learning Activity 15.8

Evaluation of research by Rockloff and Dyer (2007)

Evaluate the experiment on gambling behaviour conducted by Rockloff and Dyer (2007), described in box 15.6. Answer the following questions.

1 What was the aim of the research?
2 Construct an operational hypothesis that could have been tested by research procedures.
3 Who were the participants in the research and how were they recruited?
4 Name the type of experimental design.
5 Identify the experimental and control conditions.
6 What sampling method should have been used to assign participants to their respective condition?
7 Identify the independent and dependent variables.
8 Explain whether the results support the hypothesis (without referring to percentages).
9 What is an ethical issue of particular relevance to this experiment?
10 Explain the results with reference to social learning theory.
11 Suggest two key limitations or criticisms of the study that may impact on the generalisability of the results.

Learning Activity 15.9

Media response—symbolic gambling models in movies

Many movies glamourise gamblers and gambling or use a gambling context. For example, *Casino Royale* (2006) portrays the sophisticated fictional character James Bond as a gambler who always wins, and *Let it Ride* (1989) portrays a usually unsuccessful problem gambler who experiences a day in which he wins every bet he places. Watch one of these movies (or another relevant movie of your choice). Write a report that includes the following information:

- name of movie, year of release and a summary of the plot
- a description of the lead character(s) (the symbolic model) and their usual gambling activity or activities
- a description of how gambling venues and situations are typically portrayed
- a description of the way gambling and its consequences are typically portrayed
- other relevant comments
- an explanation of how watching this movie may contribute to the development or maintenance of problem gambling, with reference to the theories of social permission to gamble and social learning.

Use one or more examples from the movie where appropriate.

Figure 15.13 The sophisticated fictional character James Bond is portrayed as a gambler who always wins in *Casino Royale*.

Schedules of reinforcement

Gamblers are commonly observed persisting with play, sometimes for hours on end, through strings of consecutive losses, which are punctuated by wins every so often. The wins maintain their gambling behaviour but an overall financial loss is usually accumulated in the long run. When this is analysed in terms of the *schedules of reinforcement* proposed by Skinner's operant conditioning theory, people continue to gamble because they become accustomed to the *partial schedule* of positive reinforcement under which gambling operates. That is, monetary 'wins' are experienced intermittently, and the player cannot determine the frequency of reinforcement, as the delivery of a reinforcer (money) varies significantly between 'wins'. As a result, their behaviour becomes highly resistant to extinction and play can be maintained for long sessions without reward. Furthermore, losing periods can be perceived to actually increase the likelihood of a win, because gamblers have developed a conditioned expectation that one or more wins must eventually follow a sequence of losses.

In comparison to a *fixed schedule* of reinforcement in which the arrival of a reinforcer is usually predictable (e.g. every fifth or tenth correct response, or whenever five or ten seconds elapses), a *variable schedule* promotes a steady response rate that can be maintained over a longer period of time without reinforcement. The variable schedule is also much more resistant to *extinction*; that is, the gradual decrease in the strength or rate of a learned response following consistent non-reinforcement of a correct response (e.g. betting). The uncertainty of the reinforcement when partial reinforcement is used leads to a greater tendency for the response to continue. In a gambling situation, the gambler is typically highly motivated to win, usually believing that there is a chance of a big win with an expectation that this may occur sooner rather than later. Intermittent reinforcement can strengthen their expectation while maintaining their play at a consistent 'response' rate.

Skinner (1953) described the gambler as 'like a pigeon with its five responses per second for many hours, and therefore the victim of unpredictable reinforcement'. This has led psychologists to analyse different forms of gambling with specific reference to the variable ratio schedule. The use of poker machines in particular is often described as an example of gambling maintained by a variable ratio reinforcement schedule. Poker machines and many other forms of gambling, however, actually use another reinforcement schedule called a *random ratio* (Haw, 2008).

In a **variable-ratio (VR) schedule**, reinforcement is given after an unpredictable ('variable') number ('ratio') of correct responses and there is a constant mean number of correct responses for giving reinforcement. For example, a variable ratio of 10 (VR10) means the number of responses between reinforcements varies unpredictably, but the average over a large number of correct responses equals 10. Therefore, across 100 correct responses (pushing a button to gamble money on a poker machine), there will be 10 reinforcers (payouts) delivered, but at unpredictable times. Although the number of responses between reinforcements forms an unpredictable sequence in a VR schedule, this sequence is not completely random. This is mainly because when designing a VR schedule there is *an upper limit* on the maximum number of responses before reinforcement is given. If a truly random sequence is used, the schedule is called a random-ratio schedule rather than a VR schedule.

A **random-ratio (RR) schedule** occurs when the reinforcer is given after a random number of responses and each response has an equal chance of reinforcement. Unlike a VR schedule, there is no predetermined upper limit on the maximum number of responses before reinforcement is given. Therefore, with an RR schedule, each response outcome is completely independent of the previous one and it is possible that the next reward will occur after 100, 1000 or 1 000 000 responses. There is no way of knowing. A poker machine may be designed to have an RR10 but it may need 1 000 000 responses before the RR10 schedule is achieved. All contemporary Australian poker machines operate under an RR schedule and the schedule is determined by inbuilt computerised random number generators. The random number

Figure 15.14 Contemporary poker machines operate on a random-ratio schedule of reinforcement in which the reinforcer is given after a random number of correct responses, each response has an equal chance of reinforcement and there is *no upper limit* on the maximum number of responses before reinforcement is given.

generator determines the outcome of each spin and is always at work, cycling through millions of random numbers even when the machine isn't being played. Because of the computerised random number generator technology, nothing can be done to predict when there will be a payout nor can anything be done to change the outcome. Each spin is completely independent of any previous spin and each outcome is also independent of any previous outcome.

An RR schedule of reinforcement makes the monetary reward from a given play especially unpredictable. It also leads gamblers to respond at high rates (keep playing) for relatively little reinforcement, and to persist in long periods of responding even when no payout is forthcoming. This occurs because gamblers believe that each response that is not reinforced is bringing them closer to a response that will be reinforced. However, this is a false belief when the RR schedule is used (Haw, 2010).

According to Australian psychologist John Haw (2010), most people get 'tripped up' by RR schedules. Poker machines have an average RR (say RR10) and they have an average payback percentage (say 90%). A poker machine may be programmed to have an RR10 schedule with 90% payback, but the RR10 schedule may be based on 1 000 000 plays. Therefore, after 1000 plays, its schedule of reinforcement (for payouts) may actually be at RR50, with a payout percentage of 50%. This is not illegal and gaming authorities are aware of the RR schedule and how it actually operates in poker machines. However, the gambler is unaware of the use of an RR schedule and what it actually means for payouts. They persist with play under the mistaken belief that every bet will bring them closer to a big payout, regardless of wins and losses along the way. The problem is that 1 000 000 plays on a one-cent machine is $10 000 (and a lot of time) so persisting really isn't a good strategy.

Learning Activity 15.10

Review questions

1. What does the term schedule of reinforcement refer to in relation to gambling?
2. Distinguish between continuous and partial schedules of reinforcement with reference to examples of three different gambling activities.
3. **a** Define extinction in relation to gambling.
   b Explain whether gambling reinforced with continuous or partial reinforcement is more resistant to extinction.
4. Under a variable-ratio schedule of reinforcement, when is the reinforcement given?
5. Under a random-ratio schedule of reinforcement, when is the reinforcement given?
6. Explain the difference between the variable-ratio and random-ratio schedules with reference to poker machine payouts.
7. With reference to a gambling example, explain how the schedule of reinforcement used by a gambling provider or venue may contribute to the development and maintenance of gambling behaviour.

Treatment of problem gambling

Only a small proportion of people experiencing problems with gambling seek professional help. Usually, professional help is not sought until a 'crisis' occurs or 'rock bottom' is hit. For example, a person may not seek help until they are facing financial ruin, a relationship breakdown, serious work-related issues, deterioration of physical health, deterioration of psychological health (e.g. attempted suicide) or legal charges linked to their gambling activities. Research evidence also indicates that the reasons people with gambling problems do not seek professional help include feelings of guilt, shame, embarrassment and denial; a concern about social stigma; and the belief that they can resolve their gambling problems without professional help. Most people who seek professional help are primarily experiencing problems with poker machines, or they identify poker machines as the principal preferred form of gambling activity (Productivity Commission, 2009).

Among Victorians identified as problem gamblers, a major study found that 61.2% are male, which is significantly more than the proportion of males in the general population (48.5%). Furthermore, problem gamblers in Victoria are disproportionately found among the age groups 50–64 years (36.8%) and 35–49 years (33.8%), compared to their shares in the general population (28.8% and 24.6%, respectively). For people from a non-English-speaking background, 24% of regular gamblers have a gambling problem. Similarly, 28.2% of gamblers who are separated or divorced and 25.0% of gamblers on social security benefits have a gambling problem. Problem gamblers are more likely to have relatively low levels of education (less than tertiary degrees) and derive their main income from social security payments (other than the age pension). A higher proportion of people who are unemployed have gambling problems than gamblers with a different employment status. However, most problem gamblers across the different gambling forms are working full-time (ANU Centre for Gambling Research, 2004).

Psychological treatment of problem gambling may take many forms. Two treatment methods are *cognitive behavioural therapy (CBT)*, which focuses on thought processes and behaviour, and *psychodynamic psychotherapy*, which focuses on underlying conflicts within the individual.

Cognitive behavioural therapy (CBT)

As the name suggests, *cognitive behavioural therapy*, commonly referred to as CBT, is a type of therapy that combines cognitive and behavioural therapies to help people overcome psychological problems and mental disorders. CBT is based on the assumption that the way people feel and behave is largely a product of the way they think. Therefore, according to the principles of CBT, anyone can change the way they feel and behave by thinking about a situation in a more balanced and helpful way. However, CBT does not aim to persuade someone that their current way of thinking is 'wrong' or 'irrational'. Instead, CBT aims to assist the individual to identify where they may have become trapped or stuck in their way of thinking and to assist them to discover other ways of looking at their situation.

People experiencing problem gambling typically have various irrational or erroneous thoughts and beliefs about gambling. Their cognitive distortions about gambling typically underlie and maintain their gambling behaviour. Two of the most common cognitive distortions held by people with a gambling addiction are *illusions of control* and the *gambler's fallacy*. Both lead to flawed decision-making.

An **illusion of control** refers to the mistaken belief ('illusion') that the outcomes of random, unpredictable events can be influenced ('controlled') by one's thoughts or actions. It is believed that there is a way to 'beat the odds' or 'beat the system' and 'come out on top', when in fact the outcome is completely unpredictable and whatever one does will not actually exert any influence over the outcome. Essentially, people with a gambling problem (and many recreational gamblers) believe that they have more skill, knowledge or ability to predict or influence the outcome of gambling events than they actually do. Examples that demonstrate an illusion of control include 'willing' a winning result through mental effort, talking to and touching a poker machine in a certain way, choosing specific Tattslotto numbers

Figure 15.15 A craps gambler who has an illusion of control may throw the dice in a certain way, in the mistaken belief that this can increase the likelihood of success.

in preference to computer-generated numbers (e.g. the 'quick pick' option), revealing the cards slowly one at time after having been dealt a hand in poker, studying the pattern of numbers that have won in previous games and placing bets according to these past wins when playing roulette or Keno, blowing on dice before throwing them when playing the game of craps and throwing the dice 'softly' when aiming for low numbers and 'hard' for high numbers. Although these types of 'strategies' are irrational, and the gambler may be convinced of this, they persist with their use, usually attributing failure to 'bad luck'.

People experiencing problem gambling who have an illusion of control consistently *overestimate* their ability to influence the outcome of a gambling (chance) event, even though their actions have absolutely no part to play in determining the final result. They also tend to attribute wins (successful bets) to personal actions such as skill and positive thinking, and losses (unsuccessful bets) to factors outside their control. In this way, the gambler can maintain the false belief that their gambling strategies are effective, despite the continuing loss of money.

People experiencing problem gambling also tend to incorrectly believe that outcomes are predictable, irrespective of the laws of probability that actually apply. This belief involves what is commonly called the gambler's fallacy. The **gambler's fallacy** refers to the belief that in a series of independent chance events, future events can be predicted from past ones. It is a fallacy that encompasses any of the following misconceptions:

- a random event is *more* likely to occur because it has *not* happened for a period of time
- a random event is *less* likely to occur because it has *not* happened for a period of time
- a random event is *more* likely to occur because it *recently* happened
- a random event is *less* likely to occur because it *recently* happened.

The gambler's fallacy is often illustrated with coin tosses. For example, if a coin is tossed in the air and comes down heads ten times in succession, it is believed that there is an increased chance of the coin coming down tails on the next toss. This, however, is incorrect (assuming the toss of the coin is fair). If two events are independent of one another, then one event does not affect the occurrence of the other. Each toss of the coin is entirely independent of the previous toss (or tosses). Even though the gambler may have a memory of the previous coin toss, the coin does not. The chance of getting heads (or tails) on any given toss is the same (1:2 or 50%) regardless of what happened in a previous toss, including situations in which heads may have come up ten times in a row. Gamblers who believe in the gambler's fallacy also believe, for example, that in roulette certain numbers are 'due' because they haven't come up for a while, and that the chance of winning on a particular poker machine depends upon how recently someone else won on that machine. These gamblers therefore bet on roulette numbers that are 'due' in the mistaken belief that those numbers must eventually come up or they play a particular poker machine 'because it hasn't paid off all day' and must therefore be due to pay out.

Any person who thinks that they can record the results of a roulette wheel spin, the throws of the dice at a craps table or the numbers drawn in Tattslotto and then use this information to

Figure 15.16 Cognitive distortions such as 'I'm really on a hot streak' or 'I'm bound to win again' can maintain gambling behaviour.

predict future outcomes is basing their thinking on the gambler's fallacy. This also applies to the notion of the 'hot streak': the idea that a string of successful outcomes is more likely than usual to be followed by a successful outcome. Like the gambler's fallacy, it is erroneous thinking based on a misunderstanding of the laws of probability that apply to independent chance events.

The goal of the *cognitive component* of CBT in the treatment of problem gambling is to help the person to identify and correct distorted thoughts, beliefs and attitudes about playing and winning games of chance. Most people with a gambling problem are unaware that they have cognitive distortions. Nor do they have a clear understanding of the nature of probabilities and random events. An initial step therefore often involves obtaining information to identify and evaluate the individual's gambling patterns and cognitive distortions. The information is then used to assist them to become aware of specific gambling cognitive distortions and errors in judgment so that they can begin to make better decisions and choices. In order for this to be achieved, the individual may be asked to express the thoughts that crossed their mind before, during and after a recent gambling session. For example, if their problem gambling involves poker machines, the mental health professional may ask them why they decided to bet in a particular way, what they were thinking when a machine was paying out and not paying out, strategies they believed would influence payouts, whether they thought that they were more likely to win or lose under certain circumstances, and so on.

The next step often involves assisting the person to develop an awareness of relevant concepts such as randomness, probabilities, betting systems and causality, and how these apply to games of chance. For example, it is essential they come to understand the true role of chance and that each gamble is independent of every other gamble, so outcomes cannot be predicted or influenced, whatever the strategy. It is also important for the mental health professional to determine whether the person confuses games of skill and games of chance. In a game of skill, people can improve their technique and modify results in their favour. For example, the more someone practises and plays tennis or snooker, the better they can become and the more likely they are to win. Conversely, with games of chance such as roulette and poker machines, it is impossible for somebody to improve their technique to change the result.

To assist the individual to develop an understanding of relevant concepts, the mental health professional may use gambling role plays or simulations in which they can test and evaluate outcome predictions of coin tosses, lottery numbers, roulette numbers or poker machine payout patterns. The main benefit of this procedure is that the client is engaging in new learning that focuses on understanding and applying concepts such as randomness, probability, luck and skill to gambling situations and decisions.

Clients may also be encouraged to keep a diary in which they record the triggers that cause them to gamble; gambling situations and time spent gambling; their thoughts, attitudes, beliefs and behaviour when gambling; and so on. As well as providing useful information to identify and evaluate gambling patterns and cognitive distortions, this gives the client greater awareness of their problem and helps them make changes. It also enables the client and mental health professional to monitor the progress of change.

An important aspect of the cognitive component of CBT is to encourage the individual to directly challenge and correct their distorted thoughts, beliefs and attitudes about playing and winning games of chance. This is done with the assistance and guidance of the mental health professional and continues until there is a reduction in their gambling behaviour.

Problem-solving skills can also help individuals struggling against their impulses to gamble excessively to feel improved control over their gambling risks and consequences. Problem-solving strategies may include learning ways to refuse gambling opportunities and to deal with gambling urges, deciding limits on the time and money spent gambling, resolving difficulties with family members and finding suitable solutions to gambling debts. The problem-solving process learnt by the person may involve a number of steps; for example, identifying the problem accurately, collecting specific information about the problem, generating different options, exploring consequences by listing advantages and disadvantages for each, and then implementing and evaluating the preferred solution (Korn & Shaffer, 2004).

The *behavioural component* of CBT in the treatment of problem gambling involves assisting the person to use behavioural techniques to manage the tension, anxiety or arousal that is frequently associated with compelling urges to gamble.

It is common for someone with a gambling problem to report that the urge to gamble is overwhelming and beyond their control, once it has been triggered. Stimuli to gamble vary among individuals and may include boredom, stress at work or home, driving past a gaming venue or TAB, a phone call from a friend associated with gambling or the sight of the newspaper known to contain a form guide for horse-racing events. Once the thought of gambling has entered the mind of someone with a gambling addiction, it can become impossible to think of anything else. Physical symptoms such as tension, anxiety, restlessness and responses associated with activation of the sympathetic nervous system are also common. The tension may continue to build until such time as the urge is finally satisfied through gambling.

A commonly used technique to help the individual control or eliminate their urge is a variation of systematic desensitisation called imaginal desensitisation. When used for the treatment of problem gambling, **imaginal desensitisation** exposes the individual to mental images of gambling opportunities while they are in a state of relaxation, so that, over time, they will learn to associate feelings of relaxation with gambling rather than tension and arousal. For example, the individual might be asked to imagine walking past a gaming venue, TAB or racetrack without going in, but respond with feelings of relaxation rather than tension or arousal. The goal is to extinguish the learned association between arousal and gambling and replace it with a relaxation response. Rehearsing familiar gambling behaviour patterns 'in imagination' while in a physically relaxed state helps ensure that uncontrollable levels of tension are no longer provoked by gambling stimuli (Blaszczynski, 1998; McConaghy & others, 1988).

As with systematic desensitisation, learning imaginal desensitisation is a three-step process. The first step involves constructing a CD that includes brief instructions for a progressive muscle relaxation technique as well as a number of very detailed gambling scenes. The first three or four scenes describe the individual's typical behaviour when approaching their favourite form of gambling. These are followed by two or three scenes of the individual thinking about the unpleasant emotions following a loss and of being bored with the idea of gambling. Each scene is followed by the relaxation instructions.

The second step involves learning the progressive muscle relaxation technique. The third and final step involves listening to the CD and imagining the gambling scenes that have been recorded,

Figure 15.17 Imaginal desensitisation can help an individual to resist urges and cravings, such as those experienced when driving or walking past places that provide opportunities to gamble.

while at the same time applying the progressive muscle relaxation procedure. When the individual has completed about ten to 14 sessions over a week using the CD, they should be so familiar with the technique that they will be able to put it into effect when confronted with any stimulus that triggers their gambling urge (Blaszczynski, 1998).

Learning Activity 15.11

Review questions

1. **a** Explain what an illusion of control is, with reference to an example.
   b Explain how an illusion of control may contribute to continued gambling.
   c Studies have shown that lottery gamblers with an illusion of control pick their own numbers rather than have the numbers randomly selected for them. Why would this be the case?
   d Some problem gamblers engage in superstitious behaviour such as never betting on a 'bad' number or always pressing buttons on a poker machine in a specific way. Is superstitious behaviour an illusion of control? Explain your answer.
2. **a** What is the gambler's fallacy?
   b Explain how the gambler's fallacy may contribute to continued gambling.
3. Tatts annually issues a media release notifying the 'top 10 Lotto hot spots' for each state or territory. The media release names areas and agencies where most division 1 prizes and the largest amounts of money were won in the previous 12 months.
   a In what way might this type of information contribute to or reinforce a gambler's cognitive distortions about winning a Lotto prize?
   b Which type of cognitive distortion is relevant?
4. **a** What role does education about the concepts of randomness, chance and probabilities play in the treatment of a pathological gambling disorder?
   b What important point is it essential that the gambler is made aware of?
5. **a** Suggest a suitable aim of cognitive behavioural therapy in the treatment for a client experiencing problem gambling.
   b What key assumption would underlie this aim?
   c Give two examples of roles required of the client during CBT.

Learning Activity 15.12

Visual presentation on CBT

Construct a flow chart that summarises the possible treatment of problem gambling using CBT. Ensure that your flow chart:

- starts with a definition of problem gambling and a list of commonly occurring thoughts, feelings and behaviours
- refers to the aim(s) of the therapy in relation to problem gambling
- outlines key assumptions of CBT when used for problem gambling
- identifies possible therapeutic techniques
- distinguishes between key roles of the therapist and the client during the therapy.

Psychodynamic psychotherapy

Psychodynamic psychotherapy is based on the theories proposed by Freud and was widely used in treating people with problem gambling prior to the development of CBT. *Psychodynamic psychotherapy*, also called *psychoanalytic psychotherapy*, is a type of psychological treatment that aims to help people understand the roots of emotional distress by exploring unconscious conflicts, motives, needs and defences. It is based on an assumption that all mental disorders are caused by unresolved psychological conflicts that occur in the unconscious part of the mind, beneath conscious awareness. These conflicts have their origins in early childhood experiences during which our instinctive impulses and society's view of what is 'acceptable' behaviour often clash.

In explaining problem gambling, Freud (1928) proposed that the Oedipal complex was the probable source. According to Freud (1928), gambling in an addictive way provides an opportunity to *lose* and thereby punish oneself for feelings of guilt associated with the Oedipal complex. In turn, this unconscious desire for self-punishment relieves the guilt feelings.

In relation to problem gambling, the aim of psychodynamic psychotherapy is to assist the individual to achieve abstinence. *Abstinence* is the voluntary restraint from indulging in an activity that gives pleasure, which in this case is gambling. It is thought that throughout the process of psychodynamic psychotherapy, clients will gain an understanding of why they gamble and its consequences, cope more effectively with their impulse to gamble, and adopt more positive ways of functioning in everyday life. Helping the client to understand what gambling *means* for them—not only its negative consequences and meanings, but what they get out of it as well—is a crucial part of the treatment plan. It is also important that the client becomes an active participant in their own treatment, especially as treatment can be lengthy and continue over several years.

When using psychodynamic psychotherapy in the treatment of problem gambling, therapists use a range of psychodynamic techniques, including free association, dream interpretation, identification of defence mechanisms and displays of transference.

Free association is a therapeutic technique in which the client is encouraged to say whatever comes to mind, regardless of how painful, embarrassing, illogical or irrelevant it might seem, without any interference by the psychotherapist. The psychotherapist listens carefully to identify and assess which 'themes' are the most involved in the development (and maintenance) of the person's problem gambling. Themes may include power; overconfidence; feelings of nothingness, helplessness or emptiness; an inability to deal with stressful life events in socially acceptable ways; or guilt associated with loss of a loved one.

The client may also be encouraged to report their dreams, as these may shed light on what is occurring unconsciously. Psychologists who adopt the psychodynamic perspective believe that dreams symbolically represent information stored in the unconscious mind. For example, a man might dream that he lost money in each of many soft-drink machines without ever receiving a drink. This may suggest an unconscious desire to punish himself for guilt feelings and excessive gambling that inevitably results in financial loss. Alternatively, a man may dream that he simply had to touch each of many soft-drink machines and it delivered a drink. This may suggest the illusion of power and control that can be experienced when gambling.

The psychotherapist will also typically examine the *defence mechanisms* that the client is likely to be using. Defence mechanisms are the psychodynamic equivalent of coping skills. According to psychodynamic psychotherapists, use of defence mechanisms prevents exploration and resolution of the unconscious conflicts, allowing the problem to continue. Psychodynamic psychotherapists therefore believe that it is important to help clients realise that they are using defence mechanisms and explore not only how they are related to current gambling episodes, but also how and why such defences originated in the first place. Denial and omnipotence are two defence mechanisms commonly used by problems gamblers.

Denial involves refusal to believe whatever it is that may be causing one's anxiety or emotional conflict. When used by the problem gambler, denial involves rejecting or refusing to accept ('denying') that one's gambling is a serious problem. Many people with a gambling addiction refuse to recognise or accept that they have a problem. They can also come up with an endless variety of reasons and justifications for the negative consequences of their addiction, as well as reasons to explain why the label 'addicted' or 'problem gambler' doesn't apply in their case. *Omnipotence* refers to the feeling of being 'all powerful' and is a direct defence against feelings of inadequacy and helplessness. Problem gamblers are believed to have feelings of inadequacy and helplessness that lead to the creation of a fantasy world in which gambling is seen as the solution to their problems. This fantasy allows them to feel important, respected, powerful and independent, or 'omnipotent' (Rosenthal, 1986). Contemporary research findings indicate that many gamblers report such feelings of power and respect while 'in action' and believe they are more powerful than the odds themselves.

During therapy sessions, the psychotherapist would also be carefully observing any transference that is occurring. *Transference* occurs when a client unconsciously responds to the therapist as if they are a significant person in their life (often a parent) and shifts, or 'transfers', unresolved conflicts and childhood fantasies to their therapist. This is a valuable source of information about the client's characteristic ways of thinking, feeling and behaving, so the psychotherapist encourages transference by purposely remaining as neutral as possible. Transference often enables the client to relive unresolved conflicts that have been repressed since childhood, yet experience them in the context of the relationship with their therapist. For example, the client might transfer towards the therapist feelings of anger that they repressed in response to a harsh or rejecting parent with a statement such as 'what do you want from me?' At the appropriate time, the therapist offers interpretations to help the client perceive and understand the transference that is occurring.

The relationship between the client and psychoanalyst takes time to develop. Usually many regular sessions are required for the therapy and it may take years. Critics of psychodynamic psychotherapy have pointed out that concepts such as the unconscious cannot be scientifically tested and that much of the evidence for its effectiveness is based on single case studies. However, psychodynamic psychotherapy highlights the potential relevance of long-standing unresolved conflicts or emotional needs that may underlie problem gambling. For some gamblers, stopping gambling may bring these unconscious conflicts into conscious awareness, creating an uncomfortable tension that could be a factor in relapse if left untreated.

Figure 15.18 Helping the client understand what gambling means for them, and what they get out of it, is a crucial part of psychodynamic psychotherapy for problem gambling.

Learning Activity 15.13

Review questions

1. **a** What is psychodynamic psychotherapy?
   b What is its key assumption?
2. How did Freud explain problem gambling?
3. Briefly describe, with reference to examples, how each of the following may be used in the treatment of problem gambling by a psychodynamic psychotherapist:
   a free association
   b dream interpretation
   c identification of defence mechanisms
   d transference.
4. Give two examples of roles required of the person with a gambling problem during psychodynamic psychotherapy.

Learning Activity 15.14

Visual presentation on psychodynamic psychotherapy

Construct a flow chart that summarises the possible treatment of problem gambling using psychodynamic psychotherapy. Ensure that your flow chart:

- refers to the aim(s) of the therapy in relation to problem gambling
- outlines key assumptions of psychodynamic psychotherapy when used for problem gambling
- identifies possible therapeutic techniques
- distinguishes between key roles of the therapist and the client during the therapy.

Socio-cultural contributing factors

A wide variety of socio-cultural factors can contribute to an individual developing an addiction to gambling. Many psychologists believe that an important contributory factor is the transmission of information that gambling is acceptable. This occurs within a socio-cultural context in which many different forms of gambling are legal and there are numerous points of access and ample opportunities to gamble at any time of the day on any day of the year. The potential for significant harm from some types of gambling is what distinguishes gambling from most other enjoyable recreational activities (Productivity Commission, 2009).

Social permission of gambling opportunities

Although some Australians do not gamble at all, gambling as a recreational activity is well entrenched in Australian society. Gambling is viewed as a normal and enjoyable recreational pursuit for many. Around three in four Australians gamble at some time in the year. Gambling is also viewed as a part of popular culture (Productivity Commission, 2009). From the 'traditional' gambling game of 'two-up', which is often described as part of the ANZAC spirit, to the Melbourne Cup, the horse race that 'stops the nation' in November, gambling is regarded by many Australians as part of their cultural heritage. Perhaps in no other nation but Australia could a racehorse become a cultural icon as has Phar Lap (Ohtsuka & Maddern, 1999).

In Australia, there is also a substantial infrastructure in place to support gambling: the print and electronic media promote it through coverage of 'social' events involving gambling, and advertising provides and reinforces a positive image of gambling in the community (Australian Psychological Society, 1997). Despite a growing level of government and public awareness that addictive or excessive gambling can have devastating consequences, gambling continues to be a prominent recreational activity for many Australians of different socio-cultural backgrounds.

The perception that gambling is socially permissible has an influential effect in determining the rate and frequency of gambling among different sectors of the population. Research evidence suggests that the number of people in any given community who actively participate in gambling activity is related to the promotion, accessibility and availability of gambling outlets (Australian Psychological Society, 1997). Research evidence also indicates that younger Australians are more likely to perceive gambling as socially acceptable and consistent with social norms. The perception of 'social permission to gamble' encourages young people to try gambling at some stage and is a significant predictor of youth gambling frequency in Australia. 'Social permission to gamble' also decreases the likelihood of negative consequences being associated with regular gambling. For example, a young person is more likely to engage in regular gambling if their family and friends actively gamble and promote positive values and attitudes about gambling. The young person may also be more vulnerable to misunderstandings about gambling and chance events; for example, that losses can be recovered by continuing to play ('chasing losses') and that gaming machines or roulette tables can run 'hot and cold' (Productivity Commission, 2009; Ohtsuka & Maddern, 1999; Moore & Ohtsuka, 1997).

Figure 15.19 The Melbourne Cup is often described as 'the race that stops a nation'. Most Victorians have a public holiday on Melbourne Cup day.

Support factors

Social networks

In addition to psychotherapy and CBT to treat problem gambling and assist management and recovery, support may be provided through an individual's social network, as well as through recovery groups that may be accessed in the local and wider community.

