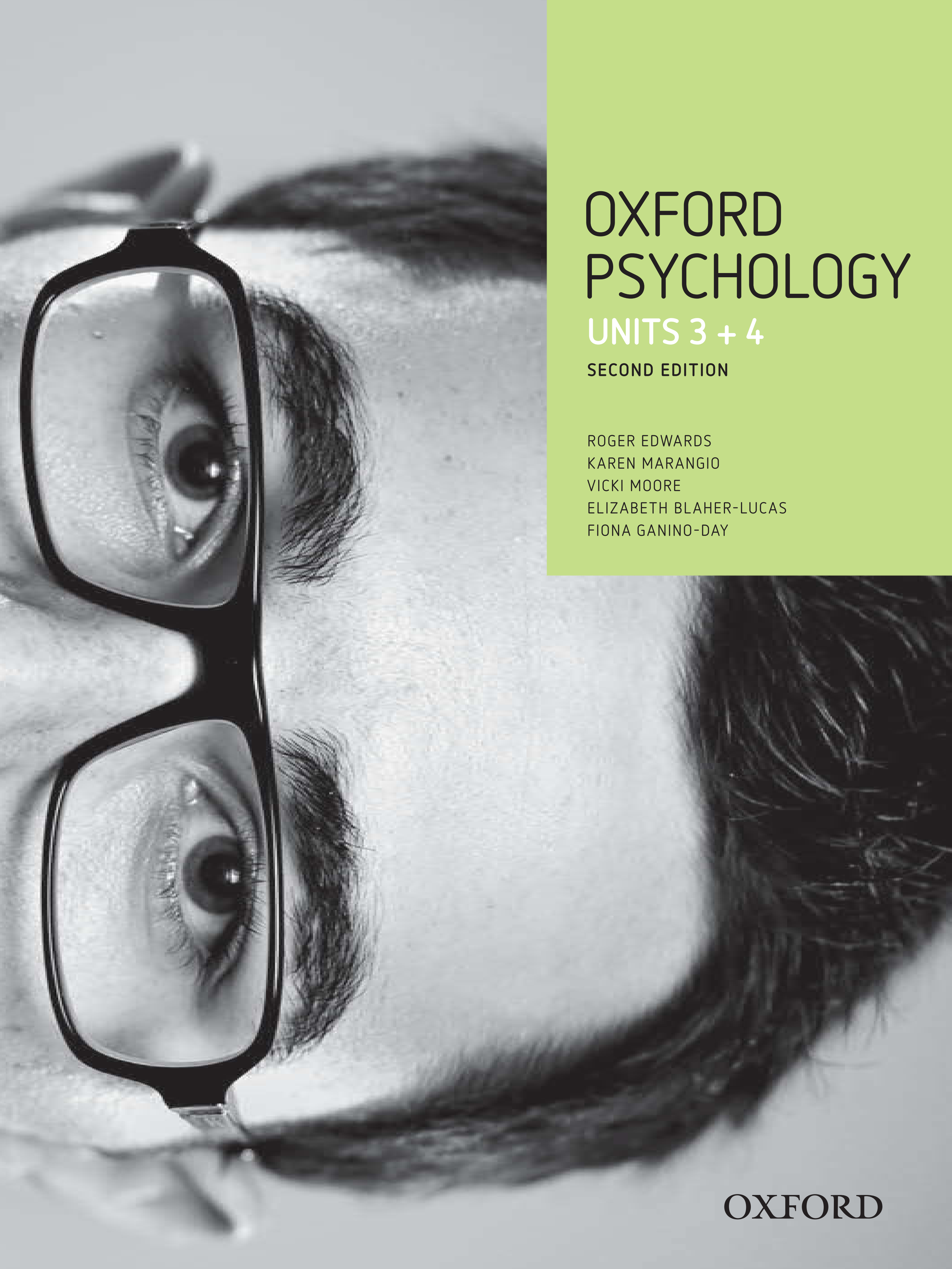

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WELCOME BACK TO THE WONDERFUL WORLD OF VCE PSYCHOLOGY!

This is the second edition of the Oxford Psychology Unit 3 & 4 Student Book and, like its predecessor, it is specifically designed and organised to make your journey through the VCE Psychology course as smooth and profitable as possible. The series has been revised to match the latest VCE Study Design, accredited from 2013–16, and the new design and features of the second edition make it even easier to use. The textbook is now also accompanied by powerful digital resources – obook and assess – to help support your learning and revision.

obook is a cloud-based web-book version of the text that is available anywhere, anytime, on any device. assess is an indispensable online assessment tool, which includes exam-style questions in an interactive format.

Using obook + assess, you can:

- navigate and search easily
- type, save and send answers to questions
- add notes, highlights or bookmarks
- complete practice tests to study and revise.

You will notice that this book proudly wears the logo of Monash University – one of the world's top 100 and Australia's top three universities. This is because each chapter has been evaluated by an academic member of the faculties of Education, Medicine or Psychology, to ensure that the content is accurate and relevant to current research findings.