The term 'social network' was first used by Australian anthropologist J.A. Barnes in the 1950s to describe the complex social relationships among people living in a Norwegian fishing village. Barnes (1954) concluded that the whole of social life could be seen as 'a set of points, some of which are joined by lines' to form a 'total network' of relations. Social psychologists subsequently built on this idea and defined a social network in terms of a social structure that maps out the relationships between individuals. They also devised elaborate ways of constructing diagrams using points and lines to represent relations among individuals in the social network. In other specialist areas of psychology, the term social network is used more generally to refer to the various individuals or groups who maintain relationships with an individual in different aspects of their lives. The relationships usually have some kind of significance or importance to the individual, such as those with immediate family members and other relatives, friends, neighbours, work colleagues, acquaintances and so on who may be part of the network. Others who may be important in a person's life and therefore be part of their social network are the family doctor, mental health professional, priest, local milkbar owner or hairdresser. Which of these people are important and part of a social network depends on the individual's lifestyle. Another characteristic of a social network is that some people within the network know each other and therefore have some kind of connection with each other, as well as with the individual.

The main benefit of an individual's social network is that it usually gives access to *social support*: help or assistance from other people when needed during a recovery process. This may take the form of *appraisal support*, by having access to someone with whom to talk and obtain feedback about impulses and problems associated with gambling; *tangible assistance*, such as help with a bill payment or providing a meal; *information support*, such as the web address of a social network for people with gambling problems, the location of a recovery group in the community or information about the potential value of these sources of support; and *emotional support*, such as help in coping with problems being experienced.

One concern with social networks is that the social network of someone experiencing problem gambling usually includes other people who are also problem gamblers. This seems to be particularly the case for females who have gambling problems with poker machines (Trevorrow & Moore, 1998). Continuing to associate with people who gamble excessively may cause the cues that promote or initiate gambling to re-emerge. One reason is that people with gambling problems usually talk positively about gambling. These triggers may cause the person trying to control or abstain from gambling to crave former gambling experiences and overlook the negative consequences. Consequently,

Figure 15.20 An important part of a gambler managing their gambling is increasing the number of people within their social network who do not gamble.

it is important for the support providers to give appropriate advice and strategies to help the problem gambler deal with this. This may include advice on how to redesign their social network to include people who do not gamble excessively and who can exert a positive influence over their recovery. When the problem gambler starts associating with people who have different values about gambling and life in general, they may begin to want more for themselves and begin to believe that they might be able to achieve it. The gambler attempting to stop, or avoid a relapse, therefore needs to be with people who have other interests. Gamblers are more likely to be able to abstain from gambling when they associate with people who support their abstinence (McCown & Howatt, 2007).

Learning Activity 15.15

Review questions

1. Explain the meaning of the phrase 'social permission to gamble'.
2. Explain how social permission to gamble and easy access to numerous gambling opportunities may contribute to the development and maintenance of a gambling problem.
3. **a** What is a social network?
   b What are two key characteristics of a social network?
4. Construct a diagram that shows several individuals and groups in your social network, and identifies connections between people in your network and a different social network.
5. **a** Give three examples of how the social network of someone with problem gambling can provide support.
   b Explain how a social network can serve to maintain a person's gambling behaviour.

Recovery groups

Not everyone experiencing problem gambling wants or needs support beyond that offered by their social network. Some people, however, may find it helpful to access and use support that is provided in their local or wider community. This can include support from recovery groups.

A **recovery group**, or *support group*, is a not-for-profit support group run by and for people who interact on the basis of common interests or experiences to support one another. Recovery groups are built on a foundation of mutual support for a specific mental or physical health condition, such as problem gambling, grief, major depression, schizophrenia, breast cancer or diabetes. They are typically organised and/or facilitated ('run') by a person who has experienced or recovered from the situation or condition, or by someone affected by it, such as a close relative. A key assumption of most recovery groups is that recovery is possible. The goal of recovery usually involves drawing on each other's experiences to develop problem-solving skills for self-management of problem gambling in a gradual step-by-step recovery (O'Brien, Kennedy & Ballard, 2007).

There are many different ways recovery groups can be conducted or accessed. For example, they may be held in a person's home or a community facility, on the internet using blogs or instant messaging, or by telephone. Some recovery groups are ongoing and new members can join at any time (called an *open group*), whereas other groups run for a certain number of weeks (e.g. ten weeks) and new members are not admitted to the group after the first couple of weeks (called a *closed group*). Some groups are very flexible in the way they are run. For example, some emphasise emotional support and shared experiences, so the groups discuss whatever members want to each week. Other groups can be more structured and have a set program. Among groups where members meet, the group leader may invite a psychologist, social worker or someone who has successfully recovered from problem gambling to talk about a topic related to the group's interests or needs.

One of the best-known recovery groups for people experiencing problem gambling is Gamblers Anonymous (GA). Gamblers Anonymous was founded in Los Angeles, California, in 1957 and has established itself worldwide as a resource for people struggling with gambling problems. It was established in Australia in 1961. It offers a self-help program for anyone with a gambling problem. The only requirement for GA membership is a desire to stop gambling. The program involves confidential group meetings, which are held in local community centres and church halls and go for 90 minutes. There are no compulsory fees or charges.

Generally, GA is based on the principles of peer support and the power of relating to people whose gambling has left them with feelings of emptiness, isolation, guilt and shame. These principles are incorporated in a 12-step recovery program also used by Alcoholics Anonymous (see box 15.7). The initial steps in recovery from problem gambling include admitting to powerlessness over the urge to gamble and surrendering to a 'higher power', which members can interpret according to their own beliefs. This is why members of GA often introduce themselves to other members at meetings with an admission of their problem; for example, 'Hi, I'm Vinnie and I'm a problem gambler'. Another key feature of GA is having a sponsor. A *sponsor* is a former problem gambler who has experience of remaining abstinent, and can provide guidance and assistance to the member throughout their recovery process.

Although not directly based on psychological theory, GA applies a number of behavioural techniques. For example, members provide one another with positive reinforcement for abstaining from gambling. Members state their length of abstinence at each meeting and special rewards (such as pins, certificates or special meetings) are provided for abstinence anniversaries. GA also provides an alternative social activity to compete with gambling. Sponsors and call lists are used so that a gambler can telephone another member and receive social support and encouragement 24 hours a day, seven days a week. In addition, the notion of taking 'one day at a time' encourages the problem gambler to make decisions on shortened timeframes, within which more rational and self-controlled decisions may be more likely (Grant & Potenza, 2007).

According to GA principles, abstinence is the only solution for problem gambling. However, this has been criticised by some psychologists, who have

Figure 15.21 Participation in a recovery group can be a valuable part of the overall management plan for an individual who has a gambling addiction.

found through research that reducing gambling to a controlled, responsible and non-harmful level can and should be a realistic and appropriate goal for some people (Dowling, Smith & Thomas; 2006; Blaszczynski, 2000). There is also research evidence that suggests that GA is 'incomplete on its own' and is more likely to be more effective when used in combination with psychological therapy provided by a mental health professional—particularly CBT (Petry & Armentano, 1999).

Although recovery groups do not suit all people, as not everyone is comfortable in a group setting, meeting with others, using the internet or exchanging messages about personal issues, connecting with other people who are 'in the same boat' can have a number of benefits. For example, a recovery group provides a means of connecting and sharing with others who truly understand what each member is going through because virtually all members 'have been there' or 'are there'. The group also provides opportunities to talk openly and honestly about feelings, to share personal experiences (e.g. what worked and what didn't) and gain a clearer understanding of what to expect in their situation. Members of a recovery group can also assist each other to develop problem-solving skills for self-care and management of their urge to gamble, and to develop and maintain healthy lifestyle habits.

Box 15.7

Gamblers Anonymous

The recovery program

Gamblers Anonymous follows a 12-step recovery program based on the following principles.

1. We admitted we were powerless over gambling—that our lives had become unmanageable.
2. We came to believe that a Power greater than ourselves could restore us to a normal way of thinking and living.
3. We made a decision to turn our will and our lives over to the care of this Power of our own understanding.
4. We made a searching and fearless moral and financial inventory of ourselves.
5. We admitted to ourselves and to another human being the exact nature of our wrongs.
6. We were entirely ready to have these defects of character removed.
7. We humbly asked God (of our understanding) to remove our shortcomings.
8. We made a list of all persons we had harmed and became willing to make amends to them all.
9. We made direct amends to such people wherever possible, except when to do so would injure them or others.
10. We continued to take personal inventory and when we were wrong, promptly admitted it.
11. We sought through prayer and meditation to improve our conscious contact with God as we understood Him, praying only for knowledge of His will for us and the power to carry that out.
12. Having made an effort to practise these principles in all our affairs, we tried to carry this message to other compulsive gamblers.

Source: www.gamblersanonymous.org/recovery.html.

Box 15.8

Gambling Help Online

Gambling Help Online provides live counselling and email support to anyone seeking support for a gambling concern in a confidential environment. Counselling is available 24 hours a day, 7 days a week and can be accessed anonymously. Email support is provided to answer questions or support people through the change process.

Source: www.gamblinghelponline.org.au/home.aspx.

Learning Activity 15.16

Review questions

1 What is a recovery group?
2 Who typically facilitates a recovery group?
3 a What is the membership requirement of Gamblers Anonymous (GA)?
  b What outcome does GA seek for its members?
  c What role might religion play in the GA 12-step program?
4 Briefly describe another recovery group available to problem gamblers in Australia, including its goal(s), how it is accessed and types of services provided.
5 List three potential benefits of participation in a recovery group for problem gamblers.

Learning Activity 15.17

Essay on causes and treatment of problem gambling

Write an essay of about 550–600 words in which you explain biological, psychological and social factors that may contribute to the development of a gambling addiction and may be relevant to its treatment. References may be used in obtaining information for your essay.

In your essay ensure that you:

- explain what problem gambling and pathological gambling are, with reference to both transitional and categorical approaches to defining and describing symptoms and other distinguishing characteristics
- explain why problem or pathological gambling is considered to be an addictive disorder
- describe a range of relevant biological, psychological and social factors
- discuss how these factors may contribute to the development and treatment of problem or pathological gambling
- give an example of how different factors may interact
- refer to relevant research findings
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms and ideas
- express your ideas in a clear and concise way
- accurately cite and reference all material.

Learning Activity 15.18

Visual presentation on causes and treatment of problem gambling

Prepare a visual presentation in which you use a biopsychosocial framework to explain biological, psychological and social factors that contribute to the development of a gambling addiction and may be relevant to its treatment.

You may select from a range of formats to present your information; for example, PowerPoint, a poster, a concept map, a flow chart, or a combination of formats. Photographs and other visual or art media may be used.

In your presentation, ensure that you:

- briefly explain what problem and pathological gambling are, with reference to both transitional and categorical approaches to defining and describing symptoms and other distinguishing characteristics
- briefly explain why problem or pathological gambling is considered to be an addictive disorder
- outline a range of relevant biological, psychological and social factors
- indicate how these factors may contribute to the development and treatment of problem or pathological gambling, including possible relationships between different factors.

Written information may be in a dot-point format but you should ensure that all relevant information is accurately and adequately explained, using appropriate examples to clarify your understanding of key concepts.

Chapter 15 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ Problem and pathological gambling involve dysfunction.

2 ______ A gambling addiction is a type of obsessive-compulsive disorder.

3 ______ It is possible to develop an addiction to a specific chemical substance but not to a specific type of behaviour.

4 ______ Schedules of reinforcement are commonly used to treat someone with an addictive disorder.

5 ______ Some people may develop a gambling addiction because the dopamine reward system in their brain does not function properly.

6 ______ Contemporary poker machines in Australian gaming venues operate on a variable-ratio schedule of reinforcement.

7 ______ Talking about problem gambling in a recovery group only makes it worse.

8 ______ When a poker machine will 'pay out' depends on the amount or frequency of previous 'payouts'.

9 ______ Addiction to gambling can vary in degree of severity, ranging from mild to severe.

10 ______ Flooding is a highly effective technique to reduce or eliminate the compelling urge that drives people to gamble.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 15 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 Which of the following is the best example of a recovery group for someone with a gambling addiction?

A members of a 'well-functioning' family who interact with someone recovering from a gambling addiction

B a group of people with a gambling addiction who meet to support each other

C a group of people who meet and devise recovery strategies for someone with a gambling addiction

D a group of mental health professionals who monitor the recovery of a client with a gambling addiction

Q2 The biopsychosocial framework explains the development of a gambling addiction by emphasising

A how biological factors influence psychological factors, which in turn influence social factors.

B the relative contribution of biological, psychological and social factors.

C the interaction of biological, psychological and social factors.

D the impact of underlying biological factors on psychological and social factors.

Q3 In relation to a behavioural addiction, tolerance refers to

A decreased sensitivity to an activity over time, whereby increased amounts of the activity are required to achieve the former effects.

B the change in subjective experience that occurs when people engage in an addictive activity.

C the process of increasingly permitting or supporting engagement in behaviour that is potentially addictive.

D the unpleasant reactions that occur when the addictive activity is discontinued or suddenly reduced.

Q4 Jack's wife has told him she wants a divorce. 'I don't know how she can be so selfish,' he thinks. 'Sure, I spend a lot of time at the casino, but I am doing it for our family. She doesn't understand that there are ups and downs in poker. So finances have been a little tight. I just need a little time to get the money back. I know how to work the table; I've got the skills needed to beat the system.'

What type of cognitive distortion is Jack exhibiting?

A gambler's fallacy
B overestimation bias
C the notion of a 'hot streak'
D illusion of control

Q5 Developing a gambling addiction has been reported to be a possible side effect of the medication used to treat

A naltrexone.
B Parkinson's disease.
C the dopamine reward system.
D major depression.

Q6 Impulse control refers to someone with an addiction

A making a psychological effort to control a compelling urge to do something.
B failing to control a compelling urge to do something.
C permanently stopping all activity associated with the addiction.
D thinking about the focus of the addiction almost all of the time.

Q7 Where in the brain is the dopamine reward system located?

A nucleus accumbens
B midbrain
C cerebral cortex
D medial forebrain bundle

Q8 Under a random-ratio schedule of reinforcement,

A a reinforcer is received after a random number of correct responses.
B a correct response must be reinforced after a set unvarying number of responses.
C there is a constant mean number of correct responses for giving reinforcement.
D any response may be reinforced irrespective of the number of times a correct response is made.

Q9 Social permission of gambling opportunities refers to

A the legally permissible age to gamble in any socio-cultural context.
B the availability of ample gambling opportunities in any socio-cultural context.
C the perceived social acceptability of gambling in a socio-cultural context in which gambling is easily accessible.
D the influence of socio-cultural factors in the development of an addictive gambling disorder.

Q10 A misunderstanding of the predictability of outcomes based on independent chance events is commonly referred to as

A probability laws or theory.
B the logical fallacy.
C the gambler's fallacy.
D an illusion of control.

The answers to the Chapter 15 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the meaning of the term addictive disorder.

1 mark

Question 2

Explain what problem gambling is with reference to three key signs, symptoms or characteristic behaviours.

3 marks

Question 3

Explain the role that the dopamine reward system is believed to play in the development or maintenance of a gambling addiction.

2 marks

Question 4

Describe two key assumptions of social learning theory in explaining the development and maintenance of a gambling addiction.

2 marks

Question 5

Describe the fundamental difference between the use of psychodynamic psychotherapy and cognitive behavioural therapy in the treatment of a client with a gambling addiction.

2 marks

The answers to the Chapter 15 short-answer questions are available at www.OneStopScience.com.au.

16 Psychotic disorder: schizophrenia

Harrison is 19 years old. He had what most people would describe as a 'normal' upbringing in inner-suburban Melbourne and he was excited about his move to Ballarat to study photography at university just over a year ago.

However, the move didn't quite work out as he had planned. He just didn't seem to 'click' with other students and found that he was spending quite a lot of time alone in his room. Harrison then noticed that his concentration and memory were not as good as they used to be. Some strange thoughts had been running through his mind, and he had a feeling that 'something was about to happen' but he wasn't sure what or why.

Then, one evening when he was walking home from a lecture, Harrison heard someone repeatedly say 'hey, idiot'. The voice seemed to be coming out of the street lamp. Then it stopped. When Harrison got back to his flat he tried to act as normal as possible. But in his room, it started again. This time the voice seemed to be coming out of his head. Harrison was frightened.

After hearing the voice for well over a month, Harrison decided it was best to stop going out altogether. He felt increasingly worried and tried to figure out what was happening to him. His thoughts were 'all over the place'.

One day, the pieces of the puzzle all fell into place. Harrison knew that scientists were testing his reactions and influencing him. He was a guinea pig in a horrible experiment and he was being observed 24 hours a day by means of a computer chip they had inserted into his brain. Via satellites, the scientists could beam the voices at him. And he felt that everybody knew about it. Because he was being observed 24/7, Harrison stopped showering and began to sleep fully clothed.

After a few weeks, Harrison's parents drove up from Melbourne to see him. Harrison didn't let them in, because, after all, they were part of the experiment too. The next day they returned with a mental health professional who admitted him to hospital.

Psychotic disorder and psychosis

The term **psychotic disorder** is used to describe a group of disorders that are characterised by difficulties with thinking, distorted perceptions and a loss of contact with reality. Psychotic disorders severely affect a person's ability to think clearly, reason, make good judgments, communicate effectively, behave appropriately and understand the difference between reality and their imagination. The person is unable to tell the difference between perceptions constructed from sensory information actually received from their physical environment and self-generated perceptions based on sensory information that is not actually present. People with a psychotic disorder often feel that they want to withdraw from the outside world. Their energy and emotions are affected. They may feel a loss of vitality. They may also feel depressed or irritable. Because of the nature of the symptoms, psychotic disorders significantly interfere with a person's ability to function effectively in everyday life.

The term **psychotic** is used to describe someone who is experiencing many symptoms of a psychotic disorder. If someone is described by a mental health professional as experiencing **psychosis** or having a psychotic disorder it means they are experiencing psychotic symptoms, but not that they are 'violent', 'dangerous', 'psychopaths' or 'serial killers', as some people believe. People with a psychotic disorder are not inherently violent or dangerous. When in a treatment or management program, they act like other people in the general population (Royal Australian and New Zealand College of Psychiatrists, 2009).

A psychotic disorder may develop gradually or it may present abruptly. In most cases, however, the presence of a diagnosable psychotic disorder is preceded by gradual changes in behaviour and perception, often over an extended period of time. During this period, the individual may start to experience changes in their thoughts, feelings and/or behaviour, but not necessarily have clearly distinguishable symptoms of a specific psychotic disorder. This is called the **prodromal phase** of the disorder. In medicine and psychiatry, *prodromes* refer to the early symptoms and signs of a disease or disorder that precede its onset in a fully developed form.

Changes that occur in the prodromal phase of a psychotic disorder vary from person to person. Symptoms may include changes from normal behaviour such as worsening of usual work or school performance, social withdrawal, emerging unusual beliefs and changes in perception, such as experiencing brief instances of hearing sounds not heard by others. Many of these changes are evident in the case of Harrison described at the beginning of this chapter. The duration of the prodromal phase is quite variable, but lasts approximately two years on average. After this time, symptoms of psychosis become evident. Symptoms also tend to gradually appear and change over time. The prodromal phase is best thought of as a 'warning' but the presence of its symptoms does not necessarily mean that an individual is going to develop a psychotic disorder (Royal Australian and New Zealand College of Psychiatrists, 2009).

The *Diagnostic and Statistical Manual of Mental Disorders* (DSM-IV-TR) has a category called 'schizophrenia and other psychotic disorders'. There are nine disorders in the category. All of these disorders are characterised by the presence of psychotic symptoms; however, they differ in terms of the duration and type of symptoms the person experiences and what is believed to contribute to their onset, as well as whether they also experience change in mood and other feelings. Box 16.1 includes a summary of the more common psychotic disorders.

Approximately, 3% of the population will experience a psychotic disorder at some time in their life. In Australia, it is estimated that about five people in every thousand living in a large town or city are in contact with a mental health service each month because of psychotic symptoms. Psychotic disorders affect males and females equally, although there is a younger age of onset in males (usually between 15 and 25 years). The majority of psychotic disorders begin in late adolescence or early adulthood. Schizophrenia and schizoaffective disorder (see box 16.1) account for more than 60% of the people with a psychotic disorder (Jablensky & others, 1999).

In this chapter we examine schizophrenia as an example of a psychotic disorder, taking the perspective of the biopsychosocial framework, as shown in figure 16.1. Schizophrenia is an extremely complex disorder. There is a great deal of variability among individuals with schizophrenia in the onset, type and duration of symptoms, as well as the length of the recovery phase. It should therefore not be surprising that many factors play a contributory role in varying degrees. Although these factors are often isolated for the purpose of study, they do not occur in isolation and often interact in very complex ways.

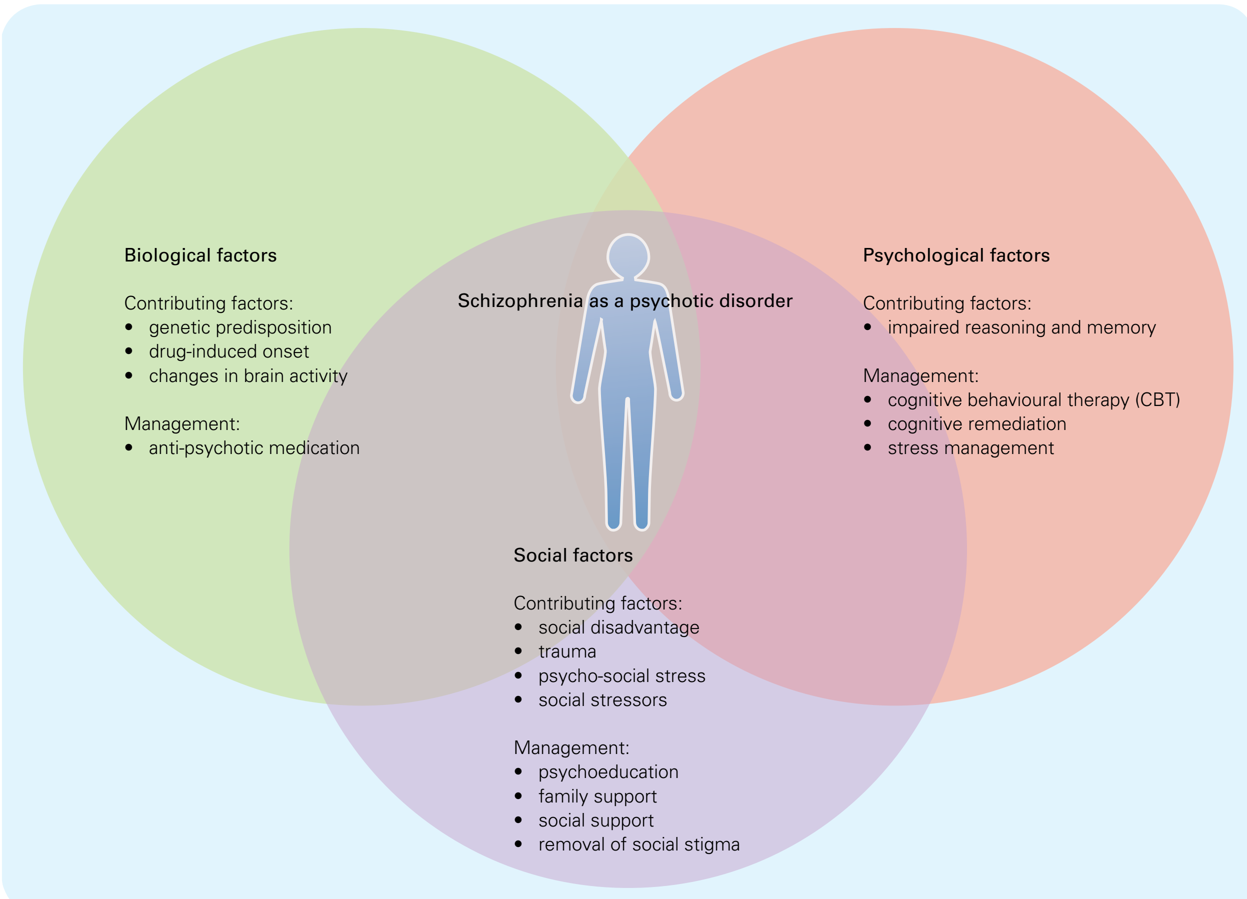


Figure 16.1 The biopsychosocial framework applied to understanding schizophrenia and its management

Box 16.1

DSM-IV-TR: schizophrenia and other psychotic disorders

The DSM-IV-TR (2000) identifies a number of different psychotic disorders, which are all characterised as involving psychotic symptoms. Some of these disorders are summarised in the table below.

Disorder	Description
Schizophrenia	Disorder characterised by two or more of the following symptoms: delusions, hallucinations, disorganised speech, grossly disorganised or catatonic behaviour (marked motor disturbance), and negative symptoms (explained on page 783). The symptoms persist for at least six months.
Schizophreniform disorder	Disorder characterised by symptoms similar to schizophrenia except for their duration—the symptoms last from one to six months.
Schizoaffective disorder	Disorder characterised by *both* symptoms of schizophrenia and a significant disturbance in mood (i.e. 'schizo' = schizophrenia; 'affective' = mood)
Delusional disorder	Disorder characterised by at least one month of non-bizarre delusions without any other symptoms of schizophrenia.
Brief psychotic disorder	Disorder characterised by a sudden onset of psychotic symptoms that last more than one day and disappear within one month. After the symptoms disappear, the person fully returns to their usual level of functioning.
Shared psychotic disorder (*folie à deux*)	Disorder characterised by a delusion(s) but when the delusion(s) is likely to have developed through a close relationship with another person(s) who has a well-established delusion. The delusion is similar in content to that of the person with the established delusion.
Substance-induced psychotic disorder	Disorder characterised by psychotic symptoms that are judged to be the direct physiological consequence of use of a drug of abuse, a medication or toxin exposure.

Figure 16.2 People with a delusional disorder may believe that they have a special relationship with a prominent person. For example, they may believe that they are a special adviser to the prime minister, even though in reality they have never met her.

Learning Activity 16.1

Review questions

1. What is a psychotic disorder?
2. Explain the meaning of the term psychotic with reference to several key symptoms and a misconception of the meaning of psychotic that is common in the wider community.
3. **a** What is meant by the term prodromal phase?
   b List three symptoms commonly experienced in the prodromal phase of a psychotic disorder.

Schizophrenia

The term 'schizophrenia' was devised by Swiss psychiatrist Eugen Bleuler (1857–1939) in 1911. Bleuler based it on the Greek words *schizo*, which means 'split', and *phrenos*, which means 'the mind', so it literally means 'split mind'. The term 'split mind' was originally used by Bleuler to refer to the way that people with schizophrenia are 'split off' from reality. That is, they often have difficulty telling the difference between real and unreal experiences, logical and illogical thoughts, and appropriate and inappropriate behaviour.

The term 'schizophrenia' is used interchangeably with 'split personality' by some people in the wider community. However, schizophrenia does *not* mean split personality. People with schizophrenia have one 'personality', just like everyone else. A rare disorder that involves multiple 'personalities' is called dissociative identity disorder. People with this disorder assume one or more additional identities (or 'personalities') and are usually unaware that they have done so. The symptoms of dissociative identity disorder are different to those of schizophrenia.

Schizophrenia is a psychotic disorder characterised by disturbances of thinking, delusions, hallucinations and disorganised behaviour. Many people with schizophrenia hear or see things that are not there, hold beliefs that are odd or not true, and speak or behave in a disorganised way that is often hard for other people to understand. As a psychotic disorder, schizophrenia involves a loss of contact with reality, and the collective influence of its symptoms severely impacts on the individual's ability to function at home, with friends, in school or university, or at work. According to the DSM, in order to be diagnosed with schizophrenia, an individual needs to have experienced key symptoms for a significant portion of time during a one-month-period with some symptoms persisting for at least six months. As shown in box 16.2, the DSM-IV-TR identifies a number of different subtypes of schizophrenia. People with schizophrenia commonly have little 'insight' into their disorder, meaning that they may not recognise that they have a mental disorder.

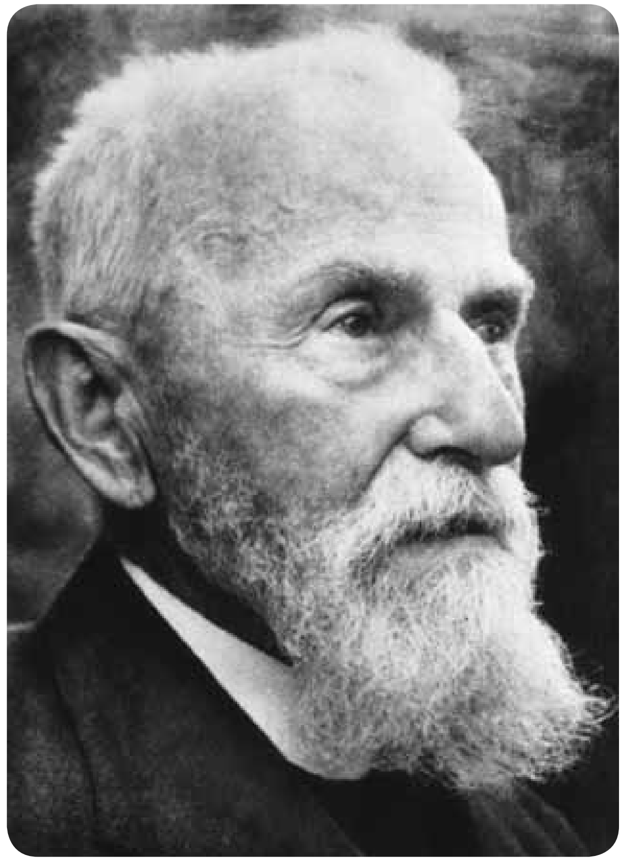


Figure 16.3 Swiss psychiatrist Eugen Bleuler coined the term 'schizophrenia' in 1911.

Box 16.2

DSM-IV-TR subtypes of schizophrenia

Disorder	Description
Catatonic schizophrenia	Disorder characterised by marked psychomotor (movement) disturbance that may involve alternations between one or more of the following: • catatonic stupor (does not react or move spontaneously and may be mute) • catatonic negativism (resists attempts to be moved) • catatonic rigidity (has rigid posture despite attempts to be moved) • catatonic excitement (excited, purposeless movements) • catatonic posturing (assumes inappropriate or bizarre positions).
Paranoid schizophrenia	Disorder characterised by delusions (false beliefs that are usually persecutory or grandiose or both) or auditory hallucinations. The symptoms characteristic of the disorganised and catatonic subtypes (e.g. disorganised speech; flat or inappropriate, catatonic or disorganised behaviour) are not present.
Disorganised schizophrenia	Disorder characterised by disorganised speech, disorganised behaviour, and flat or inappropriate affect. Speech may be unintelligible, and unusual mannerisms and facial expressions are sometimes apparent. Behaviour is often bizarre.
Undifferentiated schizophrenia	Disorder characterised by two or more of the five symptoms required for a diagnosis of schizophrenia; however, the person does not meet the criteria for paranoid, disorganised or catatonic subtypes.
Residual schizophrenia	Disorder characterised by at least one episode of schizophrenia but obvious psychotic symptoms (e.g. delusions, hallucinations, disorganised speech or behaviour) are no longer apparent. There is continuing evidence, however, of the disturbance, as indicated by the presence of negative symptoms (e.g. flat affect, poverty of speech or avolition) and/or mildly disorganised behaviour or thoughts.

Anyone can develop schizophrenia. Schizophrenia affects about one in 100 (1%) people across all countries, socioeconomic groups, cultures and subcultures. Schizophrenia usually begins when people are aged between 15 and 25, although it can emerge later in life. Males are slightly more likely to develop schizophrenia than females, although the age of onset of its symptoms tends to be earlier for males than it is for females. From the ages 16 to 20 years, more males than females are affected by schizophrenia. However, between the ages of 25 and 30 years, more females than males are affected. The reasons for age-related differences between males and females remain unclear (Royal Australian and New Zealand College of Psychiatrists, 2009).

Mental health professionals often describe two main types of symptoms associated with schizophrenia. These are called positive symptoms and negative symptoms. **Positive symptoms** are experiences that happen *in addition to* normal experience. These include symptoms such as hallucinations and delusions and those symptoms that reflect the confusion within the brain, such as disorganised thought processes, speech and behaviour. **Negative symptoms** incorporate a *loss or decrease in* normal functioning. They include experiences such as loss of pleasure or interest in normal activities, loss of motivation and loss of interest in socialisation.

The diagnosis of schizophrenia is made on the basis of the existence of a cluster of symptoms listed in the DSM (or the *International Classification of Diseases and Related Health Problems*). According to the DSM-IV-TR, in order to be diagnosed as having schizophrenia, a person must experience at least two of the following five symptoms: delusions, hallucinations, disorganised speech, grossly disorganised or catatonic behaviour, or negative symptoms. In addition, the symptoms must have been experienced for more than six months; the symptoms must have a significant impact on the person's ability to work, study or perform daily tasks; and possible causes for the symptoms other than being due to schizophrenia must have been considered and excluded.

Symptoms of schizophrenia

Delusions

A **delusion** is a fixed, false belief that is held with absolute certainty, even when there is strong factual evidence that does not support it. Delusions usually involve a misinterpretation of actual information or experience. The content of a delusion may be based on a variety of themes. The delusion(s) experienced by someone with schizophrenia may be one or more of the following types:

- *Delusion of persecution*: any belief that one is being tormented, followed, tricked or spied upon by others. For example, a person might believe that scientists are trying to poison them with radioactive particles delivered through their tap water, or that a tracking device has been implanted in their brain, or that they are under constant surveillance because ASIO agents are trying to assassinate them. A delusion of persecution is the most common type of delusion in schizophrenia.
- *Delusion of reference*: any belief that the actions of others have a special relevance ('reference') to oneself. For example, a person might believe that songs being played on the radio are about them or the newsreader on television is sending messages meant specifically for them.
- *Delusions of control*: any belief that one is being controlled by an external force. For example, a person might believe that aliens are controlling their thoughts and behaviour.

Figure 16.4 In the 1995 film *Clean, Shaven,* the main character, Peter Winter, has schizophrenia. He has hallucinations and delusions of persecution. He believes that tracking devices have been implanted in his scalp and under his fingernails.

- *Delusions of grandeur*: any belief that one is an important person or that they have done, or can do, something significant. For example, a person might believe that they are Jesus Christ, that they have the power to cure cancer, that they dictated the Harry Potter stories to J.K. Rowling, or that they are going to be awarded an Order of Australia medal.
- *Thought broadcasting*: any belief that one's inner and private thoughts are being 'broadcast' to other people and can therefore be heard by others. For example, a person might believe that other people can read their mind from the expression on their face or every time they breathe out.
- *Thought insertion*: any belief that thoughts are being inserted into one's mind from an outside source. For example, a person might believe that someone is 'injecting' thoughts into their mind against their will.

Hallucinations

Hallucinations are perceptual distortions of sensory information during which the individual sees, hears, feels, tastes or smells something that is interpreted as real but does not exist in reality. Although hallucinations can occur in any of the five major senses, the most commonly reported type of hallucinations among people with schizophrenia is auditory hallucinations, which involve 'hearing voices'.

In some cultures and religions, hearing voices is regarded as being healthy and/or a sign of spirituality. In these situations, the voices that people hear are usually friendly and supportive. However, the majority of people with schizophrenia report that the voices they hear are unfriendly and critical. The type of auditory hallucinations that are heard by people with schizophrenia usually fall into one of two categories called critical hallucinations and command hallucinations. A *critical hallucination* involves hearing a voice that provides a critical ('negative') running commentary about any aspect of one's personal characteristics or actions. For example, the voice might state 'you're such a loser' or 'what are you doing that for?' A *command hallucination* involves hearing a voice that 'forces' one to commit acts that would not ordinarily be performed. For example, the voice might state 'you are going to feel sick' or 'rip up newspapers'.

Auditory hallucinations may be experienced as being 'heard' through the ears, in the brain or mind, from the body (e.g. the stomach), or anywhere in external space. Their frequency can range from low (once a month or less) to continuous, all day long. Loudness may vary from a whisper through to shouting. The voices may also be male or female, and with tones and accents that typically differ from those of the person experiencing the hallucination. People who have auditory hallucinations also usually hear more than one voice, and these are sometimes recognised as belonging to someone who is familiar (such as a neighbour, family member or television personality) or to an imaginary character (such as God, the devil or an angel).

People experiencing auditory hallucinations usually appear preoccupied to someone else because they are paying attention to what the voices are saying. They may also be seen or heard talking to themselves because they are responding aloud to the voices inside their head. Having hallucinations can therefore make it difficult for individuals with schizophrenia to focus their attention on external activities or events, such as reading, watching television or having conversations with others.

Figure 16.5 *Voices:* SANE Australia has compiled an audio documentary about auditory hallucinations with help from those who experience this symptom, their carers and researchers from the Mental Health Research Institute. *Voices* explains how it feels to hear voices and what can be done to help.

Disorganised speech

The speech of people with schizophrenia is frequently disconnected, illogical and jumbled and reflects the level of disorganisation, or 'fragmentation', of their thinking. As a result, communication with others is usually difficult. Common signs of disorganised speech in schizophrenia include speech with characteristics such as derailment, perseveration, use of neologisms and use of clang.

Derailment, also called *loose associations*, refers to speech that rapidly shifts from topic to topic, with little or no connection between one thought and the next, thereby disrupting continuity. For example, derailment is evident in a sentence such as 'The next day when I woke up, I dyed my hair brown in Sydney' and a string of sentences such as 'I was stuck in a terrible traffic jam. All the traffic was going into the city. Why do the villains in films always have dark hair?' When derailment occurs, the person is usually unaware that they are doing it and therefore of the disconnectedness, contradictions or illogicality of their speech. *Perseveration* refers to speech with constant repetition of words and statements; for example, saying the same thing over and over, such as 'I really like Melbourne, Melbourne, Melbourne, Melbourne'. *Neologisms* are new words or phrases, so speech with neologisms uses newly made-up words or phrases that only have meaning to the person who uses them. These are evident in sentences such as 'I had the *cotter* on last night', 'I read in the *savoom* that this would happen', or 'I am going to Luna Park to ride the *wallywhoop*'. *Clang* is speech with meaningless rhyming words, such as 'I said the bread and read the shed and fed Ned at the head' or 'Deck the halls with boughs of holly, folly, polly, dolly, hello Dolly, want a lollipop?'

Grossly disorganised or catatonic behaviour

People with schizophrenia may have **grossly disorganised behaviour**, which essentially means that their behaviour appears to be fragmented, inappropriate, unusual, unpredictable, purposeless and erratic. This severely affects their ability to perform the usual activities of daily living. For example, a person with schizophrenia may not be able to attend to their personal hygiene or prepare meals for themselves. They may also dress in an unusual manner. For example, they may wear many layers of clothing, such as five different dresses over each other, or wear a hat, coat and gloves on a very hot day. A person with schizophrenia may also behave in socially inappropriate or unacceptable ways, such as urinating on a street corner and behaving in a silly manner at a funeral, or display unpredictable agitation, such as shouting and swearing, for no apparent reason. Grossly disorganised behaviour can therefore result in a decline in overall daily functioning; a dishevelled, unkempt appearance or dressing in an unusual manner; behaviours that have no purpose or are inappropriate to the context; and unpredictable or inappropriate agitation.

Catatonic behaviour is marked by highly disturbed actions or movements, or a lack of movement. It may range from extremely agitated behaviour (frenzy-like) to complete immobility and lack of speech (statue-like), or somewhere between these two extremes. During an *agitated state*, the person may shout, talk rapidly, wave and flap their arms around and quickly pace back and forth.

At the other extreme, a person may go into a *catatonic stupor* during which they remain virtually motionless and seem totally unaware of their environment for a long period of time. For example, they make no eye contact with others and are mute and motionless like a statue. This form of catatonic behaviour can be so debilitating that the individual may appear as if they are unconscious. However, when in a catatonic stupor, the person is usually consciously aware of their environment and can often recall events that occurred while in the catatonic state (American Psychiatric Association, 2000). Other forms of catatonic behaviour include *catatonic posturing* (or *catalepsy*), which is apparent when the person stands motionless in an awkward, bizarre position for a long period of time (see figure 16.6), and *waxy flexibility*, during which the person can be moulded into any position like a wax figure and hold that position indefinitely. For example, if a psychiatric nurse raises the person's arm or tilts their head during an examination, they will maintain that position until moved again.

Figure 16.6 'Birdy', the main character in the 1984 film of the same name, is a Vietnam war veteran in a psychiatric hospital who exhibits catatonic posturing. He is unresponsive to the world around him and sits perched in an awkward bird-like position for hours.

Negative symptoms

The negative symptoms of schizophrenia refer to the loss or absence of normal thought processes, emotions and behaviours typically experienced by mentally healthy individuals. Negative symptoms are often slow to develop and are likely to first become apparent during the prodromal phase of schizophrenia. One such symptom is when a person gradually becomes socially withdrawn. For example, the person may sit around doing little or nothing for long periods of time and show little interest in participating in work or social activities. Another symptom apparent during the prodromal phase is a gradual increase in lack of care about appearance and personal hygiene.

Common negative symptoms of schizophrenia include affective flattening, avolition and alogia. *Affective flattening* is apparent when there is a reduction in the range and intensity of emotional expression, including facial expressions, voice tones and eye contact. For example, the person seems to stare, has a blank look on their face, speaks in a flat ('monotonous') voice, doesn't maintain eye contact, and uses little or no body language when communicating.

Avolition is similar to apathy, when a person experiences a lack of energy or enthusiasm for doing anything. It is apparent when the person has difficulty with or is unable to initiate or follow through on a course of action. For example, the person feels drained of energy and is no longer interested in going out and meeting with friends or participating in activities about which they were once enthusiastic. Instead, they may sit or lie around at home for hours on end doing nothing. In some cases, everyday activities such as eating, dressing and undressing may be impossible ordeals.

Alogia, also called *poverty of speech*, is the reduction in speech content and fluency. In some cases, the person may give very short empty replies to questions and finds it very difficult to carry on a normal conversation. In other cases, the person will say quite a bit but will manage to convey little meaning.

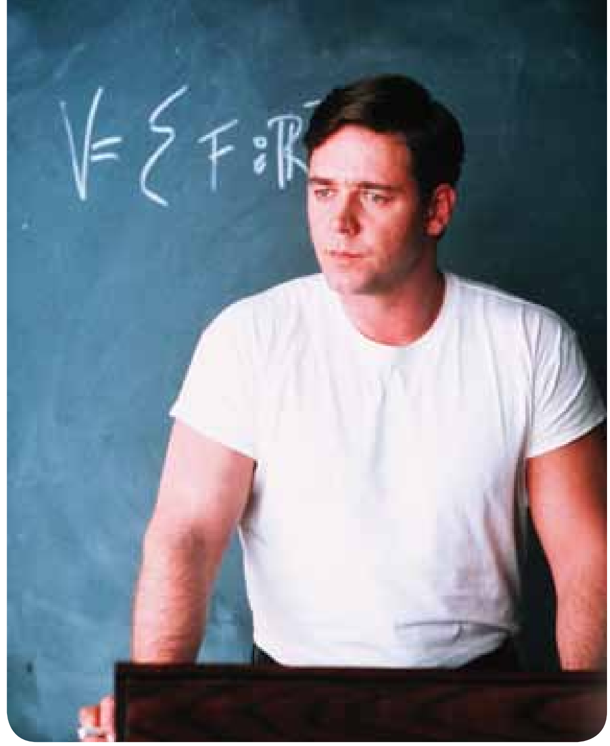


Figure 16.7 The film *A Beautiful Mind* presents a realistic portrayal of schizophrenia.

Learning Activity 16.2

Review questions

1. What is schizophrenia?
2. Name and briefly describe the different subtypes of schizophrenia described in the DSM.
3. Distinguish between positive and negative symptoms of schizophrenia with reference to examples of each type of symptom.
4. What periods of time does the DSM suggest are relevant to the diagnosis of schizophrenia?
5. **a** What is a delusion?
   b Name and describe two types of delusions that a person with schizophrenia may experience.
6. Explain what a hallucination is with reference to an example.
7. Explain the difference between a delusion and a hallucination.
8. Explain the meaning of disorganised speech with reference to two characteristics of speech associated with schizophrenia.
9. Explain the meaning of disorganised behaviour with reference to two characteristics of behaviour associated with schizophrenia.

Learning Activity 16.3

Media response

View the brief video 'Contact – The Early Intervention Team' at www.youtube.com/watch?v=XfdxWWakHvU. This short film was produced to raise awareness of psychosis. It details the fictional story of Karl, a young man who experiences psychotic symptoms for the first time while at university.

Write a 150–200 word report in which you:

- identify key symptoms shown in the film with reference to how these are represented
- suggest how relatives, friends and strangers may react to Karl when first exposed to his symptoms and how such reactions may impact on Karl's subsequent thoughts, feelings and/or behaviour.

Biological contributing factors

Schizophrenia is a complex disorder and its specific causes remain unclear. Although psychological and socio-cultural factors may influence its onset and course, it is considered to primarily be a brain disorder. Consequently, biological factors contribute to schizophrenia in significant ways. For instance, schizophrenia tends to run in families and genetics may therefore play a role in its development. Individuals with schizophrenia may also have lower levels of brain activity in the frontal lobe and excessive activity of the neurotransmitter dopamine. The effect of dopamine activity, and the fact that psychotic symptoms can be induced by ingesting certain types of drugs, has influenced the development of medications for the management of schizophrenia and other psychotic disorders. In this section, we examine each of these biological contributory factors with reference to research evidence.

Genetic predisposition

Many research studies have consistently found that people who have a biological relative with schizophrenia have a genetic predisposition, or 'tendency', to develop the disorder. A **genetic predisposition** essentially means having an increased risk for developing a mental or physical disorder due to factors associated with genetic inheritance. However, while having a genetic predisposition may place an individual at a *higher* risk than that of the general population, it does not mean that they will *definitely* develop the disorder. Nor is there any single gene for schizophrenia. Instead, a number of different genes are likely to contribute in subtle ways to the expression of the disorder.

One of the most comprehensive and best-known studies on the genetic basis of schizophrenia was reported by Irving Gottesman, an American psychiatrist and geneticist. Gottesman (1991) conducted a meta-analysis to examine how common schizophrenia is among family members with varying degrees of genetic similarly. A *meta-analysis* is a type of review process that uses statistical procedures to combine the results of a number of studies that use similar research hypotheses. The procedure is commonly used in psychology and takes account of factors such as sample size and other specific research procedures that may vary among the different studies. Gottesman analysed the results of 40 family and twin studies previously conducted by other researchers in Germany, Switzerland and the United Kingdom. He selected studies on the basis that they had been conducted by researchers believed to have no personal biases on the issue of genetics and schizophrenia and who had also used standardised procedures for diagnosing whether or not participants had schizophrenia. The pool of data analysed was vast, including one study of 4000 relatives and another of 3000 relatives.

Gottesman found that the greater the genetic similarity of relatives, the more likely they were to have been diagnosed with schizophrenia. For example, as shown in figure 16.8, identical twins (who share 100% of their genes) had a 48% risk. This means that if one twin has schizophrenia, the other one will too in 48 out of every 100 pairs of identical twins. In contrast, parents and their biological children are much less genetically alike than are identical twins. When data on parents and their offspring were analysed, it was found that if one parent has schizophrenia, there is a 17% chance of any of their biological children having schizophrenia.

Gottesman's results provided compelling evidence for a genetic predisposition to schizophrenia. Along with the results of numerous other subsequent studies by researchers throughout the world, Gottesman's findings indicate that schizophrenia is partly genetic in origin. However, the risk is nowhere near as high as would be expected if the disorder was *entirely* genetic. For example, although the results of some twin studies show that if one identical twin has schizophrenia, the risk for the other twin is 48%, the same evidence suggests that 52% of the risk of developing schizophrenia is *not* accounted for by genetic factors. This means that other factors also have a contributory role. Psychologists refer to most of these other factors collectively as 'environmental factors', with environment essentially meaning any non-genetically determined influence on the development of schizophrenia. Therefore, environmental factors as well as genes contribute to the development of schizophrenia and we consider some examples primarily in the context of socio-cultural contributing factors later in the chapter. However, isolating the relative contributory roles of genetic and environmental factors is not a simple process since genes are always inherited and exert their influence in an environmental context.

Figure 16.8 If this woman has schizophrenia, there is a 5% chance that her grandson will go on to develop it.

Even with twin studies it is difficult to separate the effects of genes and the environment on schizophrenia because twins are usually raised together. Thus, when the child of a parent with schizophrenia develops schizophrenia, three explanations are possible: (1) the mother or father may have genetically transmitted schizophrenia to the child, (2) the parent(s) with schizophrenia may

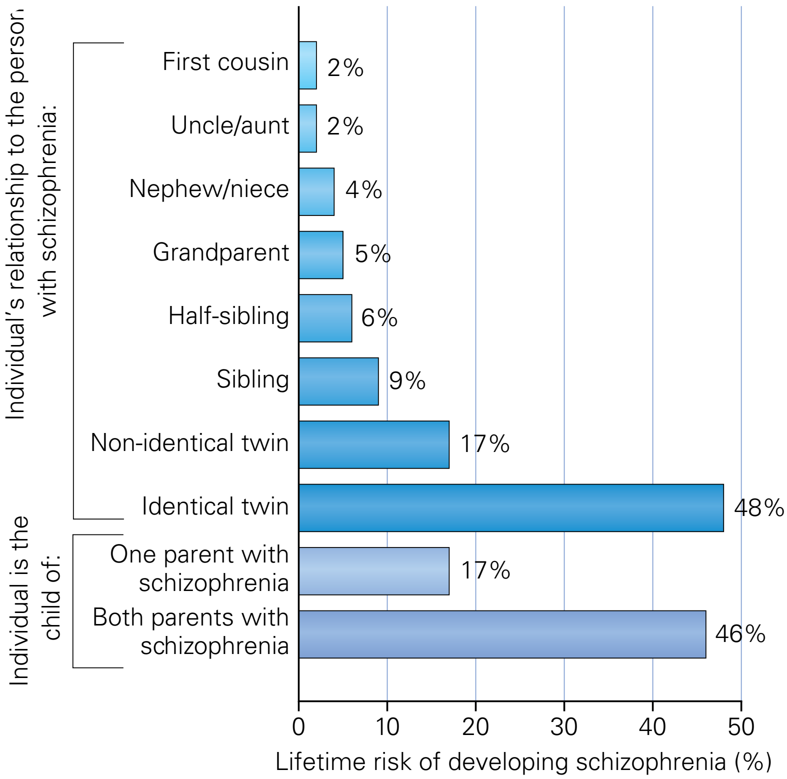


Figure 16.9 Although having a genetic predisposition increases the likelihood of developing schizophrenia, the risk depends on the degree of biological relationship and genetic predisposition alone does not 'cause' schizophrenia.

Source: adapted from Gottesman, I.I. (1991). *Schizophrenia genesis: The origins of madness*. New York: Freeman, p. 96.

have created an environment conducive to the onset of schizophrenia in other family members, or (3) the child's schizophrenia may have resulted from a combination of genetic factors and an environment conducive to the onset of schizophrenia. Therefore, researchers have also conducted adoption studies to better understand the genetic predisposition to schizophrenia as well as the role of environment.

Adoption studies involve researching individuals born to a parent(s) with schizophrenia but who have been adopted by other parents shortly after birth and have therefore had no contact with the biological parent(s). This eliminates the possibility that being raised in an environment with a parent(s) with schizophrenia increases the likelihood of developing the disorder.

In one adoption study, American psychiatrist Seymour Kety and his colleagues (1988) traced through the records of child-care authorities and institutions. Of nearly 5500 adults who had been adopted early in life, the researchers identified 33 with schizophrenia. A control group of 33 participants was then selected from the same population. These participants were adoptees who were similar in age, sex and schooling to the individuals with schizophrenia, but who did not have schizophrenia. Next, the researchers located 365 biological and adoptive relatives of these 66 adoptees, including both parents and siblings. The relatives were then separated into four groups: group 1, biological relatives of adoptees with schizophrenia; group 2, adoptive relatives of adoptees with schizophrenia; group 3, biological relatives of adoptees without schizophrenia; and group 4, adoptive relatives of adoptees without schizophrenia. Thirty-seven of the relatives were found to qualify for a diagnosis of either schizophrenia or another psychotic disorder. Most of these 37 relatives turned out to be the biological relatives of the adoptees with schizophrenia. Altogether, 14% of the biological relatives of the adoptees with schizophrenia were themselves also diagnosed with the disorder, whereas only 2.7% of their adoptive relatives were given this diagnosis. The biological and adoptive relatives of the adoptees without schizophrenia had schizophrenia prevalence rates of 3.4% and 5.5%, respectively.

These results add to the substantial evidence supporting heredity as a contributory factor in schizophrenia. Various other adoption studies have also provided considerable supporting evidence of the major role played by genes. Overall, adoption studies have consistently shown that if either biological parent of an individual had schizophrenia, the adopted individual is at greater risk to develop schizophrenia.

Drug-induced onset

The use of drugs to alter the way we experience the world is one of the oldest recreational activities of the human race. However, in some cases, a person's use of certain drugs can lead to serious mental health problems. For instance, it has long been recognised that the effects of certain drugs, particularly those that stimulate increased production of dopamine, can 'trigger' psychotic symptoms similar to those that are experienced by an individual with schizophrenia. These drugs generally fall into four groups: *hallucinogens* (e.g. LSD), *stimulants* (e.g. amphetamines, cocaine, ecstasy), *phencyclidine (PCP*, or 'angel dust') and *cannabis* (e.g. marijuana, skunk, hashish). A person under the influence of LSD may see and hear things that do not physically exist in reality and a person under the influence of cocaine or cannabis may have paranoid delusions.

If an individual experiences psychotic symptoms while they are under the influence of a drug, then they are experiencing drug-induced psychosis. **Drug-induced psychosis**, called *substance-induced psychotic disorder* in the DSM, is a disorder

Figure 16.10 The effects of certain drugs—particularly hallucinogens, stimulants, PCP and cannabis—have been associated with schizophrenia.

characterised by delusions and hallucinations that are judged to be due to the direct physiological effects of a drug. In some individuals, these symptoms are temporary and disappear once the drug wears off. For others, however, the symptoms do not go away when the effects of the drug wear off.

How long drug-induced psychosis lasts after the effects of the drug wear off, and how severe the symptoms are, depends upon a number of factors such as the quantity, frequency, potency (strength) and half-life of the drug consumed. *Half-life* is the period of time required for the concentration or amount of drug in the body to be reduced by one-half and is a measure of the time it takes for the drug's active effects to wear off. For example, a person with cannabis-induced psychotic disorder may experience psychotic symptoms for up to ten days *after* the effects of the cannabis wears off (Degenhart & Hall, 2002).

Some people will recover from an episode of drug-induced psychosis. But for others, the psychotic symptoms may persist and the drug use triggers the onset of a recurrent lifelong psychotic illness such as schizophrenia.

Box 16.3

Cannabis and your mental health

Some people experience very unpleasant psychological effects when they use cannabis, such as severe anxiety, paranoia or panic. Generally, people who start smoking cannabis when they are teenagers, and smoke heavily, are more likely to experience negative effects. Heavy or frequent use of cannabis may also lead to depression in later life, particularly for women.

In some cases, cannabis can also cause confusion, having beliefs that are not based on reality (delusions) or seeing or hearing things that are not there (hallucinations).

This is called psychosis. Usually, it only lasts until the effects of the cannabis wear off and if the person isn't used to the effects of cannabis or has consumed more than they are used to. Having said that, there is now evidence that cannabis use in adolescence is linked with an increased risk of developing schizophrenia later in life.

But some people have a greater risk of developing mental health problems than others. Cannabis use may trigger psychosis if, for example, you have a family history of mental illness/schizophrenia.

Cannabis can also make symptoms worse in people who already have depression or schizophrenia. A lot of people don't realise that it can also increase anxiety. Some people attempt to deal with their depression or anxiety by smoking cannabis to 'escape'. What they later discover is that their problems are made worse. If you have depression, cannabis may seem to help ease it before the effects of the drug wear off. But after that, using cannabis can make the depression worse. Cannabis can also reduce your chances of recovery from a psychotic episode.

Figure 16.11 Cannabis is the illicit drug most commonly used by young Australians. It can trigger problems or make symptoms worse for young people with a history of mental health issues.

The psychological effects of cannabis can have a 'flow-on' effect to other areas of your life, such as conflict at home or school/work, financial problems and memory problems, which also increase your risk of mental health problems.

If you have a mental health problem, cannabis can cause other problems (e.g. with school work or relationships) that make dealing with your mental health problem harder.

Source: youthbeyondblue (2009). *Cannabis and your mental health.* Fact sheet 10, p. 1, www.youthbeyondblue.com/wp-content/uploads/2009/05/youthbeyondblue-fact-sheet-10-cannabis-and-your-mental-health.pdf.

Learning Activity 16.4

Review questions

1 Explain the meaning of the term genetic predisposition in relation to schizophrenia.

2 a What is the risk of a person developing schizophrenia if one of their biological parents has or has had the disorder?

b What is the risk of a person developing schizophrenia if both of their biological parents have or have had the disorder?

3 a In what way do studies of people with varying genetic similarity provide evidence of a genetic basis for schizophrenia? Explain with reference to data in figure 16.8.

b In what way do the data in figure 16.8 also provide evidence for the role of environmental factors?

4 a What is an adoption study?

b Explain, with reference to the results, why the adoption study conducted by Kety and others (1988) provides evidence for some people having a genetic predisposition for schizophrenia.

5 Explain why the term causation should not be used with the term genetic predisposition.

Changes in brain activity

It is now widely believed by researchers that schizophrenia is a brain disorder. Functional neuroimaging techniques that capture detailed images of both the structure and function of the brain have provided evidence of specific abnormalities among people with schizophrenia. One common research finding concerns the level of brain activity in the *prefrontal cortex*, the forward part of the frontal lobes.

In one of the pioneering studies on abnormal brain activity among people with schizophrenia, Swedish researchers David Ingvar and Göran Franzén (1974) measured the brain activity in 31 people with chronic schizophrenia (13 women, 18 men) and compared the results with those of a matched control group. They found a significantly reduced level of brain activity in the frontal lobes of people with schizophrenia compared to the control group participants. This was isolated to the prefrontal area. Ingvar and Franzén called this reduced level of brain activity *hypofrontality* and the term has since been used to describe the reduction in brain activity in the frontal cortex, particularly in the prefrontal cortex.

Since this influential finding, a number of subsequent studies have provided supporting evidence that schizophrenia is associated with less activation of the prefrontal cortex. For example, in one study, participants with schizophrenia were given different cognitive tasks such as card sorting and matching to perform during PET scanning. When the resulting scans were compared with those of people with healthy brains who performed the same tasks, the brains of people with schizophrenia failed to show the task-related increase in prefrontal functioning in order to meet the cognitive demands of the tasks (Berman, 2002). Twin studies have also obtained similar results when the scans of an identical twin with schizophrenia have been compared with those of the other twin without schizophrenia (Andreason & others, 1986). However, other studies on hypofrontality using cognitive tasks have failed to obtain supportive evidence of hypofrontality in people with schizophrenia (Velakoulis & Pantelis, 1996). The reasons for hypofrontality in some people with schizophrenia remain unclear. One explanation is that neurons in the frontal cortex of people with schizophrenia tend to have less bushy dendrites, which may contribute to a less active prefrontal cortex (Breedlove, Rosenzweig & Watson, 2007).

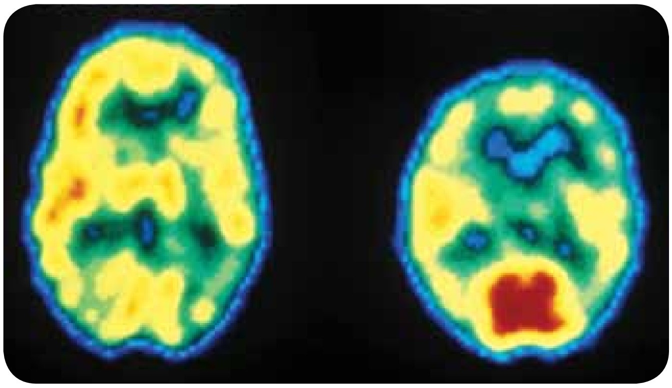


Figure 16.12 These PET scans show differences in brain activity of two individuals, one with schizophrenia (right) and the other without the disorder (left). Levels of brain activity correspond to the colours—red indicates high activity, through to blue, which indicates low activity.