Chapter 1 on Research Methods is a stand-alone chapter, to be used like a tool-chest for research. It is placed at the beginning so that it is easy to re-visit throughout both units as you design and carry out your own research and evaluate research done by others.

The following chapters in the text closely follow the VCE Study Design – as you can see, each chapter begins with the relevant Key Knowledge 'dot points' from the Study Design and a chapter overview explaining exactly what is coming up. I believe that each chapter contains all the information you will need to prepare you for your exam.

Each chapter finishes with:

- a summary of the chapter content.
- a concept map to enable you to visualise the links among various concepts covered in the chapter.
- essential exam knowledge, including a list of key terms, key ideas and research methods relating to the chapter
- examination-style questions with accurate weighting of marks to enable you to test and then consolidate your knowledge and understanding.

Of course, this is not just about a single examination, it aims to help you learn and understand the concepts that underpin all psychological knowledge. In each chapter there are some sections that have been put in Supporting Understanding boxes – this is material that we believe will help you learn and understand, but is not directly mentioned in the Study Design and will not be in the examination.

As series editor of this and the Year 10 and Units 1 & 2 texts, I was really delighted with what we produced as a first edition – well, this second edition is better! There are more review questions and investigation activities, new charts and diagrams to clarify key points and the new digital components that take the content online.

I am confident that many students will be so enthusiastic as a result of what they learn with the assistance of this series, that they will finish VCE and take up university courses in Psychology. 'I picked up Psychology as my fifth subject in Year 12 but now it's going to be my major at university!' – I have heard that so often!

Even if students have no intention of studying psychology beyond school, knowledge and understanding of the topics studied here will be important life skills. Students and parents have often asked, 'For which jobs is psychology useful?' I've always answered, 'I can't think of a job that doesn't involve psychology!'

Roger Edwards
Series Editor
Oxford University Press and Monash University

→ CHAPTER 01:

RESEARCH METHODS IN PSYCHOLOGY

This is a chapter that you will use for reference many times throughout Units 3 and 4 of VCE Psychology, so it seemed best to put it where you can easily find it. But not only that – as you will see in the next chapter, psychology applies the most rigorous of scientific methods in order to collect information and test theories, so in some ways this chapter tells you many of the most important things in all of psychology. It *should* come first!

Research skills represent the way we test theories and gain further knowledge. Psychological research involves experimentation. A true experiment always aims to discover natural laws of cause and effect – how do changes in one property cause changes in another?

This chapter is set out in a way that makes each piece of information easy to access. It is not meant to be read from beginning to end. Rather, it's like a toolbox – you dip your hand into it, get the tool you need and then go off and use it.

KEY SKILLS

Required research skills for Units 1–4 of VCE Psychology include the ability to:

→ formulate research questions and construct testable hypotheses

→ design and conduct investigations using experimental and non-experimental methods such as observation studies, case studies and correlation studies

Key skills continued...

- → collect, record and summarise both quantitative and qualitative data
- → analyse and interpret data, and draw conclusions consistent with the research question
- → evaluate the validity and reliability of research investigations including potential confounding variables and sources of error and bias
- → work independently and collaboratively as appropriate within identified research constraints
- → adhere to current occupational health and safety codes and ethical guidelines for conducting psychological investigations.

(VCE Study Design 2013)

KEY KNOWLEDGE

Students analyse research methodologies associated with classic and contemporary theories, studies and models, consider ethical issues associated with the conduct of research and the use of findings, and apply appropriate research methods when undertaking their own investigations.

The research methodologies and ethical principles for Units 3 and 4 are:

- → experimental research: construction of research hypotheses; identification and operationalisation of independent and dependent variables; identification of extraneous and potential confounding variables including individual participant differences, non-standardised instructions and procedures, order effects, experimenter effect, placebo effects; ways of minimising confounding and extraneous variables including type of sampling procedures, type of experiment, counterbalancing, single and double blind procedures, placebos, standardised instructions and procedures; evaluation of different types of experimental research designs including independent-groups, matched-participants, repeated-measures; reporting conventions as per *American Psychological Association* (APA) format
- → sampling procedures in selection and allocation of participants: random sampling; stratified sampling; random-stratified sampling; convenience 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
- → statistics: measures of central tendency including mean, median and mode; interpretation of p-values and conclusions; 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

(VCE Study Design 2013)