Box 16.4

Activation of the brain during auditory hallucinations

Functional neuroimaging studies have found that that the primary auditory cortex is activated during auditory hallucinations. Australian researchers at the Mental Health Research Institute of Victoria in Melbourne used PET to analyse the brain activity of three groups of people: group 1 comprised eight males with schizophrenia who were actively experiencing auditory hallucinations; group 2 comprised seven males with schizophrenia who had never experienced auditory hallucinations; and group 3 comprised eight male control group participants who did not have schizophrenia.

During the PET scans, the researchers instructed group 1 to indicate the onset and duration of their auditory hallucinations by pressing a button with their right index finger. Groups 2 and 3 were randomly exposed to various auditory stimuli via headphones as well as periods of no sound. Sounds consisted of speech that simulated auditory hallucinations such as a group of people all talking at the same time or crowd noise in which many human voices could be heard talking about different topics but with no single voice dominating. Like group 1, groups 2 and 3 were instructed to indicate their perception of the auditory stimulus by pressing a button with their right index finger.

The results of the study revealed that all three groups of participants demonstrated significant and extensive activation of the primary auditory cortex in both hemispheres. For group 1, the activation was in response to their auditory hallucinations and, for groups 2 and 3, the activation was in response to the random bursts of human speech generated by the researchers. It was also found that the primary auditory cortex of group 1 participants was activated in the absence of external auditory stimuli.

This study indicates that the brain activity of people hearing 'imaginary' voices (as occurs when someone with schizophrenia has auditory hallucinations) is similar to the brain activity that occurs in any person's brain when they hear 'real' voices talking to them. Essentially, the brains of people with schizophrenia respond to their auditory hallucinations the same way as a regular brain responds to hearing someone speak. According to the researchers, when a person with schizophrenia reports that they are 'hearing voices', they are simply reporting what their brain is telling them (Copolov & others, 2003).

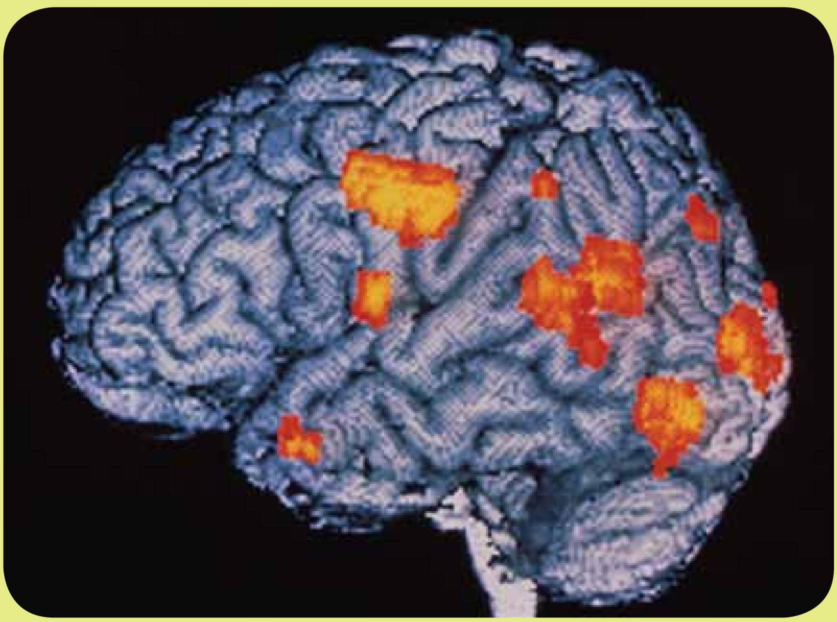


Figure 16.13 This image shows the left side of the brain of a young man with schizophrenia during auditory and visual hallucinations. It shows increased activity (yellow-orange) in the visual cortex (at right) and the auditory cortex (upper centre), indicating that relevant sensory areas of the brain may be activated when hallucinations are experienced.

Learning Activity 16.5

Review questions

1. a. Explain the meaning of drug-induced onset of schizophrenia.
   b. What specific term is used in the DSM for a psychotic disorder induced by a drug?
2. Name three groups of drugs known to trigger symptoms similar to those that are experienced by an individual with schizophrenia and give an example of each type of drug.
3. What key factors can influence the duration of a drug-induced psychosis and the severity of its symptoms?
4. a. Explain the meaning of a change in brain activity and its relevance to schizophrenia.
   b. Explain whether hypofrontality is in itself a reliable measure of the presence of psychotic symptoms associated with schizophrenia.
5. Give an example of a research method used to investigate differences in the brain activity of people with schizophrenia and explain why the use of a control condition is important.

Use of medication to treat psychosis

The neurotransmitter dopamine is found in relatively few areas of the brain but is believed to have a contributory role in the development of schizophrenia when it is present in higher than normal levels or its activity is excessive. *Dopamine* is a neurotransmitter believed to be involved in pleasure, motivation, emotional arousal and the control of voluntary movements. However, dopamine can produce different effects in different areas of the brain. For example, in some brain areas, the presence of low levels of dopamine produces the tremors and decreased mobility of Parkinson's disease. In another area, called the medial forebrain bundle, dopamine is concentrated in relatively large amounts and is involved in our experience of a distinct sense of pleasure. Consequently, this area (a neural pathway) is commonly called the dopamine reward system.

According to the **dopamine hypothesis**, the positive symptoms of schizophrenia are related to the excessive activity of dopamine normally found in the brain. The dopamine hypothesis of schizophrenia is primarily based on two observations. First, anti-psychotic medications block or reduce dopamine activity in the brain, which has the effect of reducing psychotic symptoms in many people with schizophrenia. Second, drugs that enhance dopamine activity in the brain, such as amphetamines ('speed'), cocaine and levodopa (L-dopa), can produce psychotic symptoms like those of paranoid schizophrenia in people without schizophrenia or worsen symptoms in people who already have schizophrenia. In sum, drugs that block dopamine activity *reduce* psychotic symptoms and drugs that induce excessive dopamine activity can *lead to and worsen* psychotic symptoms.

The dopamine hypothesis has been influential but there is now considerable evidence that suggests that this hypothesis is inadequate. For example, many individuals with schizophrenia do not respond favourably to dopamine-blocking medications and those who do seldom show a complete remission from symptoms. And for many individuals, these medications reduce some but not all psychotic symptoms. Furthermore, recent research studies have implicated other neurotransmitters in schizophrenia, suggesting that the disorder may involve a complex interaction among a range of different neurotransmitters and therefore biochemical processes (Schacter, Gilbert & Wegner, 2009).

Although it seems likely that dopamine is somehow involved in schizophrenia, its exact role remains unclear. The lack of understanding of the role played by dopamine, however, has not prevented further development of anti-psychotic medications. **Anti-psychotic medications**, also called *anti-psychotics* and *neuroleptics*, are drugs designed to relieve the symptoms of psychosis, such as paranoia, confused thinking, delusions and hallucinations. These medications can only be prescribed by medical practitioners and psychiatrists and are commonly used alongside psychotherapies.

Anti-psychotics are *dopamine antagonists*, which means that they reduce the symptoms of psychosis by blocking dopamine activity at the synapse and therefore the effect that dopamine has on the brain. The medication can be taken orally (as a tablet or syrup) or given as an injection (called a 'depot'). The depot releases the drug slowly over some weeks. Some people prefer depots as they find remembering to take tablets difficult. The recommended dosage depends on the type of drug, the condition for which

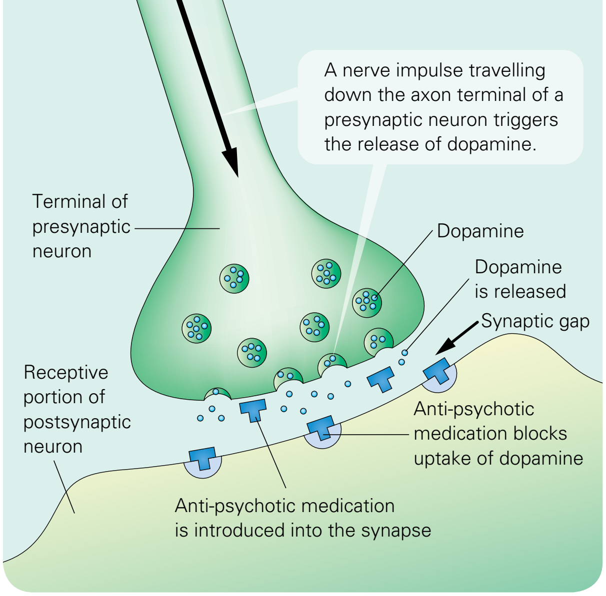


Figure 16.14 When anti-psychotics are released into the synapse, they block the uptake of dopamine by the postsynaptic neuron, thereby inhibiting the effects of dopamine.

Figure 16.15 One of the common anti-psychotic medications used to treat psychosis in Australia is called Risperdal.

it is prescribed and other factors. Individuals with schizophrenia are cautioned to take anti-psychotics exactly as directed, never in larger or more frequent doses and never for longer than directed. This is important for all individuals, but especially for older people, who may be more sensitive to this type of medication. Individuals are also cautioned not to stop taking their medication, as withdrawal symptoms following discontinuation can be severe.

There are two main types of anti-psychotic medications:

- *Typical anti-psychotics*: the older 'first generation' of anti-psychotics that were developed during the 1950s. These include haloperidol (Haldol), chlorpromazine HCl (Thorazine) and thioridazine HCl (Mellaril).
- *Atypical anti-psychotics*: the newer 'second generation' of anti-psychotics that have been developed since the 1990s. These include resperidone (Risperdal), olanzapine (Zyprexa), clozapine (Clozaril) and quetiapine (Seroquel).

While both types of medications are effective, the newer atypical anti-psychotics have advantages over the typical ones. These advantages include fewer side effects such as trembling or stiffening of muscles and less risk of developing *tardive dyskinesia*, the movement of the mouth, tongue and sometimes other parts of the body over which the person has no control (SANE Australia, 2010). This is because atypical anti-psychotics do not block dopamine activity in the motor cortex areas of the brain. Instead, they more selectively target other brain areas associated with psychotic symptoms. However, they are more likely to cause weight gain than the older typical anti-psychotics. The atypical anti-psychotics are also more effective in treating the negative symptoms of schizophrenia such as apathy and flat emotions. The atypical anti-psychotics also appear to lessen the incidence of the 'revolving door' pattern of hospitalisation and rehospitalisation. As compared to discharged patients with schizophrenia taking the typical anti-psychotics, patients taking atypical anti-psychotics are much less likely to relapse and return to hospital (Hockenbury & Hockenbury, 2006).

Many research studies have been conducted to compare the relative effectiveness of atypical and typical anti-psychotic medications. For example, in one study, conducted by Schooler and colleagues in 2005, there were 555 participants, with a mean age 25.4 years, who had all been recently diagnosed with schizophrenia. A double-blind procedure was used and the participants were randomly allocated into either of two groups. Group 1 was given a *typical* anti-psychotic (*haloperidol*) and group 2 was given an *atypical* anti-psychotic (*resperidone*). The effectiveness of the medications was measured by changes on a scale called the Positive and Negative Symptoms Scale (PaNSS). Standardised tests were also periodically conducted to measure side effects of the anti-psychotics and whether participants experienced **relapse**; that is, a return of symptoms after a period of time when no symptoms were present. All participants were monitored over a period of two years. The results of the study indicated that there was significant improvement in both groups 1 and 2. Seventy-five percent of all participants achieved at least a 20% reduction in their symptoms as measured by the PaNSS. However, there were also differences between groups 1 and 2. In group 1 (typical), 55% experienced relapse, as compared with 42% in group 2 (atypical). Furthermore, those in group 1 who experienced relapse did so more quickly (median of 205 days) than did those in group 2 (median of 466 days). Participants in group 2 also experienced significantly fewer side effects than those in group 1. The researchers concluded that atypical anti-psychotics prevent relapse in more people and for a longer time and also induce fewer side effects than typical anti-psychotics (Schooler & others, 2005).

While both types of anti-psychotic medications can relieve symptoms of psychosis, they have four main limitations. First, they do not actually cure schizophrenia. Second, psychotic symptoms often return if the person stops taking the medication. Third, the medications can produce a number of very unpleasant side effects, such as nausea and weight gain, that can cause people to stop taking their medication (see box 16.5). Fourth, although anti-psychotics can block dopamine activity almost instantly (within minutes), psychotic symptoms usually do not subside until about four to six weeks and it can take several months before the full benefits are felt. This is less true for side effects, as the individual will often feel the side effects of the medication before its benefits. The delay in onset of action for therapeutic benefits may indicate that other factors associated with neurotransmission may also be important in alleviating symptoms, rather than simply the direct effects of a decreased level of dopamine activity. For example, it is possible that anti-psychotic medications alleviate symptoms of psychosis indirectly by impacting on the activity of *other* neurotransmitters that may be involved in schizophrenia and other psychotic disorders.

Box 16.5

Side effects of anti-psychotic medications

The following extract is from SANE Australia's fact sheet about antipsychotic medication, written to help people with schizophrenia. SANE Australia is a national charity that works for a better life for people affected by mental illness.

> **Are there any side effects?**
> Like any type of medication, antipsychotics can cause unwanted effects. Your doctor should talk about this with you and encourage you to report back any problems you experience, as there is much that can be done to minimise these effects. Often these are temporary and wear off with time as your body adjusts to them. As a general rule they are less of a problem with lower doses of medication. Remember that not everyone will experience the same unwanted effects with the same medication—and some people have none. Possible unwanted effects with some medications include:
>
> - dry mouth
> - lower sexual responsiveness
> - loss of periods in women
> - stiffness or trembling in muscles
> - mild involuntary movements
> - low blood pressure
> - tiredness
> - dizziness
> - nausea, constipation
> - weight gain.
>
> Changing the dose of medication can ease side effects, as can changing the time of day you take it. That is why it is important to let your doctor know as soon as possible if you are concerned about any of these side effects. Your doctor should also monitor any weight gain closely to minimise the potential risk of developing diabetes. There are things you can do too: for example, sucking sugar-free lollies can help a dry mouth, and diet changes and an exercise program may help with weight gain, as well as improving your overall fitness.

Source: SANE Australia, *Antipsychotic medication*, Fact sheet 10, p. 1, www.sane.org/factsheets/antipsychotic_medication.html.

Learning Activity 16.6

Review questions

1 What roles is dopamine believed to play in behaviour and mental processes?

2 How does the dopamine hypothesis explain schizophrenia?

3 What evidence supports and does not support the dopamine hypothesis?

4 a What are anti-psychotic medications?
 b How do anti-psychotics reduce psychotic symptoms?
 c List three common side effects of anti-psychotics.

5 a Distinguish between typical and atypical anti-psychotics.
 b Why are atypical anti-psychotics more commonly prescribed?

6 What are three limitations of anti-psychotics in the management of schizophrenia?

Learning Activity 16.7

Evaluation of research by Schooler and others (2005)

Prepare a flow-chart summary of the key features of the Schooler and others (2005) research study on anti-psychotic medications. Your flow chart should include:

- an operational hypothesis that could have been tested in the experiment
- the name of the experimental design
- the independent variables and the dependent variables
- two relevant extraneous variables and how they were controlled
- the experimental conditions
- the results
- the conclusion
- a potential limitation in generalising the results to other relevant populations
- relevant ethical issues.

Psychological contributing factors

Schizophrenia is characterised by cognitive impairments that can take different forms and affect a wide range of other mental processes and behavioural functioning. It is estimated that as many as 85% of people diagnosed with schizophrenia experience problems with cognition. Problems with cognition may be evident even before psychotic symptoms start, and they may lead to a decline in academic or work performance. One of the earliest cognitive symptoms of schizophrenia is poor attention, but difficulty with memory and visual motor speed may also be evident before the onset of psychotic symptoms. People who have schizophrenia often experience problems in the following aspects of cognition: ability to pay attention; ability to remember and recall information; ability to process information quickly; ability to respond to information quickly; ability to think critically, plan, organise and problem-solve; and ability to initiate speech (Medalia & Revheim, 2002). These problems with cognition tend to be evident regardless of the level of intelligence, educational background, age, sex or occupation of the person and other relevant socio-cultural factors. Two cognitive problems that have been extensively researched in relation to schizophrenia are impairments in reasoning and memory.

Impaired mechanisms for reasoning and memory

To a large extent, we reason by using our memories of information learnt through past experience. Consequently, reasoning significantly depends on memory, and impaired memory functioning in one or more memory systems can underlie impaired reasoning in various situations. Impairments in reasoning and memory are highly prevalent among people with schizophrenia and are associated with many of its key symptoms.

Impaired reasoning

Reasoning is defined in many different ways and many types of reasoning have been distinguished. These include deductive reasoning, inductive reasoning, analogical reasoning and probabilistic reasoning. Although there are differences, they all involve purposeful thinking using principles of logic.

Generally, **reasoning** involves goal-directed thinking in which inferences are made or conclusions are drawn from known or assumed facts or pieces of information. When we are engaged in reasoning, we use what we already know or assume to be true and draw conclusions we believe to be correct or that best suit the available information. Reasoning enables us to solve problems, thereby allowing us to deal with the challenges we meet in everyday life. Research findings indicate that impairments of varying degrees are evident in many specific types of reasoning among individuals with schizophrenia. We consider an example of impaired reasoning involving 'jumping to conclusions' when using probabilistic reasoning.

Probabilistic reasoning involves making judgments related to probability, or the likelihood of something happening or being true. This is a type of reasoning we engage in nearly every day. For example, you may find yourself wondering how likely it is to rain tomorrow, whether the fact that you have sneezed three times in the last 10 minutes means you are getting a cold, or how likely it is that you will bump into a friend if you go to the local shopping centre on Friday night. Research evidence suggests that people with schizophrenia often have an impairment in probabilistic reasoning that affects how they interpret social situations. This type of reasoning impairment has also been implicated as a contributing factor to the development and persistence of delusions. Delusions are a key symptom of schizophrenia, occurring in approximately three-quarters of cases, and have been consistently shown by research evidence to be associated with reduced data gathering, belief inflexibility and an impaired working memory (Broome & others, 2007).

British clinical psychologists Phillipa Garety and David Hemsley and psychiatrist Simon Wessely (1991) were the first researchers to report evidence that individuals experiencing delusions are likely have a probabilistic reasoning impairment. This impairment is a type of cognitive bias, or tendency to process information in a particular way, called 'jumping to conclusions'. As the term suggests, **jumping to conclusions** involves making hasty judgments or decisions on the basis of inadequate or ambiguous information, typically resulting in unjustifiable or incorrect conclusions. Usually there is more information available than is actually used and the conclusion is reached without accessing the additional information that may have resulted in a different or accurate conclusion. When judgments and decisions are reached in this way, the person with schizophrenia usually holds them with greater confidence and inflexibility than others would. People experiencing delusional beliefs tend to reach unwarranted conclusions about the causes of events very quickly, do so on the basis of reduced data-gathering and stick to the first explanation for an event that comes to mind.

For example, imagine a woman with schizophrenia who is standing at her letterbox reading a letter she has just received from the Department of Human Services when a police helicopter flies overhead. The woman 'jumps to conclusions' and believes (with 90% certainty) that both the police and the Department of Human Services are spying on her because this is the first idea that pops into her mind. While other people may have dismissed this as an unlikely explanation, the woman's reasoning style contributes to her sticking with this explanation. She does not stop to consider other possible explanations; for example, that receiving the letter and the helicopter flying overhead were two completely unrelated incidents and it was just 'coincidence' that they happened at the same time, and that the helicopter had nothing to do with her personally. An impairment in probabilistic reasoning is therefore hypothesised to lead to the rapid acceptance and confirmation of beliefs, even if there is little evidence to support them.

Garety, Hemsley and Wessely (1991) obtained evidence for a probabilistic reasoning impairment among people with schizophrenia in an experiment in which two groups of participants were used. Group 1 comprised 27 participants who reported experiencing delusions with their schizophrenia and group 2 comprised 27 participants who did not experience delusions. The groups were compared on a test of probabilistic reasoning. The test, known as the 'beads task', is commonly used in research on probabilistic reasoning. In the beads task, participants are shown two jars of coloured beads, informed of the relative proportions of colours of beads in each jar, and then told that that they will be shown a series of beads drawn from one of the jars. They are asked, on the basis of the observed sequence, to judge which jar is the source of the beads, and to be 'as certain as possible'. However, it is never possible to be completely certain as to which jar the beads have been drawn from (see box 16.6).

The researchers found that group 1 participants (experienced delusions) requested significantly less information before reaching a decision on the reasoning task than did group 2 (did not experience delusions). Furthermore, 11 (41%) of the group 1 participants reached a firm decision (with 85% certainty) as to the identity of the jar after the very first bead was presented, compared with only one (3%) participant in group 2. These findings have been replicated by many other studies. For example, a recent study by a team of Australian psychologists compared 35 people with schizophrenia (and a history of delusions) with 34 'healthy' controls on the beads task. The results revealed that while four people from the control group (11.8%) reached a decision after only one draw, the proportion of people with schizophrenia doing so was significantly greater (34.3%) (Langdon, Ward & Coltheart, 2010).

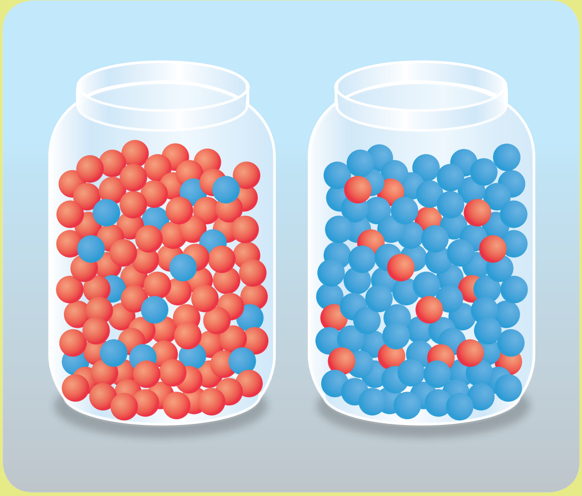
Box 16.6

The beads task

The probabilistic reasoning abilities of people with delusions have been traditionally assessed using the 'beads task'.

In a typical 'beads task', two jars are used, each with 100 beads of two different colours. One jar contains a higher proportion of beads of one colour (e.g. 85 red and 15 blue) and the other contains the reverse (85 blue and 15 red). Participants are informed of the proportions, then both jars are removed from view. One of the jars is then chosen, still hidden from view, and a bead is drawn from it and shown to the participant. The experiment is continued, with beads being drawn sequentially and always replaced. Although the participants are told that beads are being selected randomly, the sequence of colours is predetermined according to the ratio of the two colours.

The participant's task is to work out which jar the experimenter is drawing a bead from. After each bead is drawn, participants are asked if they would like to see more beads (i.e. if they would like more information) or if they can say, with certainty, from which of the jars the beads are being drawn. The dependent variable is the number of beads drawn before making a decision.



Impaired memory

There is extensive research evidence that individuals suffering from schizophrenia usually have some degree of memory impairment. Numerous laboratory and community-based research studies have established that people with schizophrenia tend to perform poorly on a wide range of memory tasks. In addition, memory impairment among individuals with schizophrenia can be comprehensive and involve all memory systems and sub-systems, including sensory memory, working memory and/or all types of long-term memory. Depending on the individual, impairments in some systems may be more or less severe.

Although the exact prevalence of specific memory problems remains unclear, memory impairment is often described as one of the major disabilities associated with schizophrenia. Depending on the extent and severity of memory impairment, the consequences for the individual with schizophrenia may range from an added burden to the already difficult circumstances of life, through to interference with the ability to benefit from management programs for their schizophrenia. The underlying causes of memory impairment also remain unclear but are generally believed to have a neurological basis. This is consistent with the contemporary view of schizophrenia as a brain disorder. A number of the older typical anti-psychotic medications, however, may cause or exacerbate memory impairment (Stip, 1996).

In order to determine the magnitude, extent and pattern of memory impairment in schizophrenia, American psychologist André Aleman and a team of psychiatrists (1999) conducted a meta-analysis of 70 research studies on memory impairment published in the previous 20 years. These studies used free recall, cued recall and recognition of verbal and non-verbal material as measures of long-term memory, and digit span testing as a measure of short-term (working) memory. All studies also compared the performance of people clinically diagnosed with schizophrenia with the performance of a control group of 'healthy normal' participants. The findings of the meta-analysis revealed memory impairment to be wide-ranging in people with schizophrenia, with significant impairments of short-term (working) memory and long-term memory. Both free recall and cued recall from long-term memory were poor, whereas recognition showed less but still significant impairment. Recall and recognition were poor for both verbal and non-verbal (visual pattern) materials. Storage duration of newly learned materials was also poor for both tests of immediate and delayed recall or recognition. Controlling for attention had very little effect on the differences in performance on long-term memory recall between participants with schizophrenia and those in the control group. It was also found that the extent of memory impairment was not affected by age, medication or severity of symptoms. Furthermore, participants who had suffered from schizophrenia for a long period of time did not perform worse than those who had been recently diagnosed.

Many of the more recent research studies have focused on impairments of different types of long-term memory. Although both explicit and implicit long-term memories are impaired, episodic memories of past events and personal experiences tend to show the greatest impairment. For example, when read a story, people with schizophrenia learn and recall much less than control group participants. If the story is repeated, they gain less information from repeated exposure than control group participants, showing a reduced 'learning curve'. In other studies of episodic memory, participants may be required to recall specific information about past events they have experienced. The researchers then verify the accuracy of the information by checking with relatives and friends. These studies have also found that people with schizophrenia tend to make more errors or omissions than do control group participants (Danion & others, 2007; Harvey & Sharma, 2002). Furthermore, a study by a team of Australian researchers found that episodic memory impairment is also present in the prodromal phase—*before* the presence of obvious psychotic symptoms (Brewer & others, 2006).

Impairments in episodic memory can be very disabling. Individuals with episodic memory impairment may experience difficulties recalling their personal histories with reference to events,

Figure 16.16 Studies have found that people with schizophrenia can have an impairment in episodic memory that makes it difficult for them to remember their own history. This, in turn, significantly impacts on their day-to-day functioning.

times, places and even the emotions they felt during events. For example, they may not be able to remember what they did yesterday and where they left their house keys earlier in the day. People with an episodic memory impairment may also lose the ability to associate themselves with personally significant past events or plan for the future on the basis of past experiences. In cases of severe episodic memory impairment, they can become 'trapped in the present'. Along with other impairments of memory and reasoning, episodic memory impairment contributes to some of the key symptoms associated with schizophrenia, particularly disorganised behaviour and the impairments apparent in day-to-day functioning.

Learning Activity 16.8

Review questions

1 Explain the meaning of cognitive impairment with reference to an example other than reasoning or memory.

2 a Explain the meaning of impaired reasoning.

b Describe a reasoning impairment that may be observed in an individual with schizophrenia and how this may affect everyday functioning.

3 a Explain the meaning of impaired memory.

b Describe a memory impairment that may be observed in an individual with schizophrenia and how this may affect everyday functioning.

4 Are hypofrontality and reduced dopamine levels in the brain of an individual with schizophrenia impaired brain mechanisms that underlie memory and reasoning impairments? Explain your answer.

Learning Activity 16.9

Evaluation of research by Garety, Hemsley and Wessely (1991)

Evaluate the experiment on probabilistic reasoning conducted by Garety, Hemsley and Wessely (1991). Answer the following questions.

1 What was the aim of the research?

2 Construct an operational hypothesis that could have been tested by research procedures.

3 Who were the participants in the research and how were they recruited?

4 Name the type of experimental design.

5 Identify the experimental and control conditions.

6 Identify the independent and dependent variables.

7 Explain whether the results support the hypothesis.

8 Are participant demand characteristics a limitation of the results? Explain your answer.

9 Does the study have external validity? Explain your answer.

Management of schizophrenia

The last two decades have seen significant advances in the development of effective psychotherapies for the management of schizophrenia. In conjunction with medication, two approaches that have been shown to be effective in reducing psychotic symptoms and improving an individual's day-to-day functioning are cognitive behavioural therapy (CBT) and cognitive remediation. We also examine the role of stress management as a way of controlling or minimising the influence of stressors that can trigger or exacerbate psychotic symptoms, and its role in helping to prevent relapse.

Cognitive behavioural therapy (CBT)

According to cognitive behavioural theory, people with schizophrenia have a different reasoning style to people who do not have schizophrenia, so a commonly used therapy involves assisting the individual with schizophrenia to identify and change the thoughts responsible for maintaining their symptoms. This type of therapy is called cognitive behavioural therapy. As the name suggests, **cognitive behavioural therapy**, commonly referred to as CBT, is a type of therapy that combines cognitive and behavioural therapies to help people overcome or more effectively manage psychological problems and mental disorders.

CBT is based on the assumption that the way people feel and behave is largely a product of the way they think. Therefore, according to the principles of CBT, anyone can change the way they feel and behave by thinking about a situation in a more balanced and helpful way. However, CBT does not aim to persuade someone that their current way of thinking is 'wrong' or 'irrational'. Instead, CBT aims to assist the individual to identify where they may have become trapped or stuck in their way of thinking and to assist them to discover other ways of looking at their situation.

Research suggests that people with delusions usually have a type of reasoning bias that makes them prone to misinterpretation and 'jumping to conclusions'. The *cognitive component* of CBT in the management of schizophrenia therefore often involves helping the client to become aware that in some situations they may be 'jumping to conclusions', identify the thoughts that may be misinterpretations of situations, carefully examine each thought and evaluate how realistic it is, and to try to generate alternative thoughts that are more realistic, helpful and balanced.

When using cognitive strategies to treat the delusions that may be accompanying a person's schizophrenia, mental health professionals first try to gain a thorough understanding of the delusions from the client's perspective and encourage them to explore the evidence *for* the delusion (why they believe it). The next step is often to gain some agreement with the client that the conclusions they have come to might be a misrepresentation of what has occurred. This is normally done by a quick examination of the likelihood of potential alternative hypotheses to explain events. Once there is some agreement from the client that there is 'a chance' alternative conclusions could be considered, the mental health professional introduces information about reasoning biases (i.e. jumping to conclusions) in order to provide the client with an explanation of how they might have arrived at their delusional interpretation of events.

For example, a mental health professional may encourage a client to consider alternative possibilities when the client has decided that someone at a bus stop looked at them with an irritated look because they were part of the 'conspiracy' against them. One explanation is that it is normal for people to look at a stranger when they approach a bus stop and if the bus is late it is not uncommon to have an irritated scowl on one's face. The mental health professional might then explain that when we are anxious, we often rush to a decision, basing our decision on only a little bit of data without considering additional information. They may add that it's hard to take the time to think things through or gather more evidence when we are worried or afraid and therefore can reach conclusions about events based on the way we feel (i.e. anxious or paranoid) rather than on the facts. So, if we don't take the time to gather and analyse evidence for our thoughts and feelings, and if we don't talk things over with other people, we run the risk of jumping to the wrong conclusion—and that wrong conclusion may well be that other people disapprove of us or are even out to hurt us (Freeman, Freeman & Garety, 2006).

British psychologist Hazel Nelson (2005) proposes using the 'feeling brain—logical brain' model to help people with schizophrenia understand how reasoning can lead to wrong conclusions (see figure 16.18). She explains that, in certain situations, we are using our 'feeling brain'—the part of the brain that thinks and reasons emotionally about things—but that it would be helpful to get our 'logical brain'—which thinks and reasons calmly and rationally—more involved.

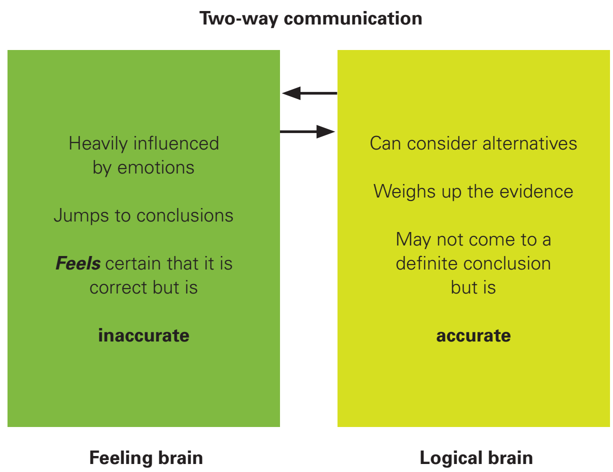
The next steps involve practising the process of 'examining the evidence' for and against delusional ideas and generating possible alternative explanations. For example, suppose that a man with schizophrenia thinks 'If one of the group of people happened to glance to my direction, that was it. I was sure it was me they were talking about'. This thought may be written down and treated similarly to the way negative automatic thoughts are managed in CBT for major depression (see page 701 in chapter 14). The man has jumped to the conclusion that people are talking about him on the basis of just one piece of possible evidence (other people's glances). He may then be asked to come up with alternative explanations for why a member of the group may glance in his direction.

Where a specific delusional idea can be identified—for example, 'I know there is a conspiracy going on because I had telepathic contact with the prime minister in Parliament House last week'—the mental health professional may suggest specific reasons why this would be unlikely. Discussion may reveal, for example, that the prime minister was overseas last week. Similarly, a person who believes that they are the reincarnation of Michael Jackson might consider a piece of factual evidence against the belief, such as that Michael Jackson died 20 years *after* the person was born.

It is important to note, however, that the aim of the cognitive component in CBT is not for the person to fully reject their delusion. They may still believe and accept their delusion to a certain degree, but the goal is to reduce the amount of *distress* it causes and the amount of *time* they spend thinking about it, which will then have a positive impact on their mood and behaviour.

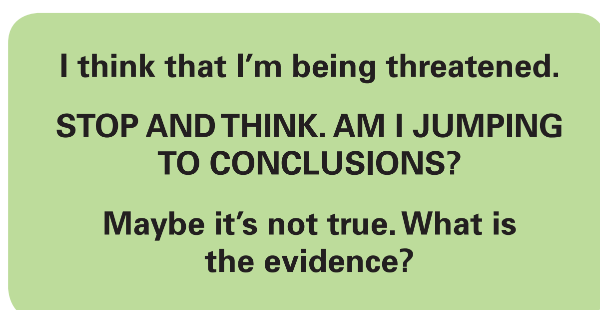
The *behavioural component* of CBT in the management of schizophrenia may consist of two components called behavioural experiments and behavioural strategies. **Behavioural experiments** are planned experiential ('hands-on') activities that are undertaken by clients in or between cognitive behavioural therapy sessions. Their primary purpose is to help the person with schizophrenia 'test out' the accuracy of their delusional thoughts. By using behavioural experiments, clients may come to realise that their delusions may not be 100% true, but this is something that they may not fully believe until it is put to the test in the experiments.

The steps involved in setting up a behavioural experiment are similar to the steps involved in carrying out scientific research: making a prediction, reviewing existing evidence for and against the prediction, devising a specific experiment to test the validity of the prediction, noting the results



Source: Nelson, H. (2005). *Cognitive-behavioural therapy with delusions and hallucinations: A practice manual* (2nd ed.). Cheltenham: Nelson Thornes, p. 227.

Figure 16.17 The feeling brain—thinking brain model



Source: Fowler, D., Garety, P., & Kuipers, E. (2003). *Cognitive behaviour therapy for psychosis: Theory and practice*. West Sussex: John Wiley & Sons, p. 136.

Figure 16.18 Flashcards can be used to remind clients to think of an alternative interpretation once a paranoid belief has been triggered.

and drawing conclusions. For example, suppose that a woman has a delusional belief that she has many special abilities, including that she can make telepathic contact with others. A behavioural experiment could be set up in which she is asked to communicate telepathically with five different people, check with each of them whether her message was received and report back on how many of those five people received her message. Suppose also that a woman has a delusional belief that the police come into her house and move things while she is out. A behavioural experiment could be set up in which she arranges to go out of the house and on her return checks to see if certain items had been moved. The woman will expect that when she returns home things will have been moved but, in fact, the things she had identified had not moved and her daughter, who was with her, provides corroborating evidence, agreeing that nothing had been moved. Also, the burglar alarm had not gone off and the dog appeared settled.

Although behavioural experiments can be very useful in the management of schizophrenia, many delusional beliefs cannot be adequately modified through behavioural experiments. For example, it may be very difficult to demonstrate clearly that ASIO agents are not bugging an individual's house or that aliens from outer space are not watching a person's every move. In addition, an individual with schizophrenia will often come up with a reason why the behavioural experiment didn't 'disprove' their delusion. For instance, in the example above, the woman who believes the police come into her home and move things may then say that they only come on some days or that the police knew that the trap was set and didn't come that day. In short, behavioural experiments will not always guarantee a person will modify their commitment to their delusion.

Another behavioural therapeutic procedure that may be used as part of CBT in the management of schizophrenia is the use of behavioural strategies. When used in the management of schizophrenia, *behavioural strategies* are behaviourally based interventions that help reduce the impact of hallucinations or preoccupation with a delusion on a person's life. Some effective behavioural strategies that have been used for auditory hallucinations or 'voices' include putting a standard earplug in one ear, using an iPod with headphones (although when the voices are problematic the volume may have to be turned up loud), talking out aloud or talking quietly to themselves so that no-one can hear, distraction (e.g. talking to someone, reading a book, playing a computer game or Xbox, watching television), engaging in physical activity (e.g. going for a run or brisk walk) and reducing stimulation or stress (e.g. engaging in relaxation, sitting somewhere quiet, having a sleep).

Figure 16.19 Almost all people gain some immediate relief from their auditory hallucinations by using behavioural strategies such as listening to music.

Learning Activity 16.10

Review questions

1 **a** Suggest a suitable aim of cognitive behavioural therapy (CBT) in the management of schizophrenia.
b What key assumption would underlie this aim?
c Give two examples of roles required of the client during CBT.

2 **a** Explain why a CBT therapist might target a reasoning impairment involving jumping to conclusions.
b Describe a strategy that may be used by a CBT therapist to treat this problem.

3 Explain what each of the following CBT techniques involve and why they may be used, with reference to a relevant example:
a behavioural experiment
b behavioural strategy.

Learning Activity 16.11

Visual presentation on CBT

Construct a flow chart that summarises how schizophrenia may be managed using CBT. Ensure your flow chart:

- starts with a list of commonly occurring thoughts, feelings and behaviours associated with schizophrenia
- refers to the aim(s) of the therapy in relation to schizophrenia
- outlines key assumptions of CBT when used for schizophrenia
- identifies possible therapeutic techniques
- distinguishes between key roles of the therapist and the client during the therapy.

Cognitive remediation

Cognitive remediation is a general term that refers to the use of training techniques to promote improvement in targeted cognitive impairments. The overall purpose of cognitive remediation is to decrease the everyday problems faced by individuals with cognitive difficulties, thereby improving the quality of their lives. Cognitive remediation techniques were initially devised for use with people who suffered from a traumatic brain injury, but have since been found to also be useful for people with schizophrenia, as well as for those who have other neuropsychological problems or mental disorders involving cognitive impairments. The techniques are tailored to each individual's needs and abilities. Cognitive remediation involves behavioural techniques but is not meant to replace medical treatments or psychotherapy. Instead, it is used to complement their effects. As with psychotherapy, it is also important that the individual is able and willing to be actively involved in the management process (Schwalbe & Medalia, 2007).

Generally, cognitive remediation techniques involve teaching clients specific information-processing skills targeted at one or more difficulties. Techniques may focus on:

- *attention and concentration*—to improve ability to focus attention, divide attention and maintain attention
- *reasoning*—to improve ability to connect and organise information in a logical, rational way and to avoid jumping to conclusions based on incomplete information, or to avoid focusing on negative aspects of a situation and ignoring the positive
- *memory*—to improve working memory through rehearsal strategies or to improve retention and recall from long-term memory through the use of mnemonic techniques
- *problem solving*—to improve ability to define a problem, come up with possible solutions and evaluate possibilities
- *decision making*—to improve ability to choose from different options and consider decisions thoroughly before taking any action
- *organisation*—to improve ability to keep track of or find items, or doing tasks in a set order and/or in a timely manner
- *executive functioning*—to improve 'higher level' cognitive skills such as how to monitor oneself; control thinking and actions; think in advance; set goals; manage time; act in socially acceptable ways; and transfer skills learned in one setting, such as a clinic, to another setting, such as the home, school or workplace (Medalia, Revheim & Herlands, 2009; Parente & Herrman, 1996).

Before cognitive remediation can begin, the individual is usually assessed in order to identify specific cognitive impairments that are interfering with everyday functioning in significant ways. The assessment also provides a means of monitoring improvement by comparing the individual before, during and after remediation.

A range of different approaches to remediation can be used. Each approach emphasises different therapeutic styles and specific techniques. Some approaches use computer software programs or paper and pencil tasks, some are conducted in a clinical setting for individuals or small groups, and others may be conducted in an individual's home. In all approaches, objectives are set and each individual's progress in achieving their specific objectives is monitored. The length of a remediation program varies according to the individual's specific problems and needs. For example, improving memory skills may take months or years. In contrast, it may take only a few days or weeks to train someone to improve their organisational skills.

A cognitive remediation program specifically designed for use with people with schizophrenia who also possess cognitive deficits is called the Neuropsychological Educational Approach to Remediation (NEAR). NEAR is a group-based program that provides highly individualised training by allowing each person in the group to work at their own pace on tasks carefully chosen to e engaging and to address their specific cognitive needs. Clients participate in NEAR at least twice a week and the sessions are typically 60 to 90 minutes long. When clients start a NEAR program, they initially complete computer-based tasks, choosing exercises from the list of software shown to them by the therapist. About two-thirds of the time involves completion of individual cognitive activities on the computer, and a third of the time is spent in a 'bridging group', which is a discussion about how their computer activities relate to things they do in everyday life. Participants share strategies for solving problems on the cognitive exercises and in real life. The task of the therapist in NEAR sessions varies from observing to motivating or providing specific assistance by suggesting ways of overcoming problems (Medalia, 2002).

Australian neuropsychologist Antionette Redoblado-Hodge and her colleagues (2010) conducted a study that provided evidence for the effectiveness of NEAR with people with schizophrenia. Their study investigated the use of NEAR with 40 participants with schizophrenia aged between 16 and 55 years (mean of 31 years). The 'immediate treatment' group (22 participants) engaged in 20 to 30 sessions of NEAR over a 16-week period, whereas a 'waiting list' group (18 participants) did not engage in any NEAR sessions during this period and therefore served as a control group (see figure 16.21).

Figure 16.20 Commercially available game and educational software can be used as part of a cognitive remediation program.

Following the NEAR sessions, significant improvements were found in the 'immediate treatment' group compared to the 'waiting list' group on a wide range of cognitive skills such as attention, visual processing speed, executive functioning, and verbal and visual memory. The 'waiting list' group then engaged in 20 to 30 sessions of NEAR and improvements in cognitive skills similar to those of the 'immediate treatment' group were observed. The gains in both groups were found to have persisted when participants were reassessed four months after the program ended. Many other studies have obtained similar results about the effectiveness of cognitive remediation programs for people with schizophrenia. For example, a meta-analysis of 26 studies involving 1151 participants with schizophrenia found that cognitive remediation produced at least moderate improvements for all participants in cognitive performance, symptoms and everyday functioning, and was even more effective when combined with psychotherapy (McGurk & others, 2007).

Stress management

Given that everyday life inevitably involves exposure to stressors, and that individuals with schizophrenia can be very sensitive to stress and change, it is important for them to learn ways to manage their

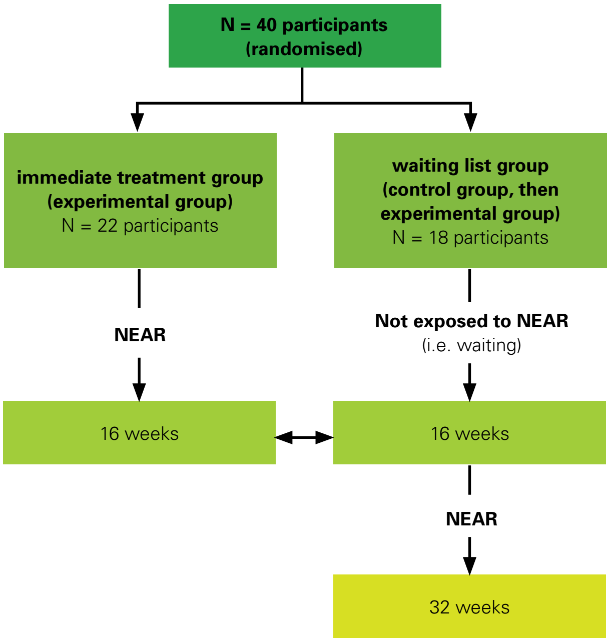


Figure 16.21 Research design of the study on NEAR conducted by Redoblado-Hodge and colleagues (2010)

Figure 16.22 For people with schizophrenia, reducing stress through stress management techniques can help prevent relapse and rehospitalisation.

stress following exposure to stressors (Mental Health Fellowship of Australia, 2010).

Stress management involves the use of various techniques to alleviate or cope with the effects of stress, usually for the purpose of improving everyday functioning. Stress management techniques used by people without schizophrenia (e.g. biofeedback, meditation and relaxation, physical exercise, and social support) are also effective for those with schizophrenia (see pages 617–24 in chapter 12). Other techniques may include learning strategies for active problem-solving and to recognise stress symptoms. Awareness of when stress may be experienced or has commenced can serve as a cue to use one or more stress management techniques (Mueser & Jeste, 2008).

Research evidence indicates that for people with schizophrenia, reducing stress through the use of specific stress management techniques or activities can help prevent relapse and rehospitalisation. For example, in a study conducted by Canadian psychiatrist Ross Norman and his colleagues (2002), 121 people with schizophrenia were assigned to receive either a 12-week stress management program with follow-up sessions or to a program involving participation in a social activities group. Participants who received the stress management program had fewer hospital admissions in the year following treatment. This effect of stress management was most apparent for those who showed high levels of attendance for follow-up sessions. It was concluded that training in stress management may provide skills for coping with acute stressors and reduce the likelihood of subsequent acute exacerbation of symptoms resulting in hospitalisation.

Learning Activity 16.12

Review questions

1. a What is cognitive remediation?
   b Explain its relevance to schizophrenia.
2. List five cognitive skills that may be targeted for cognitive remediation.
3. List the steps that may be involved in conducting a cognitive remediation program for a client, starting with a neuropsychological evaluation.
4. a Identify a computer game (other than the one pictured in the text) that could be used for cognitive remediation.
   b Describe one or more cognitive skills that could be targeted for improvement through game playing. Explain your answer.
5. a What is stress management?
   b Explain its relevance to schizophrenia.
   c Give an example of a stress management technique that may be used by an individual who has schizophrenia.
   d Outline two potential benefits of using the technique identified in (c) above.

Socio-cultural contributing factors

Socio-cultural factors involved in the development and persistence of schizophrenia can be divided into two categories. One category, called *risk factors*, includes those factors within an individual's environment that can *increase* the likelihood of the onset of schizophrenia or worsen symptoms of those who already have the disorder. The other category, called *support* or *protective factors* includes those factors that can *decrease* the likelihood of the onset of schizophrenia or alleviate symptoms of those who already have the disorder.

Risk factors

Risk factors for schizophrenia include *social disadvantage* (circumstances precluding access to life opportunities), *trauma* (extremely distressful events) and *psycho-social stress* (due to experiences in everyday life). All of these factors have been found to involve negative situations or events that can combine with the effects of other risk factors to promote the onset or persistence of psychotic symptoms of schizophrenia.

Social disadvantage

Social disadvantage is a broad term used to refer to the range of difficulties that block life opportunities and that prevent people from participating fully in society. These difficulties may include poverty, poor physical or psycho-logical health, disability, lack of education or work skills, and being subject to unfair treatment or discrimination (Vinson, 2007). Even though people from all types of socio-cultural backgrounds are diagnosed with schizophrenia, and the rate of schizophrenia tends to be the similar across cultures throughout the world, research studies have consistently found that schizophrenia is disproportionately concentrated among people who are socially disadvantaged.

Socioeconomic status is commonly used a measure of social disadvantage. *Socioeconomic status (SES)* is a combined and total measure of an individual's or family's social and economic position (i.e. 'status') in society, relative to (compared with) others, based on income, education and employment (or occupation). SES is typically divided into three categories, called *high SES*, *middle SES* and *low SES*, to describe the level of socioeconomic wellbeing of an individual or family. Although people in middle or high SES groups can experience social disadvantage (e.g. due to a disability or ethnicity), social disadvantage is far more prevalent among people who have low SES.

In some large cities, schizophrenia is up to five times more common among people living in the poorest areas and at the lowest socioeconomic level than at the highest (Keith, Regier & Rae, 1991). Two hypotheses have been proposed to explain the greater prevalence of schizophrenia among people in low SES groups, when compared with people in middle or high SES groups. These are called the social causation hypothesis and the social drift hypothesis.

The **social causation hypothesis** proposes that membership of a low SES group can trigger the development or onset of schizophrenia. One reason this is said to occur is because being a socially disadvantaged member of a low SES group involves exposure to chronically stressful life experiences. For example, physical and psychological stressors such as ongoing lack of basic necessities, poor accommodation, menial employment, long-term unemployment, concerns about meeting the next bill payments, feelings of insecurity and lack of control over one's circumstances can facilitate the development or onset of schizophrenia. In addition, people in a low SES group tend to have access to less social support. In contrast, people in the middle and high SES groups tend to have more positive life experiences to offset the negative ones, as well as a bigger social network and better access to social support when needed. Therefore, according to the social causation hypothesis, schizophrenia may be caused by the collective influence of the stressors and limitations associated with membership of the lowest socioeconomic group.

In contrast, the **social drift hypothesis**, also called the *downward drift hypothesis*, proposes that membership of a low SES group, and therefore social disadvantage, is a consequence of schizophrenia. According to this hypothesis, an individual's onset of schizophrenia or deteriorating mental health occurs first, resulting in their 'drifting downward' to the lowest SES group. For example, when an individual develops schizophrenia, they have difficulties functioning effectively in everyday life. Therefore, they are often unable to obtain or maintain viable full-time employment, which leaves them with limited means of financially supporting themselves and/or their family. This may also lead them to 'drift' to 'poorer areas', which helps explain the much greater prevalence of schizophrenia among people in such areas of big cities.

Overall, research evidence seems to support both the social causation and social drift hypotheses. For some people, the stressors and limitations associated with social disadvantage and low SES, in combination with other factors, may contribute to the development of schizophrenia. But for others, social disadvantage and low SES may be a result of schizophrenia and other aspects of their life circumstances.

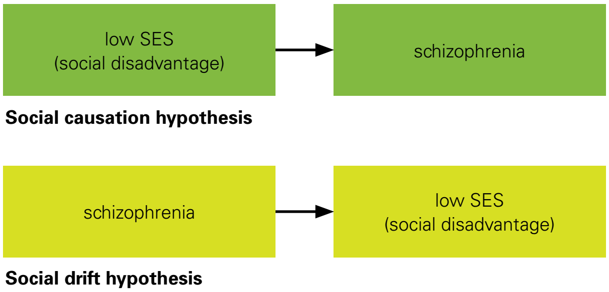


Figure 16.23 The social causation hypothesis proposes low SES and social disadvantage causes schizophrenia, whereas the social drift hypothesis proposes that low SES and social disadvantage is a result of schizophrenia.

Learning Activity 16.13

Review questions

1. What does the term social disadvantage refer to?
2. What are some of the typical indicators of social disadvantage?
3. What is an advantage and limitation of operationally defining social disadvantage in terms of socioeconomic status?
4. a Does being socially disadvantaged lead to people developing schizophrenia or does schizophrenia lead to people becoming socially disadvantaged? Explain your answer with reference to social causation and downward social drift.
   b What is a potential confounding variable in studies of social disadvantage? Give a reason for your choice of variable and explain why it may be a confounding variable.

Trauma

In relation to mental health, **trauma** refers to an event that a person experiences, witnesses or confronts that is extremely distressing and to which the person's response involves intense fear, helplessness or horror. In many cases, the threat of personal harm is sufficient to produce trauma. Just as physical trauma can cause a physical wound or injury that may heal to some extent or not at all, the effects of psychological trauma may be partly overcome, entirely overcome or not overcome. The individual's subjective response to an event is an important aspect of understanding their immediate and subsequent psychological functioning following trauma. However, research findings indicate that certain events are more likely to be perceived as traumatic by most people; for example, childhood sexual, physical or emotional abuse; rape; natural disasters; war experiences; and serious car accidents. Although the psychological effects of trauma vary among individuals, they are likely to be most severe if the trauma is caused by another person and is repeated, unpredictable, multifaceted, sadistic, experienced in childhood and/or committed by a caregiver (Becker, 2003).

Many research studies have found a relationship between the experience of trauma and development or onset of schizophrenia. Generally, these studies indicate that key psychotic symptoms of schizophrenia, such as delusions and hallucinations, are more prevalent among people who have experienced psychological trauma than among the general population. For example, British psychologist Mark Shevlin and his colleagues (2008) analysed the results of a national survey of 8580 volunteer participants aged between 16 and 74 years who had been selected using a random-stratified sampling procedure. In the first phase of the study, participants indicated whether they had directly experienced one or more of five traumatic events: (1) serious illness, injury or assault, (2) bullying, (3) violence at work, (4) violence in the home and (5) sexual abuse. In the second phase of the study, participants who reported one or more of these experiences were clinically assessed for the presence of psychotic symptoms. The researchers found that experiencing one trauma did not significantly increase the likelihood of psychosis. However, experiencing two or more types of trauma significantly increased the likelihood of psychosis, with dramatic increases associated with experiencing all trauma types. The researchers also analysed the results of a similar study conducted in America that used a stratified sample of more than 8000 participants aged between 15 and 54 years drawn from 48 states. The findings of this American study were consistent with those of the British study.

Although studies using other research methodologies have also found a relationship between the experience of trauma and the presence of psychotic symptoms, this does not mean that trauma actually causes schizophrenia. Trauma is extremely distressing and its effects are often debilitating and longlasting or permanent, although the impact of a traumatic event can be offset to some extent by access to support at the time of the event. If an individual has a genetic predisposition to schizophrenia, it is possible that exposure to a trauma may result in the onset of schizophrenia through interaction with other contributory factors. However, research evidence also indicates that it is more likely that an individual will *not* develop schizophrenia as a result of trauma, as most people who have experienced trauma do not develop psychotic symptoms, schizophrenia or any other psychotic disorder.

Psycho-social stress

Schizophrenia is not a stress-related disorder and stress in itself does not cause schizophrenia. There is considerable research evidence, however, that stress can act upon a pre-existing vulnerability to trigger the onset of schizophrenia or worsen the symptoms of individuals who have schizophrenia. Specific types of stressors that have been the subject of a great deal of research in relation to schizophrenia are often referred to as psycho-social stressors.

A **psycho-social stressor** is any event arising in the course of everyday life through interaction with others or society in general that causes or contributes to a stress response. These stressors include commonly occurring daily hassles, as well as extraordinary and unexpected major life events that can cause trauma. In addition to such specific 'negative' life events, psycho-social stressors may involve more broadly based socio-cultural or environmental problems associated with social disadvantage, such as inadequacy of personal resources or social support, or any other problem relating to the context in which an individual's difficulties have developed (DSM-IV-TR, 2000). It is believed that one or more stressful events of sufficient strength may interact with other risk factors and trigger the onset of schizophrenia or relapse, depending upon the interaction between the person and the event.

Most research on psycho-social stressors has focused on the effects of family environments on the onset and course of schizophrenia. For example, researchers have investigated such factors as dysfunctional parenting, disturbed family communication styles, and parental styles that are constantly critical or induce guilt, as possible contributors to schizophrenia.

One of the best-known studies on the potential effects of family environments was conducted by Finnish psychiatrist Pekka Tienari and his colleagues (2004). In this 40-year longitudinal study, the researchers tracked a sample of 145 adopted individuals whose biological mothers had schizophrenia (the 'high genetic risk' group). As part of their study, the researchers assessed the degree of psychological adjustment of the family in which each adopted individual was raised, including the mental health of the adoptive parents. The families were then classified as either 'psychologically healthy' or 'psychological dysfunctional'. This was achieved using a rating scale called the Oulu Family Rating Scale (OPAS). In the OPAS, characteristics of psychologically healthy families include open expression of positive and negative emotions, use of negotiation and compromise, grudges not being held for a long time (arguments are short and followed by more friendly interactions) and an overall friendly environment in which members can disagree without necessarily upsetting others. In contrast, characteristics of psychologically dysfunctional families include high levels of conflict, lack of empathy, inflexibility, lack of humour and disrupted communication. The study also included a control group of 158 adopted individuals whose biological mothers did not have schizophrenia (the 'low genetic risk' group).

Tienari and his colleagues found that adopted children with a biological mother who had schizophrenia had a much higher rate of schizophrenia than did the control group. However, this was true only when the children were raised in a psychologically dysfunctional family environment. As shown in figure 16.24, when children with a genetic background of schizophrenia were raised in a psychologically healthy adoptive family environment, they were about as likely as the control group children to develop schizophrenia.

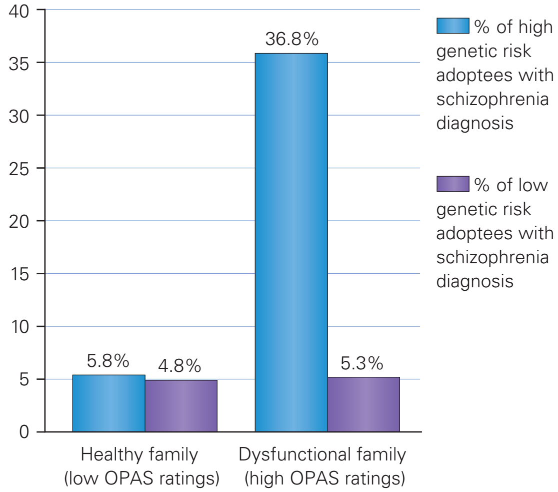


Figure 16.24 Results of the 2004 Finnish study conducted by Tienari and colleagues of the potential effects of family environments on schizophrenia

However, living in a psychologically healthy family environment did not make children with a genetic history of schizophrenia immune to the development of schizophrenia. Figure 16.24 also shows that 5.8% of the 'high genetic risk' children developed schizophrenia even though their family environment was psychologically healthy.

The results of Tienari's study demonstrate the complex interaction of genetic and environmental factors in schizophrenia. Clearly, children who were genetically at risk to develop schizophrenia benefited from being raised in a psychologically healthy family environment. This means that a healthy psychological environment might counteract an individual's genetic predisposition and therefore vulnerability for schizophrenia. Conversely, a psychologically dysfunctional family environment can act as a catalyst for the onset of schizophrenia, especially for those individuals with a genetic predisposition for schizophrenia.

Other research on psycho-social stress associated with the family environment has focused on a specific communication pattern called expressed emotion. **Expressed emotion (EE)** is a negative communication pattern that is observed among some relatives of individuals with schizophrenia and that is associated with relapse rates. Expressed emotion has five elements:

- *Critical comments*—criticisms are rated on the basis of content and/or tone. Comments are considered to be critical if the relative expresses that they dislike, disapprove of or resent a behaviour or characteristic. Vocal aspects of speech such as pitch, inflection and loudness are also used to identify the presence of this element.
- *Hostility*—statements of dislike or resentment to the family member with schizophrenia.
- *Emotional overinvolvement*—the presence of an exaggerated emotional response to the person's mental disorder. The other family members are very concerned about the person 'because they are ill', so they engage in devoted or extremely overprotective behaviours.
- *Warmth*—ratings of warmth are based on the sympathy, concern and empathy relatives show when talking about the family member with schizophrenia, the enthusiasm for and interest in their activities, the number of spontaneous expressions of affection and the tone of voice used when talking about them.
- *Positive remarks*—statements that express praise, approval or appreciation of the behaviour or personality of the family member with schizophrenia.

These five elements are used to calculate an EE index, or 'score'. The *high-EE* family environment tends to be stressful as it involves a lot of negative criticism of the person with schizophrenia, over-involvement by certain members of the family and expressed hostility. For example, high-EE relatives tend to believe that psychotic symptoms are under the personal control of the family member with schizophrenia and make such statements as 'you are a lazy person' or 'you've caused the family a lot of trouble'. In contrast, the *low-EE* environment tends not to be stressful as it tends to be characterised by warmth, affection, positive comments and interactions. The EE index strongly predicts the *course* of schizophrenia (rather than its *cause*).