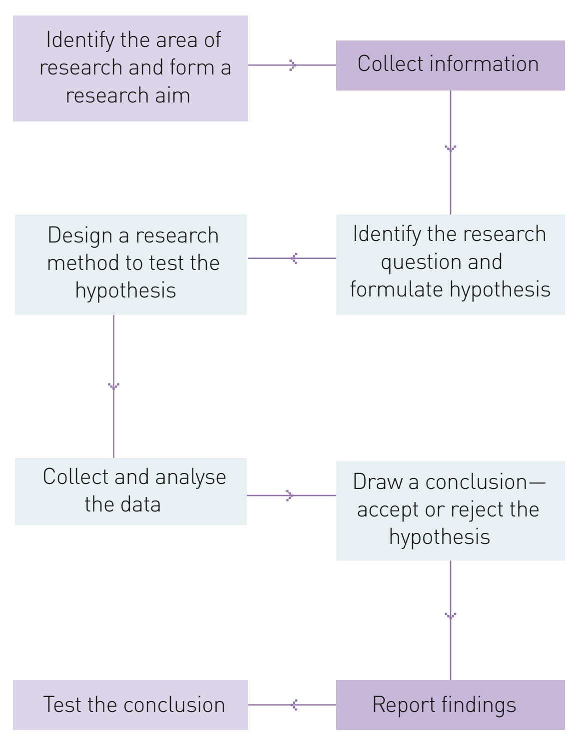
Research methods

CHAPTER OVERVIEW

The scientific method	Identify the area of research and form a research aim Collect information Identify the research question and formulate a hypothesis Design a research method to test the hypothesis Collect and analyse the data Draw a conclusion – accept or reject the hypothesis Report findings Test the conclusion
Variables and hypotheses	Forming a research hypothesis Confounding variables > Extraneous variable > Controlled variable > Confounding variable
Controlling extraneous variables	Participant selection > Convenience sample Representative samples Participant allocation – experimental and control groups > Random allocation Experimental designs > Repeated measures design > Matched participants design > Independent groups design Controlling placebo and experimenter effect > Placebo effect > Experimenter effect > Single-blind and double-blind procedure
Collecting the data	Types of data > Qualitative data > Quantitative data > Subjective data > Objective data > Standardised measures Data collection > Case studies > Observation > Interview > Questionnaires

Drawing conclusions from research statistics in psychology	Descriptive statistics Representing the data > The normal curve > Measures of central tendency > Inferring from data > Student's *t*-test Measures of relationship > Correlation > Positive correlation > Negative correlation > Strength of correlation > Scatter diagram
Ethical considerations in psychological research	Research with humans > The role of the experimenter > Participants' rights > Confidentiality > Voluntary participation > Withdrawal rights > Informed consent > Deception in research > Debriefing

The scientific method



Whether you are investigating black holes, the effects of a new wonder-drug or people's obedience to authority, you need to use the *scientific method* to discover the underlying natural laws and principles.

The **scientific method** is a logical process of problem-solving applied in all sciences. It involves eight steps.

To see exactly how the scientific method works, consider the example of some interesting research by Judith Kearins (1981) in Western Australia.

1 **Identify the area of research and form a research aim.** Kearins wished to discover whether the skills of Aboriginal people in visual tasks (especially visual memory) were better than those of other Australians.

2 **Collect information.** From previous research, it appeared that Aboriginal people brought up in bush communities were superior in their observational skills and interpretation of spatial cues.

3 **Identify the research question and formulate hypothesis.** Kearins asked the question 'Is there a difference in visual memory between Aboriginal Australians and other Australians?' She formed the hypothesis that the visual memory of Aboriginal Australians would be superior to that of other Australians.

4 **Design a research method to test the hypothesis.** Participants were 44 Aboriginal adolescents and 44 non-Aboriginal Australian adolescents. Kearins developed a test of visual memory in which 20 objects were placed on a board that was divided into 20 squares. After looking at the objects for 30 seconds, participants were asked to recall as many items as they could – in the correct location. The experiment was repeated using different types of objects – natural, manufactured or a combination of both.
5 **Collect and analyse the data.** It was found that, on average, the Aboriginal Australian participants recalled more than 16 items while the other participants recalled fewer than 12. This difference was found to be *statistically significant*.
6 **Draw a conclusion – accept or reject the hypothesis.** Kearins concluded that the culture and experience of the Aboriginal Australians caused them to have superior visual memory to other Australians.
7 **Report findings.** This study was published in a journal called *Cognitive Psychology*. Refer to page 37 where the correct protocol for presenting a psychological report is given.
8 **Test the conclusion.** Using a similar method, Klich and Davidson (1983) performed research on school children and found similar results.

Variables and hypotheses

Research is *all* about variables! What is a variable?

A variable is a quantity or quality that can be different at different times or in different places. In psychology we are mainly interested in properties that vary from person to person or within the same person at different times. These could include: age; race; gender; number of hours slept each night; size of cerebral hemispheres; level of awareness; type of brain damage; capacity of short-term memory; learning ability; type of psychological illness – the list is really endless.

Every experiment has at least one *independent* and one *dependent* variable.

- An **independent variable (IV)** is deliberately manipulated or varied in some way by the experimenter. This is planned before the experiment begins. Simple experiments use one independent variable with two values (male/female; yes/no) – in the research by Kearins it was Aboriginal Australians/non-Aboriginal Australians. In a more complex experiment the IV could be *continuous* – that is, it could have a range of values on a scale; for example, age, body mass, IQ, blood alcohol content (BAC), optimism.
- The **dependent variable (DV)** is the property that is measured in the research. Its value depends on the IV and that is why it is called ‘dependent’. The DV is therefore the property that the researcher believes will change as a result of changes in the value of the IV. The DV is usually *continuous* (that is, has any value within a certain range) and should be stated as an *operational* definition.

OPERATIONAL DEFINITIONS

Operationalisation of a variable means that it is stated in terms that show *how it is measured*. For example:

- age – operationalised as age in total months

- IQ – operationalised as the score on a 40-item multiple-choice test
- aggression – operationalised as the number of aggressive responses in an observed 30-minute period.

1.1 REVIEW

1 What are the steps of the scientific method?
2 What is meant by the term 'independent variable'?
3 What is meant by the term 'dependent variable'?
4 In your own words, explain 'operational definition'.

FORMING A RESEARCH HYPOTHESIS

A research hypothesis is a clear statement predicting how changes in the independent variable(s) will affect the value of the dependent variable(s). A hypothesis should also clearly state the population about which the researcher intends to draw conclusions.

The variables are not operationalised in the statement of the research hypothesis, but they need to be clearly stated in operational terms in the introductory part of the research report. Examples of appropriate research hypotheses are:

a That for adult drivers in Melbourne, increasing blood alcohol level will cause decreased reaction speed.

b That for patients recovering from heart surgery, regular exercise will lead to improved cardiovascular health.

c That for students showing examination anxiety in VCE Psychology, rest periods taken during examinations will lead to decreased state anxiety.

d That Unit 3 and 4 VCE Psychology students who have regular study schedules throughout the academic year will achieve better study scores than those who cram in the last two weeks before the exams.

1.1 INVESTIGATE

WRITING A RESEARCH STATEMENT

Suppose that a researcher had a theory that stated that increased protein intake increased the capacity of people's short-term memory.

We need to know how to define 'increased protein intake' so that it is measurable. This could be operationalised as a 15 per cent increase in intake of protein per day. We also have to state how we could measure 'capacity of short-term memory'.

'Capacity of short-term memory' needs to be operationalised in this research. Different types of short-term memory need to be operationalised in very specific ways; write an operational definition for each of the following:

→ memory for words
→ memory for numbers
→ memory for pictures.

INVESTIGATE 1.2

VARIABLES IN A HYPOTHESIS

Identify the independent and dependent variables in the following hypotheses:

1 Adults who drink more than five alcoholic drinks each night suffer memory loss at an earlier age than non-drinkers.

2 The words at the beginning and end of a list will be recalled more accurately than those in the middle of the list.

3 VCE students who eat breakfast get better results than those who do not eat breakfast.

4 People who sleep 7–8 hours each night are better drivers than those who sleep more or less than 7–8 hours.

Did you know?

In previous study designs, the term 'operational hypothesis' was used. This is an outdated form of statement of hypothesis where the variables are operationalised within the hypothesis, making it a very clumsy statement; for example, hypothesis 'a' in the examples, if stated as an 'operational' hypothesis could read:

'That for adult drivers in Melbourne, increasing blood-alcohol level, operationalised as breathalyser readings in .01 increments, will cause decreased reaction speed, operationalised as response time to a light flashed at irregular intervals.'

CONFOUNDING VARIABLES

An **extraneous variable** is a variable other than ('extraneous to') the IV that could cause changes in the value of the DV. Extraneous variables are undesirable. When the potential effects of an extraneous variable have been removed from the experiment (usually by the experimental design), the variable is said to be a **controlled variable**.

A **confounding variable** is a variable other than the IV that has a systematic effect on the value of the DV (it acts like a second, unwanted, IV). If a confounding variable exists, the research is usually a waste of time and no valid conclusions can be drawn, so very stringent procedures are used to prevent this happening.

There are several ways in which psychologists eliminate the unwanted effects of confounding variables, including methods of:

- participant selection
- participant allocation
- experimental design
- experimental procedures including standardised procedures

TYPE OF VARIABLE	EXAMPLE	REASON
Extraneous	In sample hypothesis 'a', which novel the participant read most recently	It is most unlikely that this will have any systematic effect on the value of the DV - yet it is obviously a variable!
Controlled	In hypothesis 'b', body mass	This is controlled by comparing scores for participants of equivalent weights
Confounding	In hypothesis 'c' nature of food eaten for breakfast	If different participants eat different foods for breakfast, it is quite likely that they will have different blood-sugar levels and hence differently affected attention and concentration abilities

PARTICIPANT SELECTION

In research, we are always interested in drawing conclusions that are valid for a particular group or groups of people. The group about which we wish to draw conclusions is referred to as the **population**.

It is rarely possible to perform an experiment on every member of a population.

As a result of this, we select a smaller number of individuals from the population to be participants in our research and to represent the population.

The selection of participants for research is called sampling. The term **sample** refers to the members of the population that have been chosen to take part in the research. Sampling procedures must ensure that the sample is representative of the population from which it is drawn. This means that personal characteristics of the sample should be distributed in the same proportions as in the population.