Australian psychologist David Kavanagh conducted a meta-analysis of 26 research studies on EE and schizophrenia. Kavanagh (1992) found that the median ('average') relapse rate for people with schizophrenia living in a high-EE family environment was 48%, compared with 21% for those living in a low-EE environment. These findings indicate that more than twice as many people suffer relapse in a high-EE environment than in a low-EE environment. However, a

Figure 16.25 People with schizophrenia with high-EE relatives are significantly more likely to relapse than those with low-EE relatives.

limitation of Kavanagh's review is that it was based on studies conducted in Anglo-American families. For example, high-EE is not associated with relapse for Mexican-American families (Lopez & others, 2004). Some psychologists have also expressed concern that the EE explanation of relapse may be used to blame families for schizophrenia, despite the limitations of the research findings and that schizophrenia is far too complex a disorder to attribute to a single causal factor and that its origins appear to lie in the biological, psychological and socio-cultural domains, as well as yet-to-be discovered factors associated with one or more of these domains.

Nonetheless, research evidence suggests that family members' negative behaviour patterns may be a source of stress that can actually increase the chance that psychotic symptoms of schizophrenia will persist or worsen, at least in certain socio-cultural environments. Although dysfunction in families may contribute to schizophrenia, the reverse may also be true. The dysfunctional and bizarre behaviour of a family member with schizophrenia may in itself promote dysfunctional communication and interactions among family members (Kavanagh, 1992).

The role of psychosocial and other stressors in the development and persistence of schizophrenia is commonly explained in terms of the stress-vulnerability model. The *stress-vulnerability model* proposes that (1) vulnerability to schizophrenia is mainly biological; (2) different individuals have differing degrees of vulnerability; (3) vulnerability is influenced partly by genetic influences on development and partly by environmental risk factors; (4) risk factors such as exposure to poor parenting, a high stress environment or inadequate coping skills may help determine whether schizophrenia actually appears, and also influence the course of the disorder and the likelihood of relapse; and (5) protective factors such as good social support and taking medication as prescribed may also influence the course of the disorder and the likelihood of relapse (Royal Australian and New Zealand College of Psychiatrists, 2010).

Learning Activity 16.14

Review questions

1. **a** Explain the meaning of trauma.
   b Give three examples of traumatic events that may contribute to the onset or relapse of psychotic symptoms.
   c Describe the relationship between trauma and schizophrenia.
2. Construct a definition of psycho-social stress.
3. Explain whether trauma may be considered a psycho-social stressor.
4. **a** What is expressed emotion?
   b List key characteristics of low- and high-EE family environments.
   c What is the relationship between high EE and schizophrenia?
   d Give an example of how 'the dysfunctional and bizarre behaviour of a family member with schizophrenia' may in itself promote a high-EE family environment.
   e Is EE a way of operationalising psycho-social stress? Explain your answer.
5. **a** Briefly state the aim of the study conducted by Tienari & other (2004) and how the research was conducted.
   b Briefly state the key results.
   c What do the results suggest about genes and family environment as contributory factors to schizophrenia?
   d What potential implications do the results of this study have with regards to what preventive measures could be taken by parents to reduce the likelihood that their child will develop schizophrenia? Explain your answer.
6. Explain the role of psycho-social stress as a contributory factor to schizophrenia, with reference to the stress-vulnerability model.

Support factors

In addition to the use of medication, cognitive behavioural therapy (CBT) and cognitive remediation in the management of schizophrenia, support may be provided in a number of other ways. We consider how support may be provided through *psychoeducation* (learning about the disorder), *caring social environments* (including the family) and the *removal of social stigma*, which is the top-ranking factor that Australians with a mental disorder say would improve their lives.

Psychoeducation

Psychoeducation is the process of increasing an individual's knowledge and understanding of their mental disorder and its management. It is based on the assumption that increased understanding of symptoms, management options, services available and recovery patterns enables individuals with schizophrenia to cope more effectively with their psychotic symptoms and reduces the likelihood of relapse or rehospitalisation.

Psychoeducation is designed to be part of an overall management plan and often involves family members and other carers of the individual with schizophrenia. Psychoeducation can be implemented in a number of different formats and settings, but it rarely involves classroom-type teaching. The format depends on such factors as the individual's symptoms, their age and their circumstances and needs. Psychoeducation programs can be group-based, family-based, parent-based or individually implemented. Psychoeducation most commonly involves the individual with schizophrenia. Interactive learning such as role-plays and discussion may be used, as may resources such as pamphlets, DVDs and computer-based training programs (Mueser & Jeste, 2008). Common in psychoeducation programs for schizophrenia is education about:

- the nature of the disorder (including information on the disorder and its symptoms; for example, how schizophrenia is diagnosed and biological, psychological and socio-cultural factors that may contribute to its development, persistence and management)
- what having schizophrenia is like for the individual both psychologically and physiologically

Figure 16.26 Psychoeducation may involve a pharmacist explaining the key features of prescribed anti-psychotic medications.

- the stigma attached to the diagnosis
- what it is like for people living with someone who has schizophrenia
- identifying trigger factors
- medication (what it does, how it works, benefits and side effects, when and how often it must be taken, what can happen when it is not taken)
- the role of hospitalisation
- types of psychotherapies that are available and suitable, and the effectiveness and cost
- realistic expectations that may be held about schizophrenia, its course and relapse
- healthy lifestyle
- stress management
- what to do in emergencies
- financial, legal and social support that is available for families, carers and others to aid in caring and catering for the individual's needs.

Research has shown that the more educated a person is about their mental disorder and how it affects their own life and the lives of others, the more control that person has over their disorder and the more likely they are to actively participate in self-management of their disorder and relapse prevention. When used in conjunction with medical treatment and psychotherapy, the benefits of psychoeducation include improved cooperation with treatment (e.g. taking anti-psychotic medication) and therapeutic strategies, an increased awareness of the 'early warning signs' of relapse (i.e. if symptoms are coming back), reduced number of hospital admissions due to psychotic symptoms, improvements in day-to-day functioning and improvements in the understanding of their illness (Fowler, Garety & Kuipers, 2003; Pekkala & Merinder, 2002).

Supportive social environments

Up until the 1960s, people with mental disorders were admitted to a psychiatric hospital for 'the mentally ill' and sometimes remained there for the rest of their lives. Because of changes in the mental health care system, resulting from a better understanding of mental disorders and their management, most people with a serious mental disorder such as schizophrenia now remain in the community with their families. However, in certain circumstances, people with schizophrenia may still need care as an inpatient in a psychiatric hospital. For example, hospitalised care may be preferable during a severe psychotic episode when the person is acutely unwell or cannot be treated effectively while living at home. This is usually for a period of days or weeks only, until symptoms respond to medical treatment (SANE Australia, 2010).

Family

For many people with schizophrenia, their *family* is the primary source of long-term support. Research studies show that recovery is aided if the management strategies for schizophrenia involve collaboration ('teamwork') between the individual with schizophrenia, their family (or partner), their doctor and their mental health professional. Family members can provide ongoing emotional support as well as practical support such as helping ensure that the individual takes medication as prescribed, attends scheduled medical or psychological appointments, has a well-balanced diet and does regular exercise. This is no different to the support provided by a family to a person who has just come out of hospital after an operation for a physical disorder. Following psychoeducation, the family can also provide support by being an immediate source of information to help clarify a diagnosis and aspects of medical treatment, helping with identification of early warning signs or symptoms, keeping records of the effectiveness of medication and accessing community resources. Family members may also play an important role in encouraging and supporting a return to social, academic and vocational activities (Royal Australian and New Zealand College of Psychiatrists, 2010).

SANE Australia (2010) describes a supportive family environment as one in which there is a practical and positive attitude to the person with schizophrenia. The means that the primary caregiver in the family must first come to terms with the fact that someone they care for has a mental disorder and that this is likely to have a serious emotional impact on the family as well as on them. They may feel anger that this has happened in the family, confusion or a sense of loss and grief at how the person has been changed by their illness. It is important to acknowledge and talk about these feelings, seeking professional support if necessary. The primary caregiver and other family members should also learn as much as possible about schizophrenia and its medical treatment and management, and consider what can be reasonably done to support the person. It is also important for the carer to develop a sense of balance between:

- acknowledging the effects of the illness on the person and hopes for recovery
- wanting to do things to help the person but encouraging them to be independent; showing care for the person but not being over-involved
- giving the person time but having time for oneself and other family members too
- encouraging the person to do things but not being unrealistic and demanding.

Social networks

Research evidence indicates that the social support provided by members of a person's social network outside their immediate family is also important in the management of schizophrenia and can reduce the risk of relapse. The term **social network** is used more generally to refer to the various individuals or groups who maintain relationships with an individual in different aspects of their lives. The relationships usually have some kind of significance or importance to the individual, such as those with relatives, close and other friends, neighbours, work colleagues, teachers, acquaintances and so on who may be part of the network. Others who may be important in a person's life, and therefore be part of their social network, are the family doctor, mental health professional, priest, local milkbar owner or hairdresser. Which of these people is important and part of a social network depends on the individual's lifestyle. Finally, another characteristic of a social network is that some people within the network know each other and therefore have some kind of connection with each other, as well as with the individual.

The main benefit of an individual's social network is that it gives access to *social support* (help or assistance) from other people when needed. This may take the form of *appraisal support*, by having access to someone with whom to talk and obtain feedback about how they're feeling; *tangible assistance*, such as help with routine chores at a time when energy and enthusiasm for such tasks is low; *information support*, such as the web address of a social network for people with schizophrenia, the location of a support group in the community, or information about the potential value of these sources of support; and *emotional support*, such as help in coping with problems being experienced or just having someone to spend time with and experience the feeling that someone cares and understands.

Research findings by Christensen and colleagues (1999) suggest that social support may be a predictor of long-term survival among people with schizophrenia. For example, a team of American psychologists examined the medical records of 67 men and 66 women with schizophrenia who had been inpatients at a psychiatric hospital. Two independent raters used the records to assess the quantity and quality of support available in each person's social environment. It was found that the social environment, specifically the level of social support, may impact on the longevity of people with schizophrenia. This finding was based on results that people with schizophrenia who had frequent social interaction lived on average 25% longer than people with schizophrenia who had little or no social interaction. How often people with schizophrenia interacted with support providers or confidants seemed to make a difference in their lives (Christensen & others, 1999).

Learning Activity 16.15

Review questions

1. a What is psychoeducation?
   b List five topics that you believe should be covered in a psychoeducation program for an individual recently diagnosed with schizophrenia.
2. Briefly describe three potential benefits of psychoeducation.
3. a Explain the meaning of 'supportive social environment' in relation to an individual with schizophrenia.
   b Give three examples of how a supportive family environment can help a person with schizophrenia.
   c Give three examples of how a supportive social environment beyond the family environment can help a person with schizophrenia.
4. Suggest a limitation or potential confounding variable for the research findings reported by Christensen and others (1999).

Removal of social stigma

The word 'stigma' is derived from the Latin *stigmat* and was used to refer to a sign that was cut or burnt into the body of a slave, traitor or criminal to publicise that there was something bad or unusual about them and they therefore should be avoided. The contemporary meaning of stigma is based on this original meaning. *Stigma* means a mark or sign of disgrace or discredit, and to *stigmatise* means to regard a person as unworthy or disgraceful. The term 'social stigma' is used to describe the attitudes, beliefs and behaviour towards people who are stigmatised. In relation to mental disorders, **social stigma** refers to negative attitudes and beliefs held in the wider community and society in general that motivate people to fear, reject, avoid and discriminate against people with a mental disorder. Although all types of mental disorder may attract some degree of stigma, schizophrenia is the most stigmatised of all.

Social stigma is often described as having three components: stereotyping, prejudice and

Figure 16.27 An example of information that contributes to social stigma. The cartoonist got the idea for the cartoon from an article he read about the problems that real estate agents have selling property near psychiatric hospitals.

discrimination. *Stereotyping* involves grouping, or 'categorising', people and attributing the same characteristics to all the individuals in that group, regardless of the individual differences among members of that group. A problem with stereotyping is that it can lead to prejudice, which can in turn result in discrimination. *Prejudice* involves holding a negative attitude towards the members of a group, based solely on their membership of that group. *Discrimination* is the behavioural consequence of prejudice and refers to positive or negative behaviour that is directed towards a group and its members. Discrimination based on prejudice often results in the unfavourable treatment of a person, such as being denied educational opportunities, employment, adequate housing, a loan, health insurance or access to a premise, clubs and sports solely because of their history of schizophrenia.

Social stigma against people with schizophrenia primarily occurs because of a misunderstanding of the disorder. For example, people with schizophrenia are inaccurately believed to be violent, unpredictable, incompetent, unintelligent, personally responsible for their illness and not ever going to recover. One explanation for the misunderstanding is that fictional portrayals of people with schizophrenia in movies, on television and in books often depict them as violent and unpredictable.

Social stigma can have profound negative effects on the wellbeing of the individual with schizophrenia and often results in self-stigma. *Self-stigma* occurs when individuals with a mental disorder apply negative stereotypes to themselves; for example, 'I am weak', 'I must have done something to bring this on myself', 'I will always be loony'. Experiencing stigma significantly affects the quality of life of people with schizophrenia by adding unnecessary stress, lowering self-esteem and increasing feelings of hopelessness. People experiencing self-stigma may be so embarrassed or ashamed by their symptoms that they try to conceal them and fail to seek support. This is particularly relevant as it has consistently been found that longer periods of medically untreated psychosis are related to slower recovery rates and reduced chances of full recovery, greater relapse rates and lower levels of social and occupational functioning. By contrast, early diagnosis and treatment leads to improved recovery and a better outcome.

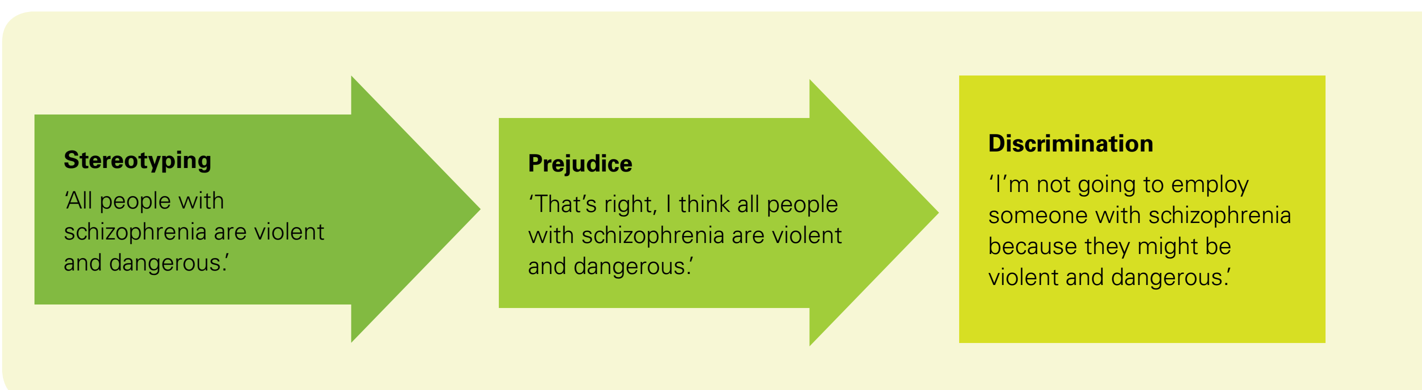


Figure 16.28 The three components of social stigma

Table 16.1 Components of social stigma and self-stigma

Social stigma	Self-stigma
Negative stereotype: Negative belief about a group (e.g. they are dangerous, incompetent or weak)	**Negative stereotype:** Negative belief about the self (e.g. 'I am weak', 'I am incompetent')
Prejudice: Society agrees with the negative belief and has a negative emotional reaction (e.g. anger, fear)	**Prejudice:** Person holds negative belief and has a negative emotional reaction (e.g. low self-esteem, underestimate their capabilities)
Discrimination: Behaviour reflects prejudice (e.g. work, housing opportunities are denied, the person is avoided, or help and support is withheld)	**Discrimination:** Behaviour is a response to prejudice (e.g. the person fails to pursue work and housing opportunities, does not attend therapy sessions or take prescribed medication)

A nationwide Australian study on the mental health and wellbeing of people with a mental disorder provided evidence of the potential consequences of social stigma and self-stigma. It was found that people with psychotic disorders are often victims of violence. For instance, 15.3% of people with a psychotic disorder (17.2% of males and 12.4% of females) did not feel safe in their present neighbourhood. In addition, 17.6% reported having been physically assaulted, beaten, molested or otherwise a victim of violence in the previous 12 months, and 13.2% indicated that they would have liked police or legal help but were unable to get it. It was also found that social isolation is widespread among people with a psychotic disorder. For example, 63.5% of participants were single and 31.3% lived alone, and there were very low rates of involvement in shared household activities. Furthermore, almost 40% reported having no 'best friend' with whom they could share thoughts and feelings, and 44.9% felt in need of 'good friends' (Jablensky & others, 1999).

In an Australia-wide study conducted in October 2000, SANE Australia, a national charity that supports people with a mental disorder, found that people with schizophrenia, families, other carers and mental health workers rated removal of social stigma as the number one factor that would improve the lives of people with schizophrenia. Since stigma involves prejudice, strategies for the removal of social stigma have drawn on research findings and approaches to reducing prejudice. Three strategies that can be used involve *protest*, *education* and increased *interpersonal contact* with people who have schizophrenia. Protest is a reactive strategy, whereas education and interpersonal contact are proactive strategies.

Protest

Protest is a reactive strategy that attempts to change inappropriate stereotypes and negative attitudes by actively and visibly highlighting misrepresentations about schizophrenia (and other mental disorders) whenever they occur. For example, since 1999, SANE Australia has been running an internet-based program called StigmaWatch (see box 16.7). This program monitors print and electronic media, as well as asking members of the public for reports of stigma. Cases of inaccurate or offensive material relating to schizophrenia and other mental disorders are detailed on SANE Australia's website and those responsible are contacted directly and encouraged to engage in more accurate reporting in the future. StigmaWatch also provides positive feedback to the media about accurate and responsible reporting and portrayals of mental disorder.

An example of protest through StigmaWatch involved the movie *Me, Myself and Irene* (2000), starring Jim Carrey. In the movie, Carrey plays a police officer with 'split personalities'. The two 'personalities', called Charlie and Hank, are attributed to his condition of 'schizophrenia with involuntary narcissistic rage'. When 'mild' Charlie forgets to take his medication, he turns into 'aggressive and violent' Hank. Upon the release of the film, SANE Australia was concerned about the inaccurate, offensive and stigmatising portrayal of Carrey's character. SANE protested against the 'from gentle to mental' promotion of the movie, which resulted in the movie's distributor changing their promotion for the home video version in Australia.

Any individual can also protest against social stigma by expressing concern about and discouraging the use of negative language or stereotypes about people with schizophrenia; for example, by giving appropriate feedback to friends, relatives and others who use such terms as 'psycho', 'lunatic', 'nutter' or 'schizo'. Individuals can also contribute to a reduction in social stigma by using first-person language. A phrase such as 'a person with schizophrenia' rather than 'a schizophrenic' emphasises and reinforces that an individual with schizophrenia is person, not a 'thing', and that their disorder is a part but not all of them.

Figure 16.29 The movie *Me, Myself and Irene* (2000) was heavily criticised by SANE Australia for being an inaccurate, offensive and stigmatising portrayal of a person with schizophrenia.

Box 16.7

SANE Australia's StigmaWatch program

With the support of volunteers, the SANE StigmaWatch program monitors the Australian media to ensure accurate and respectful representation of mental illness and suicide.

StigmaWatch voices community feedback about representations within the media that stigmatise mental illness or inadvertently promote self-harm and suicide by explaining the harm stigma causes and encouraging them to report in a more sensitive, responsible manner. Serious cases are taken further and may involve more wide-reaching action, such as public statements or formal complaints to industry bodies.

The StigmaWatch program also provides positive feedback to the media about accurate and responsible portrayals of mental disorders that help increase understanding and awareness, contacting those responsible to pass on positive feedback and highlighting the key role such media coverage plays in battling stigma.

During 2008–09, StigmaWatch received 326 reports of stigma. The most extreme stigmatising media coverage was sensationalised news reporting, often concerning violence, or the inaccurate, misleading and hurtful use of terms such as 'schizophrenic'.

Source: SANE Australia (2010). StigmaWatch, www.sane.org/stigmawatch/stigmawatch.html.

Figure 16.30 SANE Australia is a national charity working for a better life for people affected by mental disorders through campaigns, education and research.

Figure 16.31 Educational material produced by Orygen Youth Health, a mental health service for 15 to 24 year olds in Melbourne, aims to raise awareness of mental health issues facing young people.

Education

Increased community knowledge and understanding of diseases that have historically been stigmatised (e.g. AIDS, epilepsy, syphilis and leprosy) has gradually reduced or removed the social stigma associated with them. As with these diseases, there is similar scope for public attitudinal change towards people with mental disorders such as schizophrenia.

Education attempts to remove social stigma by providing the community with information about mental illnesses that helps people identify inaccurate and negative stereotypes and replace these stereotypes with accurate, factual information. Education can take many forms including books, brochures, lectures, DVDs, audio CDs, posters, curriculum materials for school programs and television commercials. A key aspect of SANE's StigmaWatch program is to educate by providing positive feedback to the media about accurate and responsible portrayals of mental disorders. Research studies have found that members of the general population who are more knowledgeable about mental disorders are less likely to endorse or engage in stigma and discrimination.

Interpersonal contact

Every day we 'rub shoulders' with people who have a mental disorder without knowing it. However, for many in the general population, their only known exposure is to people whom they *perceive* as having a mental disorder—perhaps people who are homeless and not receiving any treatment or support, and are seen talking to themselves or going through rubbish bins. This adds to stigma, as the high visibility of such people not receiving treatment and support means this is the stock image the public has of people with a mental disorder, an image that ties in with irrational views about people who are 'different' or 'unclean' (Carr & Halpin, 2002).

Research studies on public attitudes towards people with a mental disorder have consistently found that previous contact with someone who has a mental disorder is associated with more positive attitudes and reduced stigma. Therefore, another strategy for removing social stigma involves promotion of interpersonal contact with members of the stigmatised group; that is, by encouraging or creating opportunities for face-to-face mutual

Figure 16.32 Schizophrenia Awareness Week, run by the Mental Illness Fellowship of Australia, is an event held in May every year. It provides an opportunity to raise community awareness of schizophrenia, encourage people to learn more and lessen the stigma felt by those diagnosed with it.

interactions between people with limited exposure to mental disorders and people with schizophrenia.

Generally, the more familiar a person is with a mental disorder, such as having a friend or family member with schizophrenia, the more likely it is that the person will be accepting of those individuals and the less likely they are to fear and avoid them. Knowing people who have schizophrenia provides accurate information that most people with this disorder are not dangerous and that they can lead worthwhile lives. The more people get to know others with a mental disorder, the more likely it is that they will correct their negative stereotypes and prejudiced attitudes and, therefore, their negative behaviour. Though not as effective as direct interpersonal contact, programs that use prominent 'speakers' who have a mental disorder in presentations in schools and the wider community also are a means of contact and help break down stereotypes and reduce prejudice and stigmatisation.

Box 16.8

Effects of viewing a documentary about schizophrenia on social stigma

American psychologists David Penn, Cliff Chamberlin and Kim Meuser (2003) conducted an experiment to investigate whether their hypothesis that viewing a documentary that depicts individuals with schizophrenia can reduce stigma. One hundred and sixty-three first-year psychology students at their university participated in the study as part of their course requirements. The sample was 55.8% female and 81.5% Anglo-American. The mean age of participants was 18.85 years.

The participants were randomly assigned to one of four conditions: no documentary film, a documentary about polar bears, a documentary about people with obesity, and a documentary about people with schizophrenia.

The effects of the documentaries were examined on a range of stigma-related variables including whether a person with schizophrenia should be blamed or deemed responsible for their disorder (blame/responsibility) and whether schizophrenia can change over time (changeability). These variables were measured by responses to items in a seven-point Likert scale. The items and scales were blame (1 = not at all to blame to 7 = entirely to blame), responsibility (1 = not at all responsible to 7 = entirely responsible), and changeability (1 = not at all likely to change to 7 = will change). Higher scores reflected higher levels of blame and responsibility, and lower levels of changeability. Figure 16.33 shows the results for the first two stigma-related variables.

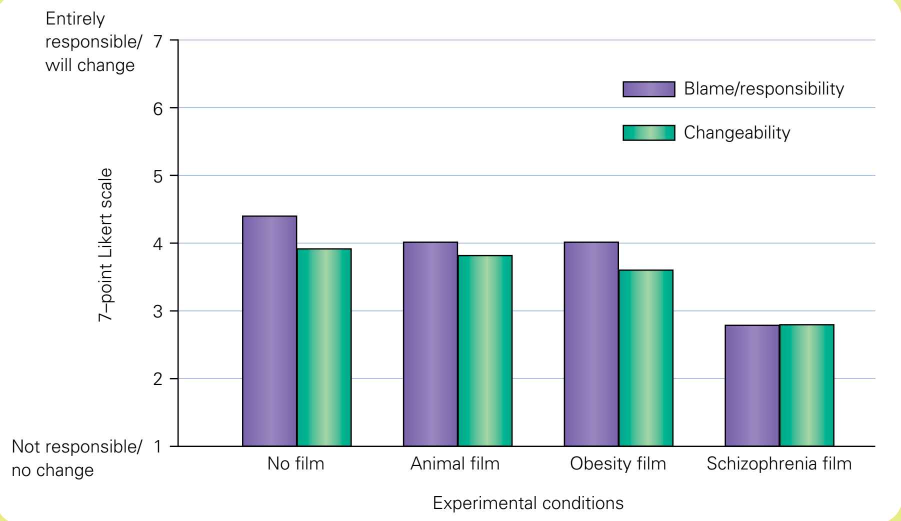


Figure 16.33 Results for two stigma-related variables examined by Penn and others (2003)

The study also examined beliefs about how likely people with schizophrenia are to be a danger to others. In terms of the 'dangerousness' measure, participants who viewed the schizophrenia film generally perceived individuals with schizophrenia as less dangerous than did participants in the other conditions. However, the mean differences were not statistically significant, suggesting that the schizophrenia film was unable to affect general attitudes reflecting social stigma.

Source: Penn, D.L., Chamberlin, C., & Mueser, K.M. (2003). The effects of a documentary film about schizophrenia on psychiatric stigma. *Schizophrenia Bulletin, 29*(2), 383–391.

Learning Activity 16.16

Review questions

1. What is social stigma?
2. In what way does stigmatisation involve stereotyping, prejudice and discrimination? Explain with reference to an example.
3. What are three common negative stereotypes about individuals with schizophrenia?
4. Suggest a reason to explain why schizophrenia is the most stigmatised of all the mental disorders.
5. Explain why individuals with schizophrenia view the removal of stigma as important.
6. Explain why mental health professionals view the removal of stigma as important.
7. Briefly describe three ways social stigma can be reduced or removed, with reference to an example of each.

Learning Activity 16.17

Evaluation of research by Penn, Chamberlin and Mueser (2003)

Prepare a flow-chart summary of the key features of the research study by Penn and others (2003) on whether viewing a documentary film on schizophrenia reduces stigma.

Your flow chart should include:

- the hypothesis expressed operationally
- the participants and how were they selected
- a procedure for randomly assigning participants to different conditions
- the name of the experimental design
- the independent and dependent variables
- the experimental and control conditions
- the results
- the conclusion
- relevant ethical issues
- a potential implication of the results for developing programs to reduce social stigma
- a potential limitation in generalising the results.

Learning Activity 16.18

Media response

Conduct a search of the Australian media or the internet and select an item on schizophrenia that you believe is inaccurate, inappropriate and/or irresponsible and may therefore contribute to social stigma.

Write a report that includes answers to the following, using one or more examples from your chosen media item:

- name of item and source details
- a summary of what the item is about
- a description of how schizophrenia is represented, with references to examples
- other comments that you believe are relevant
- an explanation of how this item may contribute to the development or maintenance of social stigma, with reference to information in this text

Ensure that you include a copy of the item or its source where appropriate (e.g. a weblink).

Learning Activity 16.19

Essay on causes and management of schizophrenia

Write an essay of 550–600 words in which you explain biological, psychological and social factors that may contribute to the development of schizophrenia and may be relevant to its management. References may be used in obtaining information for your essay.

In your essay ensure that you:

- explain what schizophrenia is with reference to key symptoms
- describe a range of relevant biological, psychological and social factors
- discuss how these factors may contribute to the development and management of schizophrenia
- give an example of how different factors may interact
- refer to relevant research findings
- accurately define and explain all key terms
- use appropriate examples to demonstrate your understanding of key terms and ideas
- express your ideas clearly and concisely
- accurately cite and reference all material.

Learning Activity 16.20

Visual presentation on causes and management of schizophrenia

Prepare a visual presentation in which you use a biopsychosocial framework to explain the causes and management of schizophrenia.

You may select from a range of formats to present your information; for example, PowerPoint, a poster, a concept map, a flow chart, or a combination of formats. Photographs and other visual or art media may be used.

In your presentation, ensure that you:

- explain what schizophrenia is with reference to key symptoms
- outline a range of relevant biological, psychological and social factors
- indicate how these factors may contribute to the development and management of schizophrenia, including possible relationships between different factors.

Written information may be in a dot-point format but you should ensure that all relevant information is accurately and adequately explained, using appropriate examples to clarify your understanding of key concepts.

Chapter 16 true/false quiz

Indicate whether each item is true or false by writing 'T' or 'F' in the blank space next to each statement.

1 ______ There are different types of schizophrenia.

2 ______ Schizophrenia is a brain disorder.

3 ______ Schizophrenia is a cognitive disorder rather than a behavioural disorder.

4 ______ Schizophrenia is inherited.

5 ______ Schizophrenia cannot be cured.

6 ______ Schizophrenia can be induced by smoking cannabis.

7 ______ Stigma is a type of prejudice.

8 ______ Hypofrontality involves reduced levels of dopamine in the frontal cortex.

9 ______ Psychotic medications are commonly used in the treatment of schizophrenia.

10 ______ The social drift hypothesis proposes that social disadvantage may cause schizophrenia.

The answers to the true/false questions are in the Answers section on page 823.

Chapter 16 test

Section A—Multiple-choice questions

Choose the response that is **correct** or that **best answers** the question. A correct answer scores 1, an incorrect answer scores 0. Marks will not be deducted for incorrect answers. No marks will be given if more than one answer is completed for any question.

Q1 The period during which the individual may start to experience changes in their thoughts, feelings, perceptions and/or behaviour but has not yet started experiencing clearcut psychotic symptoms is called the ____________ phase.