Convenience sample

Unfortunately, much psychological research uses convenience sampling – using any person 'conveniently' available as part of the sample. This could be a teacher using her psychology class in research aimed at discovering information about all VCE students; obviously psychology students are special and as a group cannot represent all students. Students in one school cannot represent all students.

This means that convenience samples are essentially biased and research findings would be unreliable based on such a sample.

Representative samples

The sample *represents* the population, so that conclusions from research on the sample can be *generalised* to the wider population.

Two procedures used to make sure that the sample is representative are *random sampling* and *stratified sampling* (*stratified random sampling*).

Random sampling is a sampling procedure in which every member of the population has an equal chance of being selected – just as the Tattslotto numbers do in each draw!

Imagine, for example, that we wish to draw conclusions about all 50 000 students of VCE Units 3 and 4. VCAA has allocated a number to each VCE student, so all we need to do is put all the VCAA numbers in a barrel – just like a huge Tattslotto barrel – roll the barrel and pull out one number at a time until we have enough for our experiment.

Obviously this would be very time-consuming, so we would use technology to help. All scientific calculators and computers have the capacity to generate a list of random numbers. If we just instruct the computer to give (say) 500 random numbers between 1 and 50 000, we can then get a list of the population from VCAA and pick the persons whose VCE numbers appear in the 500 different positions shown in the random number list.

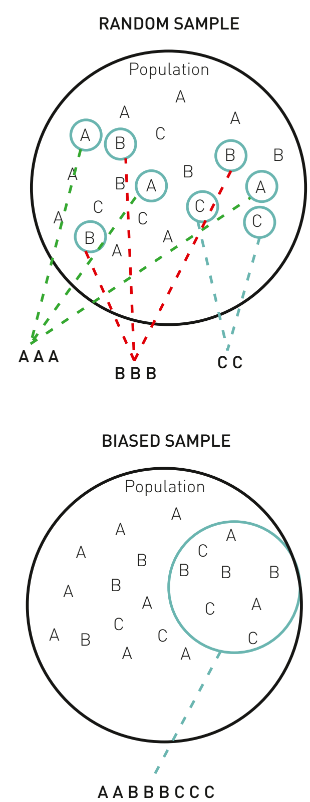


FIGURE 1.1 Personal characteristics are distributed in the random sample in the same proportions as in the population. The biased sample has certain elements over-represented (C) and under-represented (A).

Stratified sampling and **stratified random sampling** are processes by which the effects of a certain variable can be eliminated as a possible **confound** in an experiment. This involves a number of procedures:

1 Identifying a property that we believe may interfere with the effects of the IV on the value of the DV.
2 Measuring that property for each member of the population.
3 Dividing the population into particular strata (groups) based on the value of that variable.
4 Deciding on the number of participants required for the experiment.
5 Selecting participants in the same proportions as exist in the population to make up the sample (a stratified sample).
6 Selecting a random sample from each stratum, in the same proportions as exist in the population (random-stratified sample).

The stratum could really be any personal variable, such as age, years of completed education, gender, body mass, sleep patterns.

Stratified sampling is used in the creation of many high-quality psychological measuring instruments such as the Wechsler Memory Scales. These scales are stratified according to ethnicity, age group and years of completed education.

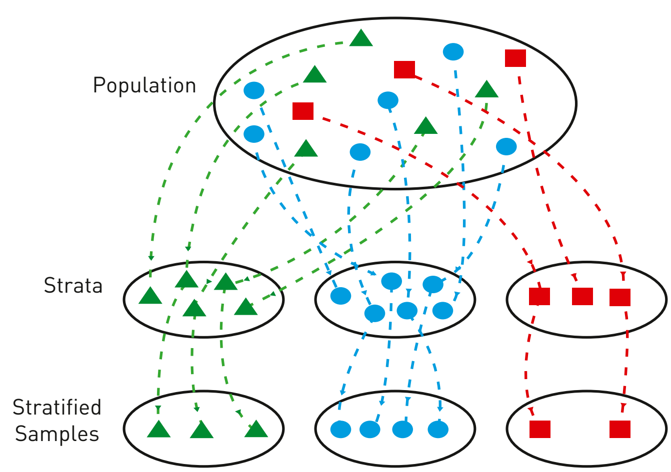


FIGURE 1.2 Stratified sampling involves dividing the population into distinct 'subgroups' and then selecting a separate sample from each subgroup in the same proportions as they occur in the population.

INVESTIGATE 1.3

IDENTIFY THE VARIABLE

Identify at least one variable on which the sample should be stratified in the following research questions.

Example: Does increased time spent studying lead to increased performance in Unit 3 & 4 VCE Psychology exams?

Answer: A sample should be stratified on intelligence because more intelligent students are likely to need less time to study.

1 Does consumption of one standard alcoholic drink interfere with an adult's short-term memory ability?
2 Do teachers who use PowerPoint presentations get better results than those who dictate notes?
3 Are girls better at VCE Psychology than boys?