A preliminary
B prodromal
C preceding
D pre-existing

Q2 If an individual with schizophrenia strongly believes that they are a participant in a 'top-secret' experiment run by 'the government', despite the fact that there is strong evidence that does not support this belief, it is likely that they are experiencing a

A delusion.
B hallucination.
C derailment.
D neologism.

Q3 Jumping to conclusions involves

A impaired memory.
B psychoeducation.
C impaired reasoning.
D cognitive remediation.

Q4 If someone has a genetic predisposition for schizophrenia, it is most likely that they ______________________________ with schizophrenia.

A have the single gene responsible for schizophrenia
B do not have a close biological relative with schizophrenia
C have been adopted by someone with schizophrenia who may also be a biological relative
D have a close biological relative with schizophrenia

Q5 Which of the following symptoms are the most likely to result from drug-induced psychosis?

A delusions and hallucinations
B affective flattening and heightened emotional expression
C excessive dopamine activity and reduced frontal lobe activity
D the apparent existence of two or more distinct identities ('personalities')

Q6 For an individual with schizophrenia, cognitive remediation is likely to

A stop delusions and/or hallucinations.
B reduce distress caused by delusions and/or hallucinations.
C improve attentional, memory and/or problem-solving skills.
D reduce the frequency of examining evidence for and against delusional ideas.

Q7 The dopamine hypothesis proposes that schizophrenia is caused by

A reduced activity of dopamine in the brain.
B excessive activity of dopamine in the brain.
C dopamine agonists reducing dopamine production.
D dopamine antagonists stimulating dopamine production.

Q8 An individual with schizophrenia appears to be acting erratically and is unable to persist long enough to complete activities of daily living such as making toast and getting fully dressed in appropriate clothing. Their behaviour is best described as

A catatonic posturing.
B catatonic behaviour.
C catatonic stupor.
D disorganised.

Q9 Hearing voices that are not real is an example of a

A derailment.
B delusion.
C hallucination.
D neologism.

Q10 Which of the following statements about anti-psychotic medications is correct?

A Anti-psychotics are also called neuroleptics.
B Typical anti-psychotics are the newer medications.
C Typical anti-psychotics have fewer side effects.
D Atypical anti-psychotics often increase the risk of trembling or stiffening of the muscles associated with the side effect called tardive dyskinesia.

The answers to the Chapter 16 multiple-choice questions are in the Answers section on page 823.

Section B—Short-answer questions

Answer all questions in the spaces provided.

Question 1

Explain the meaning of the term psychotic disorder.

1 mark

Question 2

Define schizophrenia.

2 marks

Question 3

Explain the difference between positive and negative symptoms of schizophrenia.

2 marks

Question 4

a Name a socio-cultural risk factor for schizophrenia.

1 mark

b Explain how this factor may contribute to the development of schizophrenia or relapse, with reference to an example.

2 marks

Question 5

In what two ways do the aims of cognitive behavioural therapy differ from those of stress management when used to assist people with schizophrenia?

2 marks

The answers to the Chapter 16 short-answer questions are available at www.OneStopScience.com.au.

Answers

Chapter 1

Learning activity 1.5, qu. 5, on p. 24: IV—interest value of the task/type of text; DV—number of errors detected; Potential confounding variable—task difficulty. As well as being less interesting, the physics text might have been more difficult to spell-check. If so, task difficulty would have been confounded with task interest, making it impossible to determine whether performance differences were caused by task interest or task difficulty.

True/false

1 T, **2** T, **3** F, **4** F, **5** F, **6** T, **7** T, **8** F, **9** T, **10** T

Multiple-choice

1 A, **2** C, **3** D, **4** D, **5** D, **6** A, **7** B, **8** D, **9** A, **10** A, **11** B, **12** B, **13** B, **14** B, **15** C, **16** D, **17** B, **18** C, **19** B, **20** A, **21** A, **22** A, **23** D, **24** B, **25** C

Chapter 2

True/false

1 F, **2** T, **3** T, **4** T, **5** F, **6** T, **7** T, **8** F, **9** F, **10** T

Multiple-choice

1 A, **2** B, **3** C, **4** B, **5** D, **6** B, **7** D, **8** B, **9** B, **10** C, **11** A, **12** A, **13** A, **14** B, **15** C

Chapter 3

True/false

1 F, **2** T, **3** F, **4** T, **5** T, **6** F, **7** F, **8** T, **9** F, **10** F

Multiple-choice

1 B, **2** D, **3** A, **4** A, **5** D, **6** B, **7** C, **8** C, **9** B, **10** A, **11** B, **12** D, **13** C, **14** D, **15** B

Chapter 4

Difference in the photos in figure 4.49 is that the top picture shows a clump of trees to the left of the statue's head.

True/false

1 T, **2** F, **3** F, **4** T, **5** F, **6** F, **7** T, **8** F, **9** T, **10** F

Multiple-choice

1 C, **2** D, **3** B, **4** B, **5** D, **6** B, **7** A, **8** C, **9** A, **10** A, **11** D, **12** D, **13** B, **14** C, **15** B, **16** A, **17** A, **18** C, **19** D, **20** B, **21** A, **22** C, **23** A, **24** C, **25** C

Chapter 5

True/false

1 F, **2** F, **3** T, **4** T, **5** T, **6** F, **7** F, **8** T, **9** T, **10** T

Multiple-choice

1 C, **2** B, **3** D, **4** B, **5** B, **6** D, **7** A, **8** A, **9** C, **10** C

Chapter 6

Learning Activity 6.25 on p. 334:

1 p, **2** j, **3** a, **4** i, **5** g, **6** d, **7** c, **8** b, **9** h, **10** f, **11** l, **12** m, **13** k, **14** o, **15** n, **16** e

True/false

1 T, **2** F, **3** T, **4** T, **5** F, **6** T, **7** F, **8** F, **9** F, **10** F

Multiple-choice

1 B, **2** A, **3** D, **4** D, **5** A, **6** A, **7** C, **8** D, **9** B, **10** C, **11** C, **12** D, **13** C, **14** D, **15** B, **16** C, **17** A, **18** A, **19** B, **20** D

Chapter 7

Learning Activity 7.7 on page 374:

1 instep, **2** Henry Bolte, **3** séance, **4** venison, **5** magenta, **6** tiara, **7** Angel Falls, Venezuela, **8** Jim Morrison, **9** Homebush, **10** ketchup

True/false

1 T, **2** T, **3** F, **4** F, **5** T, **6** T, **7** F, **8** F, **9** F, **10** T

Multiple-choice

1 A, **2** D, **3** B, **4** D, **5** C, **6** B, **7** B, **8** A, **9** C, **10** C

Chapter 8

True/false

1 F, **2** T, **3** T, **4** F, **5** T, **6** F, **7** T, **8** T, **9** F, **10** T

Multiple-choice

1 B, **2** A, **3** D, **4** C, **5** D, **6** B, **7** B, **8** B, **9** A, **10** A

Chapter 9

True/false

1 T, **2** T, **3** F, **4** F, **5** T, **6** F, **7** T, **8** F, **9** F, **10** F

Multiple-choice

1 C, **2** B, **3** A, **4** B, **5** A, **6** D, **7** A, **8** C, **9** B, **10** C, **11** C, **12** B, **13** C, **14** B, **15** A

Chapter 10

Answers to Learning Activity 10.26 on p. 505: **1** h, **2** e, **3** j, **4** m, **5** k, **6** i, **7** l, **8** b, **9** f, **10** n, **11** d, **12** c, **13** g, **14** a

True/false

1 F, **2** F, **3** F, **4** T, **5** T, **6** F, **7** F, **8** F, **9** T, **10** T

Multiple-choice

1 A, **2** C, **3** B, **4** C, **5** D, **6** A, **7** C, **8** C, **9** C, **10** B, **11** A, **12** C, **13** D, **14** A, **15** B, **16** C, **17** B, **18** C, **19** C, **20** D, **21** D, **22** B, **23** B, **24** D, **25** C, **26** D, **27** A, **28** B, **29** A, **30** A

Chapter 11

True/false

1 T, **2** F, **3** F, **4** T, **5** F, **6** F, **7** T, **8** T, **9** F, **10** F

Multiple-choice

1 B, **2** B, **3** A, **4** A, **5** C, **6** D, **7** D, **8** C, **9** C, **10** D

Chapter 12

True/false

1 F, **2** T, **3** F, **4** T, **5** T, **6** F, **7** T, **8** F, **9** T, **10** T

Multiple-choice

1 D, **2** A, **3** B, **4** C, **5** A, **6** C, **7** C, **8** B, **9** D, **10** A, **11** D, **12** C, **13** B, **14** C, **15** D

Chapter 13

True/false

1 T, **2** F, **3** F, **4** T, **5** T, **6** F, **7** F, **8** F, **9** F, **10** T

Multiple-choice

1 B, **2** D, **3** B, **4** D, **5** A, **6** A, **7** D, **8** C, **9** C, **10** A

Chapter 14

True/false

1 T, **2** F, **3** T, **4** F, **5** F, **6** T, **7** F, **8** F, **9** T, **10** F

Multiple-choice

1 B, **2** A, **3** C, **4** D, **5** B, **6** C, **7** D, **8** A, **9** C, **10** A

Chapter 15

True/false

1 T, **2** F, **3** F, **4** F, **5** T, **6** F, **7** F, **8** F, **9** T, **10** F

Multiple-choice

1 B, **2** C, **3** A, **4** D, **5** B, **6** A, **7** D, **8** A, **9** C, **10** D

Chapter 16

True/false

1 T, **2** T, **3** F, **4** F, **5** T, **6** T, **7** T, **8** F, **9** F, **10** F

Multiple-choice

1 B, **2** A, **3** C, **4** D, **5** A, **6** C, **7** B, **8** D, **9** C, **10** A

Glossary

abnormality a pattern of thoughts, feelings or behaviour that is deviant, distressing and dysfunctional

abuse psychological and/or physical maltreatment of a person by another, often to intimidate them and to get them to do what the abuser wants

acquisition in classical conditioning, the process through which an organism learns to associate two events (the conditioned stimulus and the unconditioned stimulus); in operant conditioning, the establishment of a response through reinforcement

acronym a mnemonic device that involves composing a pronounceable word from the first letters of a sequence of words to be remembered

acrostic a mnemonic device that involves making verbal associations for items to be remembered by constructing phrases containing words that begin with the first letters of the information to be remembered

adaptive plasticity changes in the brain's neural structure to enable adjustment to experience, to compensate for lost function and/or to maximise remaining functions in the event of brain damage

addiction a condition in which an individual feels a recurring urge to use a specific type of substance or engage in a certain activity despite potentially harmful consequences

agonist a drug or medication that imitates or stimulates a neurotransmitter's activity

alarm reaction stage the first stage of the general adaptation syndrome in which the body goes into a temporary state of shock, then rebounds (countershock), following initial exposure to a stressor

allostasis the body's ability to maintain a stable physiological environment by adjusting and changing to meet internal and external demands

allostatic load 'wear and tear' on the brain and body due to cumulative exposure to increased secretion and presence of stress hormones over a period of time

altered state of consciousness (ASC) a condition of awareness that is distinctly different from normal waking consciousness in terms of level of awareness and experience, and the quality or intensity of sensations, perceptions, thoughts, feelings and memories

Alzheimer's disease a neurodegenerative disease involving the gradual widespread degeneration of brain neurons, causing increasingly severe memory loss and gradual deterioration of mental abilities, personal skills and behaviour

amnesia loss of memory, either partial or complete, temporary or permanent

amplitude in relation to brain waves, the intensity of brain waves as shown by the size of the peaks and troughs of the brain-wave pattern from a baseline of zero activity

anhedonia the loss of interest in activities that a person would normally engage in, or not feeling any enjoyment in activities previously enjoyed

antagonist a drug or medication that inhibits or blocks a neurotransmitter's activity

anterograde amnesia loss of memory only for information or events occurring after the trauma that causes amnesia

antidepressant medication designed to relieve the symptoms of major depression

anti-psychotic medication a drug designed to relieve the symptoms of a psychotic disorder, such as paranoia, confused thinking, delusions and hallucinations

anxiety a state of physiological arousal associated with feelings of apprehension, worry or uneasiness that something is wrong or that something unpleasant is about to happen

anxiety disorder a mental disorder that is characterised by chronic feelings of anxiety, distress, nervousness and apprehension or fear about the future, with a negative effect

aphasia a term that collectively describes language disorders, but often used more specifically to refer to a language disorder apparent in speech (comprehension or production), writing or reading produced by injury to brain areas specialised for these functions

artificiality in laboratory-based research, the lack of realism and differences to real-life settings

association area an area of the cerebral cortex where information from different brain areas is combined and integrated to perform more complex functions; association areas (also called association cortex) are found in all four lobes of each cerebral hemisphere

association cortex a general term used to describe parts of the cerebral hemispheres other than those that have specialised functions

Atkinson–Shiffrin multi-store model a model that represents memory as consisting of three separate components called the sensory register, the short-term store and the long-term store, and distinguishes between the structural features and control processes of memory

attention a concentration of mental activity that involves focusing on specific stimuli and ignoring other stimuli

attentional bias in relation to phobia, the tendency to selectively attend to threat-related stimuli rather than to neutral stimuli

automatic process when information-processing involves little conscious awareness and mental effort, and minimal attention, and does not interfere with the performance of other activities

automatic thought a habitual way of thinking in response to a specific situation or event

autonomic nervous system (ANS) one of two subdivisions of the peripheral nervous system comprising a network of nerves that connects the central nervous system with the body's internal organs and glands, providing feedback to the brain about their activities; many of its functions are self-regulating; it is further divided into the sympathetic and parasympathetic nervous systems

aversion therapy a form of behaviour therapy that applies classical conditioning processes to inhibit or discourage undesirable behaviour by associating it with an unpleasant stimulus such as a feeling of disgust, pain or nausea

axon the part of a neuron that transmits information from the neuron to other neurons or to the cells in muscles or glands

Baddeley and Hitch's model of working memory a multi-component model of working memory that describes its structure and function in terms of three separate but interacting components called the phonological loop, the visuo-spatial sketchpad and the central executive; a fourth component called the episodic buffer was added later by Baddeley

behaviour any externally expressed action made by a living person (or animal) that can be directly observed

behavioural experiment in CBT, a planned 'hands-on' activity undertaken by a client to test the accuracy of a cognitive distortion

behavioural model in relation to therapy, an approach to understanding and treating or managing a mental disorder that emphasises the role of learning and experience

benzodiazepines a group of drugs that have the effect of 'calming down' the body by reducing physiological arousal and promoting relaxation; commonly referred to as minor tranquillisers

biased sample a research sample in which everyone in the target population does not have an equal chance of being selected

biofeedback information received by an individual about the state of one or more of their physiological responses (functions or processes)

biopsychosocial framework an approach to describing and explaining how biological, psychological and social factors combine and interact to influence an individual's physical and mental health

brain stem an area in the lowest part of the brain where the spinal cord enters the skull

brain trauma any brain damage that impairs the normal functioning of the brain, either temporarily or permanently

brain wave spontaneous electrical activity emitted by the brain; four types of brain waves associated with different states of consciousness or activities are alpha, beta, theta and delta waves

Broca's aphasia a language disorder resulting from damage to Broca's area and involving production of speech that consists of very short sentences comprising mostly verbs and nouns

Broca's area a specialised area of the brain located in the left frontal lobe that coordinates movements of muscles involved in speech production and supplies this information to the appropriate motor cortex areas

carry-over effect the influence that an experimental treatment or task has on performance in a treatment or task that follows it

case study an in-depth investigation of behaviour or event in an individual, a small group or a situation

catatonic behaviour behaviour that may range from extremely agitated behaviour (frenzy-like) to complete immobility and lack of speech (statue-like), or somewhere between these two extremes

categorical approach an approach to classifying mental disorders involving assessment of whether an individual has a disorder on the basis of symptoms and characteristics that are described as typical of the disorder

central executive in Baddeley and Hitch's model, the working component of working memory that controls attention, integrates information and coordinates the flow of information between the working memory system and long-term memory

central nervous system (CNS) a major branch or subdivision of the human nervous system comprising the brain and spinal cord

cerebral cortex the coiled outer layer of the brain's cerebral hemispheres that is involved with information-processing activities such as perception, language, learning, memory, thinking and problem-solving, as well as the planning and control of voluntary bodily movements

cerebral hemispheres the two almost-symmetrical 'halves' of the brain called the left and the right cerebral hemispheres; separated by a groove running from the front to the back of the brain, but connected at several points by the corpus callosum and other smaller nerve strands

change blindness the difficulty observers have in noticing a large change in a visual scene

chunking the grouping of bits of separate information into a larger unit that can be remembered as a single unit

circadian rhythm naturally occurring bodily processes and functions that follow a predictable 24-hour cycle of changes (e.g. the sleep–wake cycle, core body temperature and blood sugar level)

classical conditioning a form of learning based on the repeated association of two (or more) different stimuli; learning is only said to have occurred when a particular stimulus consistently produces a response that it did not previously produce

cognitive behavioural therapy (CBT) a combination of cognitive and behavioural therapies to help people overcome mental health problems and disorders

cognitive bias a tendency to think in a way that involves errors of judgment and faulty decision-making

cognitive model an approach to understanding and treating or managing a phobia that emphasises how the individual processes information about a phobic stimulus and related events, particularly their 'distorted' ways of thinking

cognitive remediation training techniques that promote improvement in targeted cognitive impairments

computerised axial tomography (CAT) a neuroimaging technique that produces a computer-enhanced image of a cross-section of the brain from X-rays taken from different angles that is primarily used to study brain structure; the image is called a computerised tomogram scan (CT scan) or computerised axial tomogram scan (CAT scan)

conclusion a decision or judgment about the meaning of the results of an research investigation

conditioned response (CR) the learned or acquired response to the conditioned stimulus

conditioned stimulus (CS) the stimulus that is neutral at the start of classical conditioning and does not normally produce the unconditioned response but eventually becomes associated with the unconditioned stimulus

conditioning a learning process through which stimuli and responses become associated with one another

confounding variable a variable other than the independent variable that has an unwanted effect on the dependent variable, making it impossible to determine which of the variables produces the change in the dependent variable

consciousness the awareness of objects and events in the external world and of our own existence and mental experiences at any given moment

consolidation theory the proposal that structural changes to neurons in the brain occur after learning takes place as information is encoded from short-term to long-term memory

construct validity the extent to which a characteristic or behaviour relates to that being assessed or investigated

context-dependent cue a cue for memory retrieval based on environmental factors in the specific situation in which a memory was formed

continuous reinforcement when a correct response is reinforced every time it occurs

control condition the condition in an experiment in which the independent variable is absent or the participants are treated differently to those in the experimental group/condition; it is a standard of comparison for the experimental condition

control group the group of participants in an experiment that is not exposed to the independent variable; it provides a standard against which the performance of the experimental group can be compared in order to determine the effects of the independent variable on the dependent variable

control process in the Atkinson–Shiffrin multi-store model, an activity that is consciously performed to assist the memory process, such as attention and maintenance rehearsal

controlled process when information-processing involves conscious alert awareness and mental effort focused on achieving a particular goal

convenience sampling selecting participants who are readily available without any attempt to make the sample representative of a population; also called opportunity sampling

coping in stress management, the process of constantly changing cognitive and behavioural efforts to manage specific internal and/or external stressors that are appraised as taxing or exceeding the resources of the person

corpus callosum a band of nerve tissue that connects the left and right cerebral hemispheres enabling the exchange of information and coordination of their activities

correlation a statistical measure that indicates the extent to which variables of research interest are co-related

correlation coefficient a decimal number, ranging from +1.00 to −1.00, that indicates the strength and the direction (positive or negative) of a correlation

cortical lobes four anatomical areas of the brain, or divisions of each cerebral hemisphere, called the frontal, parietal, occipital and temporal lobes; each lobe is associated with different sensory and motor functions and more complex mental functions

counterbalancing arranging the order that the conditions of a repeated-measures experiment are experienced by participants so that each condition occurs equally often in each position; commonly used to control order effects

Craik and Lockhart's levels of processing framework a conceptual description of memory that emphasises that the depth at which information is processed during learning determines how well it is stored; levels of processing range from very shallow to very deep

cued recall reproducing information from memory by using a prompt to assist retrieval

daily hassle a relatively minor event arising out of day-to-day living, such as the everyday concerns of work or school, that may be a stressor

data the information collected when conducting research; see also qualitative data and quantitative data

daydreaming an altered state of consciousness in which attention shifts from external stimuli to internal thoughts, feelings and imagined scenarios

decay theory (of forgetting) an explanation of forgetting based on the assumption that when something new is learned, a memory trace or neural imprint of the experience that contains the stored information is formed in the brain; the trace gradually fades over time through disuse unless it is reactivated by being used

declarative memory the long-term memory system for specific facts and events that can be brought consciously to mind and explicitly 'declared'; its two sub-types are called episodic memory and semantic memory

defence mechanism the process of protecting against anxiety associated with unresolved conflicts by denying, falsifying or distorting reality at an unconscious level

delusion a fixed, false belief that is held with absolute certainty, even when there is strong factual evidence that does not support it

demand characteristic a cue expressed by the researcher or that is present in a research study that communicates the type of response and behaviour expected from participants

dementia a general term for a variety of symptoms of a large group of illnesses or neurodegenerative diseases that cause a progressive decline in mental functioning

dendrite thin extension of a neuron that looks like a 'branch' and is specialised to receive information from other neurons

denial a defence mechanism for protecting against anxiety that involves refusing to recognise or accept that something has occurred or is currently occurring

dependent variable (DV) a variable in an experiment that is observed or measured and is expected to change as a result of the manipulation of the independent variable (essentially, the participant's response)

depression a mood disorder characterised by intense sadness, feeling 'down' and worthless, and difficulties in functioning effectively in everyday life for a period of two weeks or more

descriptive statistics statistics used to analyse, organise, summarise and describe important features of data so that they can be more easily interpreted and communicated

developmental plasticity changes in the brain's neural structure in response to experience during its growth and development

***Diagnostic and Statistical Manual of Mental Disorders* (DSM)** a categorical system for diagnosing and classifying mental disorders based on recognisable symptoms that are precisely described for each disorder; 365 mental disorders are grouped into 16 major categories and diagnosis involves identifying the disorder(s) that best matches or reflects the symptoms presented by an individual

dimension a cluster of related psychological and/or behavioural characteristics that tend to occur together and can be measured

dimensional approach an approach to classifying mental disorders that quantifies a person's symptoms or other characteristics of interest and represents them with numerical values on one or more scales or continuums, rather than assigning them to a mental disorder category

direct brain stimulation a technique for brain research using a device that emits a weak electric current to activate or inhibit the normal activity of neurons in a specific brain area

disease identifiable physiological changes associated with an abnormal bodily condition

displacement a defence mechanism for protecting against anxiety that involves directing feelings away from the object or person causing them to a substitute object or person that is less threatening

dopamine a neurotransmitter believed to be involved in pleasure, motivation, emotional arousal and the control of voluntary movements

dopamine hypothesis an explanation of the cause of the positive symptoms of schizophrenia in terms of the excessive activity of the neurotransmitter dopamine in the brain

dopamine reward system a neural pathway in the brain that delivers rewards, or 'pleasurable experiences', when stimulated; located in the medial forebrain bundle

double-blind procedure a procedure in an experiment to ensure that the participants and the researcher directly involved with the participants are unaware of the conditions to which the participants have been allocated

drug-induced psychosis the experience of psychotic symptoms such as delusions and hallucinations due to the direct physiological effects of a drug

echoic memory auditory sensory memory that stores sounds in their original sensory form for up to three or four seconds

elaborative rehearsal the process of linking new information in a meaningful way with information already stored in memory or with other new information to aid its storage and retrieval from long-term memory

electroencephalograph (EEG) a device that detects, amplifies and records electrical activity of the brain

electromyograph (EMG) a device that detects, amplifies and records the electrical activity of muscles

electro-oculargraph (EOG) a device that measures eye movements or eye positions by detecting, amplifying and recording electrical activity in eye muscles that control eye movements

emotion-focused coping strategies to attend to emotional responses to a specific stressor

encoding the process of converting information into a useable form that can be stored and represented in memory

episodic buffer a component of Baddeley and Hitch's model of working memory (added in 2000) that enables all its components to interact with long-term memory

episodic memory a declarative long-term memory system that stores information about specific events or personal experiences

ethics standards that guide individuals to identify good, desirable or acceptable conduct

eustress a positive psychological response to a stressor, as indicated by the presence of positive states such as feeling enthusiastic, excited, active and alert

experiment a research method used to test a hypothesis under controlled conditions in order to measure the effects of an independent variable(s) on a dependent variable(s)

experimental condition the condition in an experiment in which the independent variable is present; may also be used to refer collectively to all the conditions of the experiment

experimental group the group of participants in an experiment that is exposed to the independent variable

experimenter effect the change in a participant's response because of the researcher's expectations, biases or actions, rather than the effect of the independent variable

expressed emotion (EE) a negative communication pattern that is observed among some relatives of individuals with schizophrenia

external validity how well research findings can be generalised or applied beyond the specific participants and settings used in a study

extinction the gradual decrease in the strength or rate of a response; in classical conditioning, extinction occurs over time when the unconditioned stimulus is not presented; in operant conditioning, extinction occurs over time when reinforcement ceases

extraneous variable any variable other than the independent variable that can cause a change in the dependent variable and therefore affect the results of the experiment in an unwanted way

fear hierarchy a list of feared objects or situations, ranked from least to most anxiety-producing

fight–flight response an involuntary reaction of the sympathetic nervous system that results in a state of physiological readiness to deal with a sudden and immediate threat by either confronting it (fight) or running away (flight)

fixed-action pattern an inborn predisposition to behave in a certain way when appropriately stimulated; typically involves a set (fixed) sequence of responses

fixed-interval schedule a schedule of reinforcement for which a correct response is reinforced after a set period of time has elapsed since the previous reinforcer

fixed-ratio schedule a schedule of reinforcement for which a correct response is reinforced after a set number of correct responses

flooding a type of exposure therapy that involves bringing an individual into direct contact with an anxiety- or fear-producing stimulus and keeping them in contact with it until the conditioned response is extinguished

forgetting the inability to retrieve previously stored information

forgetting curve a graph showing a characteristic pattern (rate and amount) of forgetting that occurs over time for a wide variety of materials under different conditions

free recall reproducing information from memory in any order, without the assistance of cues

frequency in relation to brain waves, the number of brain waves per second

frontal lobe the largest of the four lobes in each cerebral hemisphere, which occupies the upper forward half of each hemisphere and is involved in higher mental abilities

functional magnetic resonance imaging (*f*MRI) a neuroimaging technique that provides computer-generated images of the 'working' brain (function) by detecting changes in oxygen levels in the blood flowing through the brain; based on standard MRI

functional neuroimaging a brain-scanning technique that captures images of the brain 'at work' (as well as brain structure)

galvanic skin response (GSR) a physiological response that indicates the change in the resistance of the skin to an electrical current (electrical conductivity of the skin)

gambler's fallacy the belief that in a series of independent chance events, future events can be predicted from past ones

gamma-amino butyric acid (GABA) the primary inhibitory neurotransmitter in the central nervous system that works throughout the brain to inhibit the activity of postsynaptic neurons

general adaptation syndrome (GAS) the total mobilisation of an organism's resources and defence systems in response to stress; consists of three stages: alarm reaction, resistance and exhaustion

generalisation a decision or judgment about how widely the findings of a study can be applied

genetic predisposition an inherited tendency (or increased risk) for developing a particular physical or psychological characteristic or pattern of characteristics

graduated exposure a therapeutic technique used in the treatment of disorders involving fear and anxiety during which an individual is gradually exposed to increasingly similar stimuli that produce the conditioned response and ultimately to the conditioned stimulus itself

grossly disorganised behaviour behaviour that appears to be fragmented, inappropriate, unusual, unpredictable, purposeless and erratic

habituation a simple form of learning in which an organism learns not to respond to an event that occurs repeatedly

hallucination a perceptual distortion of sensory information during which the individual sees, hears, feels, tastes or smells something that is interpreted as real but does not exist in reality

health a state of complete physical, mental and social wellbeing and not merely the absence of illness or disease

hemispheric specialisation the specialisation and dominance of certain functions of the left and right cerebral hemispheres

hippocampus a tubular curved structure in the lower region of the temporal lobe of each hemisphere; believed to play an important role in memory

HPA axis chain of reactions in the physiological response to stress involving the hypothalamus, pituitary gland and the adrenal glands

hypothesis in research, a tentative and testable prediction of the relationship between two or more events or characteristics; see also operational hypothesis

iconic memory visual sensory memory that stores visual images in their original sensory form for between 0.2 and 0.4 seconds

illness a person's subjective experience of feeling unwell in relation to one or more aspects of their physical or psychological health

illusion of control the mistaken belief that the outcomes of random unpredictable events can be influenced by one's thoughts or actions

imaginal desensitisation in the treatment of problem gambling, a variation of systematic desensitisation in which the individual visualises images of gambling opportunities while they are in a state of relaxation, so that they learn to associate feelings of relaxation with gambling rather than tension and arousal

imaginal exposure exposure to a fear- and/or anxiety-producing stimulus when using visual imagery

impulse control the psychological effort made to resist an urge, drive or temptation to do something

inattentional blindness a failure to notice something in a scene when the same scene continually remains in sight and there is no reliance on memory

independent-groups design an experimental research design in which each participant is randomly allocated to one of two or more entirely separate (independent) groups; also called between-participants design or between-subjects design

independent variable (IV) the variable in an experiment that is systematically changed or varied by the experimenter in order to measure its effect on the dependent variable

individual participant differences the differences in personal characteristics and experiences of the individual participants in an experiment; also called participant variables

inferential statistics mathematical procedures used to judge whether the results for a sample would also occur in the population from which the sample was drawn; also used to estimate how likely it is that the results for a study occurred by chance

insight learning a form of learning involving a period of mental manipulation of information associated with a problem, prior to the sudden realisation of a solution

instrumental learning a term used by Thorndike to refer to the process through which an organism learns the association between behaviour and its consequences; also called operant conditioning

interference theory an explanation that proposes that forgetting in long-term memory occurs because other memories interfere with retrieval of what you are trying to recall, particularly if the other memories are similar to the one you are trying to remember

internal consistency the interrelatedness of items in a psychological test for measuring the same ability or trait

internal validity the soundness of the research design and procedures used to conduct the study