1.2 REVIEW

1 What is a hypothesis?
2 What is an extraneous variable?
3 What happens in research if a variable other than the independent variable affects the value of the dependent variable?
4 What is a convenience sample – give an example and explain what sort of bias this sample might show
5 a What is a random sample?
  b What is the purpose of the random sampling procedure?
  c Describe how a researcher could obtain a random sample of all adults in Bendigo.
6 a What is a random-stratified sample?
  b How could a researcher obtain a random sample, stratified by ethnic background, of Year 8 students from Somewhere Secondary College?

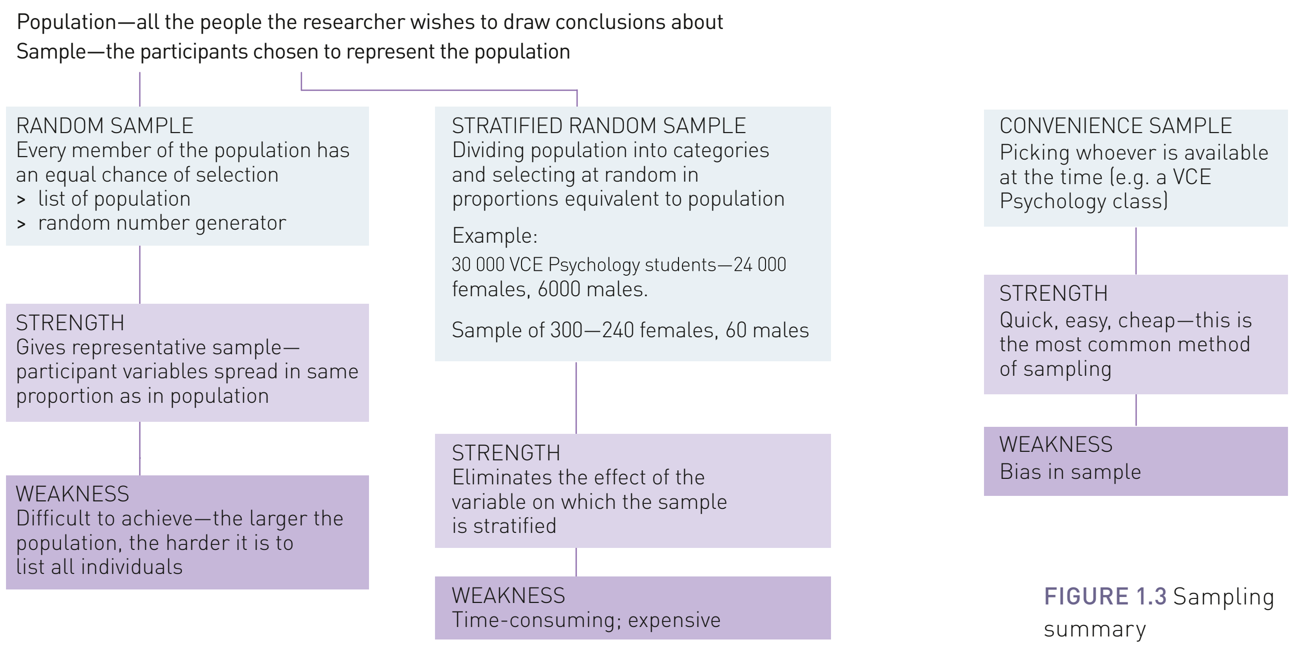


FIGURE 1.3 Sampling summary

PARTICIPANT ALLOCATION – EXPERIMENTAL AND CONTROL GROUPS

The basic experimental method uses two different groups called the **experimental group** (E-group) and the **control group** (C-group).

Members of the experimental group are exposed to the IV. This is referred to as the condition that receives the **treatment**. The treatment is the variable that the experimental group participants receive and members of the control group do not.

The purpose of the E-group is to show the effects of the IV on the value of the DV.

The control group consists of the participants who are *not* exposed to the IV – they do not receive the treatment.

The purpose of the C-group is to form a basis for comparison with the E-group.

It is important that the experimental group and the control group are as similar as possible in relevant participant characteristics, and that they are treated as similarly as possible throughout the experiment.

After the experiment the average value of the DV for the E-group is compared with the average value of the DV for the C-group. If there is a significant difference it is concluded that the independent variable (the treatment) has caused this difference.

Random allocation

Random allocation means that all participants who have been selected for an experiment must have an equal chance of being in E-group or C-group.

When the sample is large enough, this means that the E-group and C-group will be equivalent on all participant characteristics and the presence or absence of the IV will be the *only* difference between them – meaning that it is entirely responsible for any difference in the measured DV.

For example, suppose we performed an experiment to test the theory that sleep deprivation adversely affects performance on a memory task, and we allocated all males to the E-group and all females to the C-group. No conclusions could be drawn from this research because the difference in results between the two groups may be due to differences in the gender of the participants rather than (or as well as) the effects of the sleep deprivation. We would say that these results were *confounded by gender*.

REVIEW 1.3

1 a What is a control group?
  b Explain the purpose of the control group.
2 a What is an experimental group?
  b Explain the purpose of the experimental group.
3 a What is the meaning of the term 'random allocation'?
  b Explain why random allocation is a necessary part of the experimental process.

EXPERIMENTAL DESIGNS

Another method of controlling extraneous variables is by the *design* of the experiment. We shall examine three experimental designs, each of which has certain advantages and certain disadvantages. A researcher will choose a design that best suits the population and variables to be investigated.

Three experimental designs are:

- repeated measures
- matched participants
- independent groups.

Repeated measures design

In **repeated measures design** (also known as *within participants design*), each participant is part of both E-group and C-group. For example, in the research described above, looking at the effects of sleep deprivation on problem-solving ability, all participants would be tested for problem-solving on two occasions – once in a normally rested state and once in a sleep-deprived state – and the results for each participant can be compared.

- **Advantages:** Using the same participants as E-group and C-group means that confounds caused by 'participant variables' will be eliminated. It is also possible to use fewer participants than with other designs.
- **Disadvantages:** The repeated measures procedure takes a long time – participants have to take part in both conditions so 'drop-outs' are likely. The procedure can also suffer from confounding variables known as **order effects**:
  a Participants may perform better on the task when doing it a second time because of the effect of *practice*.
  b Participants may do worse the second time because of *fatigue* or *boredom*.
  c Obviously, the greater the time that passes between the two measurements being taken, the less chance there is that either practice or boredom will affect the results. The problem, however, is that increasing the interval between the two events increases the likelihood that participants will withdraw.
  d A better method of overcoming order effects is **counterbalancing**. In the counterbalancing procedure, half the participants will first perform the task with the IV present (experimental condition) and then perform the task with the IV absent (control condition). The other half of the participants will experience the conditions in the reverse order. Random selection should be used to decide which participants perform the tasks in which order.

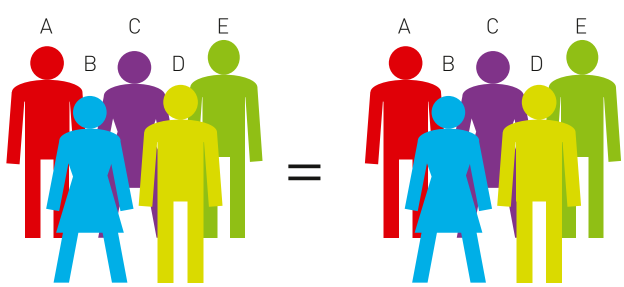


FIGURE 1.4 A repeated measures design involves using the same subjects in each condition of an experiment, e.g. giving a group of subjects a driving test with no alcohol, followed at a later time by the same test after a glass of wine.

Matched participants design

The **matched participants design** enables a researcher to identify a variable that is likely to confound and to eliminate the effects of this variable from the experiment. Participants can be ranked in accordance with their scores on this variable and then allocated to the respective groups.

A researcher was investigating whether cognitive behavioural therapy (CBT) is effective in treating anxiety due to stress. He believed that long-term memory ability of participants could be a confounding variable, so he measured the long-term memory (verbal) of each participant, using the Wechsler Memory Scale. The two participants with the highest score were randomly allocated – one to the E-group and one to the C-group. The two with the third and fourth highest scores were also randomly allocated – one to each group. This procedure continued until all participants were allocated and the mean scores for E-group and C-group were the same.

- **Advantage:** The variable on which the participants are 'matched' will not influence the results because its effects will be the same in the E-group and the C-group.
- **Disadvantages:** It is very time-consuming (and therefore expensive) to find out the value of this variable for each participant. Also, if one of the pair drops out, the scores for the other must also be eliminated.

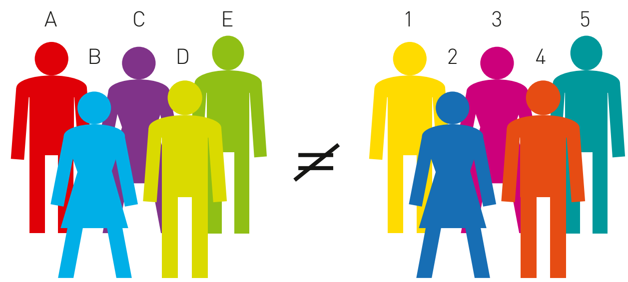


FIGURE 1.5 A matched pairs design involves using different but similar participants in each condition of an experiment. An effort is made to match the participants in each condition in important characteristics that might affect performance, such as driving ability or alcohol tolerance.

Independent groups design

The **independent groups design** (also known as *between participants design*) allocates participants to E-group or C-group at random.

- **Advantage:** The independent groups procedure can all be done at once and drop-outs are unlikely.
- **Disadvantage:** The procedure needs a large number of participants to ensure that the spread of participant variables in the sample will match the spread in the population.