***International Classification of Diseases and Related Health Problems* (ICD)** a categorical system for diagnosing and classifying diseases and mental disorders based on recognisable symptoms described for each disease and disorder; 21 chapters cover all physical and mental conditions and disorders, with chapter V covering mental and behavioural disorders

interneuron a neuron that transmits information within the CNS and interconnects messages from sensory and motor neurons

interpretive bias in relation to a phobia, the tendency to interpret or judge ambiguous stimuli and situations in a threatening manner

interview a data-collection procedure used to obtain self-report information on a research topic

in vivo exposure actual exposure to a fear- and/or anxiety-producing stimulus in real life

jumping to conclusions making hasty judgments or decisions on the basis of inadequate or ambiguous information, typically resulting in unjustifiable or incorrect conclusions

Korsakoff's syndrome a neurodegenerative disease involving severe memory disorders associated with damage to brain structures and areas involved with memory; occurs mainly in individuals who are long-term alcoholics

latent learning a form of learning that occurs without any direct reinforcement but remains unexpressed, or hidden, until it is needed

law of effect behaviour followed by a pleasant consequence is strengthened (more likely to occur again) and behaviour that is followed by an unpleasant consequence is weakened (less likely to occur again)

leading question a question that is phrased in such a way as to suggest what answer is desired or to lead to the desired answer

learned helplessness a learned feeling or belief by an individual that they are helpless and unable to have any effect on events in their lives, so they give up trying

learning a relatively permanent change in behaviour that occurs as a result of experience

learning curve a graph that indicates how learning usually progresses when something new is learnt for the first time

long-term memory (LTM) the relatively permanent memory system that holds vast amounts of information for a long period of time

long-term potentiation (LTP) the strengthening of the synaptic connections of neurons, resulting in the enhanced or more effective functioning of the neurons whenever activated

magnetic resonance imaging (MRI) a neuroimaging technique that uses magnetic fields and radio waves to vibrate atoms in the brain's neurons to produce a detailed image of the brain (or body)

maintenance rehearsal repetition of information so that it can be kept in short-term (or working) memory for longer than the usual maximum of about 18 seconds

major depression a mood disorder characterised by one or more major depressive episodes involving symptoms such as intense sadness, loss of interest in everyday activities and a range of 'negative' thoughts, feelings and behaviours

major depressive episode according to the DSM-IV-TR, experiencing at least five of a possible nine symptoms associated with major depression

matched-participants design an experimental research design in which pairs of participants who are very similar in a characteristic(s) that can influence the dependent variable are selected and then allocated to a different group (the experimental or the control group); also called matched-subjects or matched-groups design

maturation a developmental process leading towards maturity of an organism, based on the orderly sequence of changes that occur in the nervous system and other bodily structures under the control of the genes

mean a score that is the arithmetical average of all the individual scores (or measures) in a set of scores

measure of central tendency a score that indicates the central or average value in a set of scores

measure of retention a method of measuring the amount of information retained in memory; three measures are recall, recognition and relearning

medial forebrain bundle a neural pathway in the brain (commonly referred to as the dopamine reward system) that ascends from the midbrain through the hypothalamus into the nucleus accumbens; when stimulated, neurons in this pathway activate the release of dopamine, producing pleasurable experiences

medial temporal lobe the inner surface area towards the middle of the temporal lobe that includes the hippocampus, the amygdala and other cortical tissue

median the middle score (or midpoint) of a set of scores

meditation the intentional attempt to bring about a deeply relaxed state

memory storage and retrieval of information acquired through learning

memory bias in relation to a phobia, when recall or recognition is better for negative or threatening information than for positive or neutral information

mental health the capacity of an individual to interact with others and the environment in ways that promote subjective wellbeing, optimal development throughout the lifespan and effective use of their cognitive, emotional and social abilities

mental illness a psychological dysfunction that usually involves impairment in the ability to cope with everyday life, distress, and thoughts, feelings and/or behaviour that are atypical of the person and may also be inappropriate within their culture; also called mental disorder

mental processes personal (subjective) thoughts, feelings and ways of thinking and feeling that cannot be directly observed

method of loci a mnemonic device that uses a well-learned sequence of locations as a series of cues for the information to be remembered

microsleep a very short period of drowsiness or sleeping that occurs while a person appears to be awake

mnemonic device a technique for enhancing or improving memory

mode the most frequently occurring score in a set of scores

monoamine hypothesis an explanation of major depression in terms of depleted levels in the brain of the neurotransmitters serotonin and noradrenaline (classified as monoamines)

mood a mental state or overall feeling that colours our perception of the world and influences how we go about daily life

mood disorder a mental disorder that is characterised by a severe persistent disturbance in a person's mood that causes psychological discomfort or impairs the ability to function, or both

motion after-effect the perceptual illusion of movement of a physically stationary visual stimulus following exposure to visual motion; the stationary stimulus appears to move in the opposite direction to the original (physically moving) stimulus

motivated forgetting when forgetting in long-term memory arises from a strong motive or desire to forget, usually because the experience is too disturbing or upsetting to remember

motor area an area in each of the frontal lobes that is involved in the planning and control of voluntary bodily movements; also called motor cortex

motor neuron a specialised neuron that carries messages away from the central nervous system towards the muscles, organs and glands, thereby enabling bodily movements, and activating internal organs and glandular secretions

narrative chaining a mnemonic device that involves connecting otherwise unrelated items to one another in a meaningful story or narrative

naturalistic observation an observational study in which a researcher views a naturally occurring behaviour in an inconspicuous manner so that their presence (or procedures) does not influence the behaviour being observed

negative punishment the removal of a stimulus (consequence) thereby decreasing the likelihood of a response occurring again

negative reinforcement the removal or avoidance of an unpleasant stimulus; because the outcome is a pleasant one, the behaviour that removes or avoids the unpleasant stimulus is strengthened or more likely to occur again

negative reinforcer any unpleasant or aversive stimulus that, when removed or avoided, strengthens or increases the frequency or likelihood of a response occurring again

negative symptoms a category of symptoms associated with schizophrenia involving the loss or absence of normal thought processes, emotions and behaviours typically experienced by mentally healthy individuals

neural impulse a combination of electrical and chemical energy that contains the neural information that travels within the neuron, along the axon; also called action potential

neurodegenerative disease a disease characterised by a progressive decline in the structure, activity and function of brain tissue

neuroimaging a brain-scanning technique that captures detailed images of the brain

neuron a nerve cell specialised to receive, process and/or transmit information to other cells in the body; the three types are sensory neurons, interneurons and motor neurons

neurotransmitter a chemical substance made by neurons that transmits messages across the synaptic gap between the axon ending of one neuron and the dendrite of another; enables communication between neurons

non-participant observation when a researcher does not participate in or tries to conceal their presence during an observational study

non-standardised when research procedures or instructions are not the same for all participants (except for exposure to the independent variable by participants in the experimental group)

noradrenaline a neurotransmitter believed to be involved in attention, alertness, states of arousal and the stress response; also called norepinephrine

normal waking consciousness state of consciousness associated with being awake and aware of one's thoughts, memories, feelings and sensations from the outside world

normality a pattern of thoughts, feelings or behaviour that conforms to a usual, typical or expected standard within a cultural context

NREM sleep non-rapid-eye-movement sleep; has four stages that constitute about 80% of our sleep and can each be distinguished by characteristic brain-wave patterns

objectivity when personal factors are prevented from influencing any aspect of research (or its reporting) so that an investigation and results are free of bias

observation any means by which a phenomenon (an observable event) is studied, including data that represent the phenomenon, such as spoken or written responses, test scores and brain-wave recordings

observational learning when someone uses observation of another person's actions and their consequences to guide their future actions; also called modelling

observational study a research method involving collection of data by carefully watching and recording behaviour as it occurs

occipital lobe one of the four lobes in each cerebral hemisphere of the brain; primarily involved in vision

Oedipal complex a developmental conflict involving the unconscious powerful, passionate love and desire that a child has developed toward their parent of the opposite sex

one-trial learning a form of learning involving a relatively permanent change in behaviour that occurs with only one experience

operant a response (or set of responses) that occurs in the absence of any stimulus and acts on the environment to produce some kind of effect

operant conditioning a form of learning for which the likelihood of a particular response occurring is determined by the consequences of that response; a response that has a desirable consequence will tend to be repeated and a response that has an undesirable consequence will tend not to be repeated

operational definition when what is being studied is defined in terms of the procedures (operations) used to measure it; defining what will be measured by describing how it will be measured

operational hypothesis a research hypothesis that states how the variables being studied will be observed, manipulated and measured; also refers to the population from which the sample has been selected

order effect when performance in an investigation is influenced by the specific order in which the conditions, treatments or tasks are presented to or experienced by participants

***p* value** a probability value that shows the statistical level at which chance is likely to have operated on the results obtained from research

parasympathetic nervous system a division of the autonomic nervous system that keeps the systems of the body functioning efficiently and also restores the body to a state of calm by reversing the direction of the bodily changes activated by the sympathetic nervous system

parietal lobe one of the four lobes in each cerebral hemisphere of the brain; receives and processes sensory information from the body and other sensory areas in the brain; also involved in spatial perception and memory

partial reinforcement when a correct response is reinforced only some of the time

participant observation when a researcher participates in an observational study and attempts to be mistaken by the participants as being part of the group or situation being observed

participants people selected to take part in a research study; also called subjects

pathological gambling disorder persistent and recurrent gambling that disrupts personal, family and/or work-related relationships and activities

peg-word method a mnemonic device that involves memorising a rhyme that includes mental pegs on which you 'hang' the material to be remembered

perception the mental process of organising and interpreting information from the senses into meaningful objects and events

perceptual anomaly an irregularity in perception, usually involving an inconsistency between the perceptual experience and physical reality

peripheral nervous system (PNS) all parts of the nervous system that lie outside the central nervous system; links the central nervous system to all other parts of the body

phobia an anxiety disorder involving excessive or unreasonable fear of a particular object, situation or event that causes significant distress or interferes with everyday functioning

phonological loop a component of Baddeley and Hitch's model of working memory that stores a limited number of speech-like sounds for a short period of time

physical exercise physical activity that is usually planned and performed to improve or maintain one's physical condition

physical health the body's ability to function efficiently and effectively in work and leisure activities, to be in good condition, to resist disease and to cope in threatening or emergency situations

physical illness an individual's subjective experience of a physical health problem that interferes with the normal functioning of their body and adversely impacts on their ability to function effectively in everyday life

placebo a fake treatment

placebo effect when a participant's response is changed by their belief that they are receiving some kind of experimental treatment

plasticity the ability of the brain's neural structure or function to be changed by experience

polysomnography an intensive study of a sleeping person involving simultaneous monitoring and recording of various physiological responses during sleep

population the larger group from which a sample is drawn for a research study

positive punishment the presentation of an unpleasant stimulus (consequence) that decreases the likelihood of a response occurring again

positive reinforcement the presentation of a pleasant stimulus (consequence) following a desired response, thereby strengthening a response or making it more likely to occur again

positive reinforcer a stimulus that strengthens or increases the frequency or likelihood of a desired response by providing a satisfying consequence (reward)

positive symptoms a category of symptoms associated with schizophrenia involving experiences in addition to those of individuals without schizophrenia

positron emission tomography (PET) a neuroimaging technique that provides computer-generated images of the 'working' brain (function) by tracking blood flow (through glucose use by active neurons); also provides images of structure

postsynaptic neuron the neuron that receives neurotransmitter

poverty an enforced lack of socially perceived necessities

presynaptic neuron the neuron that releases neurotransmitter

primacy effect the serial position effect of superior recall for items at the beginning of a list

primary appraisal in the transactional model of stress and coping, an evaluation of the significance of a potential stressor resulting in a decision that it is either irrelevant, benign–positive or stressful

primary auditory cortex an area in each temporal lobe that receives and processes sounds from the ears

primary motor cortex a strip of neural tissue at the rear of the frontal lobe of each cerebral hemisphere that is specifically involved in controlling voluntary bodily movements through its control of skeletal muscles

primary somatosensory cortex a strip of neural tissue in the parietal lobe of each cerebral hemisphere that receives and processes information from the skin and body, enabling perception of bodily sensations, including touch, pressure and temperature, and information about muscle movement and the position of limbs

primary visual cortex neural tissue in the occipital lobe that receives and processes visual information from the eyes

proactive interference when information learned previously interferes with the ability to remember new information

probabilistic reasoning making judgments related to the likelihood of something happening or being true

problem gambling gambling that is characterised by difficulties in limiting money and/or time spent on gambling, which leads to adverse consequences for the gambler, for others or for the community

problem-focused coping a strategy to manage or change a stressor

procedural memory the long-term memory of skills and thought processes for how to do something; also called implicit memory

prodromal phase a period of time during which an individual experiences early symptoms and signs of a disease or disorder that precede its onset in a fully developed form

psycho-social stressor any event arising in relation to everyday-life interactions with others that cause or contribute to a stress response

psychodynamic model in relation to therapy, an approach to understanding and treating or managing a mental disorder that emphasises the role of unresolved psychological conflicts occurring at an unconscious level

psychodynamic psychotherapy a type of psychological treatment that aims to help a person understand the roots of their emotional distress by exploring unresolved unconscious conflicts, motives, needs and defences

psychoeducation the process of increasing an individual's knowledge and understanding of their mental disorder and its management

psychological construct a concept used to describe specific psychological activity or a pattern of activity that is believed to occur or exist but cannot be directly observed or measured

psychological dysfunction a breakdown in cognitive, emotional and/or behavioural functioning, thereby interfering with an individual's ability to adjust to the challenges of everyday life and carry out some or all of their usual daily activities in an effective way

psychology the scientific study of mental processes and behaviour in humans

psychosis a mental disorder involving loss of contact with reality

psychotic a term used to describe someone who is experiencing many symptoms of a psychotic disorder

psychotic disorder a mental disorder characterised by difficulties with thinking, distorted perceptions and a loss of contact with reality

punishment a negative consequence (an unpleasant event or taking away something that is pleasant) following a response, which decreases the likelihood of that response occurring again over time

qualitative data information about the qualities or characteristics of what is being studied

quantitative data information about the quantities or amounts of what is being studied

questionnaire a set of written questions designed to draw out self-report information from participants on a research topic

random allocation a procedure for assigning participants to the various groups in an experiment that ensures that each person has an equal chance of being selected for any of the groups and that different groups are equivalent in important characteristics of participants

random-ratio schedule a schedule of reinforcement in which a reinforcer is given after a random number of responses and each response has an equal chance of reinforcement

random sampling a procedure for selecting a group of participants from the population of research interest that ensures each member of the targeted population has an equal chance of being chosen to be part of the sample

reappraisal in the transactional model of stress and coping, a re-evaluation of a potential stressor in relation to coping resources

reasoning goal-directed thinking in which inferences are made or conclusions are drawn from known or assumed facts or pieces of information

recall a measure of memory that involves reproducing information that has been stored in memory with few cues to assist retrieval

recency effect the serial position effect of superior recall for items at the end of a list

reciprocal model in relation to major depression, combination of the stress exposure and stress generation models that proposes a two-way relationship between stress and depressive symptoms

recovery group a not-for-profit support group run by and for people who interact on the basis of common interests or experiences (e.g. of a mental disorder) to support one another

reflex an automatic, or involuntary, response to a stimulus that is essentially the same each time it occurs

rehearsal the process of actively manipulating information so that it can be retained in memory

reinforcement any stimulus that strengthens or increases the frequency or likelihood of a response that it follows

reinforcer any stimulus that provides reinforcement; often used interchangeably with reward

relapse the recurrence of symptoms or behaviour after a period of improvement, recovery, absence or abstinence

relaxation any activity that brings about a state of reduced psychological and/or physiological tension

relearning a measure of memory based on learning information again that has been previously learned and stored in LTM

reliability in research, the consistency, dependability and stability of results obtained from the study

REM rebound following a period of lost REM sleep, spending more time than usual in REM sleep when next asleep

REM sleep rapid-eye-movement sleep during which the eyeballs rapidly move beneath closed eyelids; constitutes about 20% of our sleep and is the period in which most dreaming occurs

repeated-measures design an experimental research design that uses the same participants in both the experimental and control groups (or conditions); also called within-participants or within-subjects design

repetitive TMS (rTMS) a direct brain-stimulation technique using the transcranial magnetic stimulation procedure for repeated delivery of a magnetic pulse; see transcranial magnetic stimulation

reporting conventions well-established and widely recognised standards about how a report is written and presented

repression an unconscious process (defence mechanism) through which an individual blocks a memory of an event or experience from entering conscious awareness because of the anxiety associated with recall; said to be a type of motivated forgetting

research hypothesis the hypothesis used in research; see hypothesis

research method a technique used to systematically collect information on a topic of research interest

response a reaction by an organism to a stimulus

response cost when any stimulus valued by an organism is removed, whether or not it causes a response

restorative theory an explanation of the purpose of sleep that proposes that sleep provides 'time out' to recover from and repair the wear and tear on the body caused during waking time

reticular activating system (RAS) a network of neurons that extends in many directions from the reticular formation to different parts of the brain and to the spinal cord; involved in maintaining and regulating cortical arousal

reticular formation part of the reticular activating system in the brain that runs through the centre of the brainstem and upward through the midbrain to the forebrain; involved in sleep and arousal

retrieval the process of locating and recovering stored information from memory so that we are consciously aware of it

retrieval cue a stimulus that assists the process of locating and retrieving information stored in memory

retrieval failure theory an explanation of forgetting due to the lack of or failure to use the right cue to retrieve information stored in memory; the information is not lost forever but it simply cannot be retrieved at that moment

retroactive interference when new information interferes with the ability to remember old information

retrograde amnesia loss of memory only for information or events occurring before the trauma that caused the amnesia

rhyme a phrase or string or words, often with emphasis on similar-sounding words; may be used as mnemonic device

rumination repeatedly thinking about or dwelling on undesirable thoughts and feelings, such as problems or moods, without acting to change them

sample a group that is a subset or portion of a larger group chosen to be studied for research purposes

sampling the process of selecting participants for a research study; see also random sampling, stratified sampling, stratified-random sampling

schedule of reinforcement the frequency and manner in which a correct response is reinforced

schizophrenia a psychotic disorder characterised by disturbances of thinking, delusions, hallucinations and disorganised behaviour

secondary appraisal in the transactional model of stress and coping, an evaluation of internal and external coping options and resources for dealing with a stressor

selective serotonin re-uptake inhibitors (SSRIs) a class of anti-depressant medications, containing serotonin only; SSRIs block the re-uptake of serotonin into the presynaptic neuron, thereby increasing the action of the serotonin on the postsynaptic neuron

self-reference effect a form of elaborative rehearsal in which new information to be remembered is linked to personal experiences and situations to enhance encoding and aid retention

self-report a participant's written or spoken responses to questions, statements or instructions presented by the researcher; see questionnaire and interview

semantic memory a declarative (explicit) long-term memory system that stores information about the world

semantic network theory a description of the organisation of information in long-term memory in terms of overlapping networks (grids) of interconnected concepts (nodes); activating one node during retrieval increases the likelihood that associated nodes become activated

sensitive period a specific period of time in development when an organism is more responsive to certain environmental stimuli or experiences; also called critical period

sensory area a part of the cerebral cortex that has a specialised sensory function; different sensory areas are located in different lobes (e.g. the primary visual cortex is located in the occipital lobe)

sensory memory the entry point of memory in which the stimuli that bombard the senses are retained in their original sensory form for a very brief time

sensory neuron a specialised nerve cell that detects and sends messages from sense organs and sense receptor sites to higher brain centres via the spinal cord

serial position effect a research finding that the free recall of items in a list is best for items at the end of the list, then the beginning, and worst for items in the middle of the list

serotonin a neurotransmitter believed to be involved in a wide range of psychological activity; low levels are associated with sad and anxious moods, hunger, food cravings and disruptions to the sleep cycle

shaping an operant conditioning procedure in which a reinforcer is given for any response that successively approximates and ultimately leads to the final response, or target behaviour

short-term memory (STM) a memory system or sub-system(s) with limited storage capacity and duration in which information is lost rapidly unless it is rehearsed; it is a mental 'workbench' that allows us to manipulate information entering from sensory memory or retrieved from long-term memory; also called working memory

single photon emission computed tomography (SPECT) a neuroimaging technique that provides computer-generated images of the 'working' brain (function) by tracking blood flow (through glucose use by active neurons); it is like PET but uses a longer-lasting radioactive tracer; also provides images of structure

single-blind procedure a procedure in an experiment to ensure participants are not aware of the group (or condition) to which they have been allocated and therefore the experimental treatment (the independent variable)

Skinner box a small soundproof chamber in which an experimental animal learns to make a particular response for which the consequences are controlled

sleep a regularly occurring altered state of consciousness that typically occurs spontaneously and is primarily characterised by a loss of conscious awareness

sleep debt accumulated nightly sleep loss that is owed and needs to be made up

sleep deprivation going without sleep

sleep diary a record of an individual's sleep and waking time activities over a period of time; also known as a sleep log

sleep disorder a sleep problem that disrupts the normal NREM–REM sleep cycle; types of disorder include insomnia, hypersomnia and sleep apnea

sleep–wake cycle shift in adolescence, a shift forward of the normal onset time of the sleep period, resulting in sleepiness at a later time

social causation hypothesis the proposal that development or onset of a mental disorder is caused by one or more factors within the individual's social environment

social disadvantage a broad term used to refer to the range of difficulties that block life opportunities and that prevent people from participating fully in society

social drift hypothesis the proposal that having a mental disorder impairs psychological and social functioning and this leads to a downward drift in socioeconomic circumstances

social isolation the absence of social contacts, interactions and relationships with family, friends, neighbours, colleagues and acquaintances on an individual level, and with people in the community and society at large on a broader level

social learning theory a description and explanation of learning that combines operant conditioning and observational learning processes, taking account of the environment, or 'social context', in which they occur

social network the various individuals or groups who maintain relationships with an individual in different aspects of their lives

social readjustment the amount of change in lifestyle a person is forced to make following a specific event in their life

social stigma negative attitudes and beliefs held in the wider community and society in general that motivate people to fear, reject, avoid and discriminate against people with a mental disorder

social stressor a stressor attributable to circumstances arising from social roles performed in everyday life that are generally considered problematic or undesirable

social support help or assistance from other people when needed

socioeconomic status a combined and total measure of an individual's or family's social and economic position in society, relative to others, based on income, education and employment

somatic nervous system one of two subdivisions of the peripheral nervous system comprising a network of sensory neurons that carry information received by sensory receptors in the body to the central nervous system and motor neurons that carry information from the central nervous system to control voluntary movements of skeletal muscles

spatial neglect an attentional disorder caused by damage to areas of the parietal lobe, usually in the right hemisphere, and characterised by behaviour indicating a failure to notice anything either on the left or right side of the body and external environment

specific environmental trigger in relation to a phobia, a specific object or situation in the environment that produces an extreme fear response

specific phobia an anxiety disorder characterised by significant anxiety produced by exposure to a specific feared object or situation, often leading to avoidance behaviour

spinal cord a part of the central nervous system that connects the brain to other parts of the body through the peripheral nervous system; major functions are to transmit sensory information to and motor information from the brain

split-brain surgery surgical cutting of the corpus callosum and sometimes other connecting nerves to separate the two cerebral hemispheres

spontaneous recovery the reappearance of a conditioned response after its apparent extinction

stage of exhaustion the third stage of the general adaptation syndrome, when the effects of a stressor can no longer be dealt with and the organism becomes weak and vulnerable to disease and illness

stage of resistance the second stage of the general adaptation syndrome, when the body's resistance to a stressor develops and rises above normal levels

standardised instructions identical instructions (directions) given to participants, as relevant to the specific group (condition) to which they have been assigned

standardised procedures use and administration of the same procedures for participants, as relevant to the specific group (condition) to which they have been assigned

state of consciousness level of awareness of one's internal state and external events

state-dependent cue a cue for memory retrieval based on an individual's internal physiological and/or psychological state at the time the memory was formed

statistical significance an indication of how likely it is that the results obtained from research could have occurred by chance

stimulus any event that produces a response from an organism

stimulus discrimination the ability to distinguish between two (or more) different stimuli, even if the stimuli are similar

stimulus generalisation the tendency for similar stimuli to produce the same, but not necessarily identical, response

stratified sampling a sampling procedure that involves dividing the population to be sampled into distinct subgroups (strata) then selecting a separate sample from each stratum in the same proportions as they occur in the population of research interest

stratified-random sampling a sampling procedure that involves identifying all of the people within each subgroup (stratum) of research interest, then randomly selecting samples of proportionate size from within each subgroup

stress a state of physiological and psychological arousal produced by internal or external stressors that are perceived by the individual as challenging or exceeding their ability or resources to cope

stress exposure model the proposal that individuals who have been exposed to a very significant stressor or stressors will be more likely to develop a mental disorder such as major depression or schizophrenia than those who have not

stress generation model the proposal that having a mental disorder can contribute to the occurrence of stressors and therefore actually 'generate' stress

stress management the use of one or more techniques to alleviate or cope with the effects of stress

stress response the physiological and psychological changes experienced when confronted by a stressor

stressor any person, situation or event that produces stress

structural feature in the Atkinson–Shiffrin multi-store model, a built-in, fixed feature of memory that does not vary from one situation to another

suppression a type of motivated forgetting in which individuals actively keep a memory out of conscious awareness by choosing not to attend to or think about it

survey a highly structured questionnaire used to collect self-report data from a large number of people in a relatively short period of time

survival theory an explanation of the purpose of sleep that proposes that sleep evolved to enhance survival by protecting an organism, making it inactive during the part of the day when it is most dangerous to move about

sympathetic nervous system a division of the autonomic nervous system that activates nerves, glands and visceral muscles (blood vessels, heart and intestines) in times of stress or threat

synapse the site of communication between adjacent neurons; often described as having three components: the synaptic gap, the axon ending of presynaptic neuron, and the dendrite of the postsynaptic neuron

synaptic gap the tiny space between the axon ending of a presynaptic neuron and the dendrite of a postsynaptic neuron

synaptic pruning the elimination of synaptic connections, particularly during the brain's early development

synaptogenesis the formation of new synapses, particularly during the brain's early development

synesthesia a perceptual experience in which stimulation of one sense produces additional unusual experiences in another sense

systematic desensitisation a behaviour therapy technique that attempts to replace an undesirable response, such as fear, with a relaxation response through conditioning; the individual learns to associate being relaxed with the fear-arousing stimulus through a series of graded steps

taste aversion a conditioned response involving avoidance of food; associated with being ill and usually the result of a single experience

temporal lobe one of the four lobes in each cerebral hemisphere of the brain; primarily involved with hearing, but also plays an important role in memory and other mental processes

test of significance a statistical test used to determine whether the mean scores of two groups (e.g. an experimental and control group) differ significantly; whether the difference is due to the independent variable and is unlikely to have occurred by chance alone

thalamus a brain structure that filters information from the senses and transmits the information to the cerebral cortex; receives inputs from all the major senses (except smell); it also receives information from the reticular formation about state arousal, therefore influencing wakefulness and level of alertness

theory a set of ideas proposed to describe and explain a set of observations and the relationships between them

three-phase model of operant conditioning a description and explanation of operant conditioning as having three components: (1) the stimulus (S) that precedes an operant response, (2) the operant response (R) to the stimulus, and (3) the consequence (C) to the operant response

tip-of-the-tongue phenomenon (TOT) the feeling of being aware of knowing something and being confident that it will be remembered, but unable to retrieve the information at that point in time

token economy a setting in which an individual receives tokens for desired behaviour that can then be exchanged for actual rewards

tolerance the decreased sensitivity to a substance or activity over time, whereby increasing amounts of the particular substance or activity are required to achieve the original effects

transactional model of stress and coping a model that proposes that stress involves an encounter between an individual and their environment, and that a stress response depends upon the appraisal of the stressor and ability to cope with it

transcranial magnetic stimulation (TMS) a direct brain-stimulation technique that delivers a magnetic pulse through the skull and temporarily activates or disrupts the activity of neurons in a specific area of the cerebral cortex

transference in psychodynamic psychotherapy, when a client unconsciously responds to the therapist as if they are a significant person in their life (often a parent) and transfers their unresolved conflicts and fantasies to their therapist

transmission of threat information in relation to a phobia, the delivery of information from parents, other family members, peers, teachers, the media and other secondary sources about the potential threat or actual danger of a particular object or situation

trauma in relation to mental health, an event that a person experiences, witnesses or confronts that is extremely distressing and to which the person's response involves intense fear, helplessness or horror

trial and error learning a type of learning in which one response after another is tried and rejected as ineffective, until eventually a successful response is made

unconditioned response (UCR) the response that occurs automatically as a result of the unconditioned stimulus; a reflexive, or involuntary, response is a UCR as it is predictably caused by an unconditioned stimulus

unconditioned stimulus (UCS) any stimulus that consistently produces an unconditioned response

validity in research, when the study has produced results that accurately measure the behaviour or event that it claims to have measured; see construct validity

variable any factor that can change (vary) in amount or type over time

variable-interval schedule a schedule of reinforcement in which a reinforcer is given after irregular periods of time have passed, provided the correct response has been made

variable-ratio schedule a schedule of reinforcement in which a reinforcer is given after an unpredictable ('variable') number of correct responses

vicarious conditioning when an individual observes a model displaying behaviour that is either reinforced or punished and later behaves in the same way, in a modified way or refrains from doing so as a result of the observation

vicarious punishment when an individual observes a model displaying behaviour that is punished, which has the effect of reducing the likelihood of the observer performing that behaviour in a modified or identical way

vicarious reinforcement when an individual observes a model displaying behaviour that is reinforced, which has the effect of increasing the likelihood of the observer performing that behaviour in a modified or identical way

visuo-spatial sketchpad a component of Baddeley and Hitch's model of working memory that temporarily stores a limited amount of visual and spatial information for a brief time

Wernicke's aphasia a speech impairment resulting from damage to Wernicke's area and involving difficulties with speech comprehension and in producing fluent speech

Wernicke's area a specialised area usually in the left temporal lobe that is involved with comprehending the sounds of human speech

withdrawal the unpleasant psychological and/or physical reactions that occur when ingestion of a particular substance or engaging in a particular activity is suddenly reduced or discontinued

working memory a sub-system of memory in which information we are consciously aware of is actively 'worked on'; information from sensory memory is processed here and information is retrieved from long-term memory to be used in working memory; also called short-term memory

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