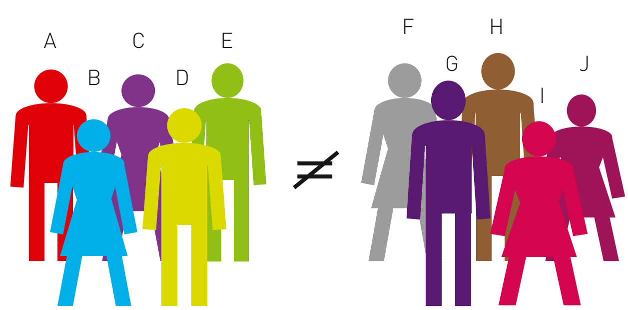


FIGURE 1.6 An independent groups design involves using different subjects in each condition of the experiment, e.g. giving one group of participants a driving test with no alcohol, and a different group of participants the same test after a glass of wine.

REVIEW 1.4

Draw a table as shown below and complete the nine boxes:

EXPERIMENTAL DESIGN	REPEATED MEASURES	MATCHED PARTICIPANTS	INDEPENDENT GROUPS
Description			
Advantages			
Disadvantages			

A **placebo** is literally an object or procedure that is expected to have no effect on the value of the DV, administered to the control group to provide a basis for comparison with the effects of the IV, administered to the **experimental group**.

CONTROLLING PLACEBO AND EXPERIMENTER EFFECT

Placebo effect

The **placebo effect** refers to the participants' behaviour being influenced by their *expectations* of how they should behave, caused by the belief that they have received some treatment. This means that the expectations of the participants, as well as (or instead of) the IV, may be affecting the value of the DV, and therefore the results of the experiment are not valid.

The placebo effect can be eliminated by using a **single-blind procedure** in the experimental process – allocating participants to groups in such a way that they do not know whether they are in E-group or C-group.

FIGURE 1.7 The placebo effect is most often heard about in relation to research about the effectiveness of a drug. One of these capsules contains only sugar, but participants in a single-blind procedure would not know whether they received a real drug or a sugar pill.

Experimenter effect

The **experimenter effect** refers to the outcome of an experiment being unintentionally (or even intentionally) influenced by the experimenter. This can happen, for example, if the experimenter treats the members of E-group and C-group differently and therefore influences the behaviour of participants and the outcome of the experiment.

The experimenter effect can be addressed by using a **double-blind procedure** in the experimental procedures, ensuring that neither the experimenter nor the participants are aware of which participants are in E-group or C-group. This procedure is obviously most commonly used when there is a possibility that the expectations of either the experimenter or the participants will influence the outcome of the experiment.

Table 1.1 summarises the way in which psychologists control possible confounding variables in research.

CASE STUDY

SINGLE-BLIND PROCEDURE: EXPERIMENTER UNAWARENESS

Although a 'single-blind design' usually refers to a procedure where the participants are unaware of the condition to which they are assigned, sometimes single-blind designs take place where the participants are aware of whether or not they received the treatment but the experimenter is not.

For example, Dr Feng was investigating the effects of sleep deprivation on driving ability. Her experimental group set their alarms so they would wake up every 30 minutes during the night, while the control group had a normal night's sleep. The next day, all participants were taken for a trial drive by another researcher, Dr Shan, and her assistants who scored the participants' driving ability the same way that a driving examiner scores someone taking their test.

In this case, it was obviously important that those scoring the test were unaware of which condition the participant belonged to (to eliminate experimenter effect) but it was not possible for participants to be unaware. The single-blind design was used and the experimenter is said to be 'blinded' to the condition.

Did you know?

Placebo is a term from Latin, meaning 'I shall please'. For thousands of years, doctors have known that sick people will often recover if they simply believe that the treatment they are getting will be effective. This is called the placebo effect. Do you remember in *Harry Potter and the Half-Blood Prince*, when Harry pretended to give Ron the magic 'good-luck' potion and Ron played the quidditch match of his life? That was the placebo effect at work!

Other sources of error (possible confounds)

Apart from the participant variables and sources of experimental error described above, there are certain specific issues that may introduce confounding variables.

Non-standardised instructions and procedures. It seems obvious that standardised instructions and procedures are essential if the only difference between the E-group and C-group is to be variation in the value of the independent variable (the treatment condition). The words used, the manner of the researcher and the order in which items are presented can all have significant influence on the outcome of research. You can see exactly the same effect in the effect of misleading questions on eyewitness testimony (see page 341).

TABLE 1.1 Controlling extraneous variables and bias

SOURCE OF PROBLEM	DESCRIPTION OF PROBLEM	CONTROL PROCEDURES
Participants	> participant variables > interpersonal differences	> large sample (independent groups) > repeated measures > matched participants
Procedure	> experimenter effects (due to different methods of administering IV)	use standardised procedures
Design	> order effects > placebo effects > experimenter effects > participant effects	> counterbalancing > independent groups > single-blind > double-blind
Data collection	bias/distraction/confusion	standard procedures and instructions

Collecting the data

Deciding what type of data to collect and how to collect that data is a very important part of research design.

TYPES OF DATA

Researchers wish to be as accurate as possible in the data collected, so the variables must be measured as precisely as possible. There are various ways of describing different types of data. Data can be classified as *qualitative* or *quantitative*.

- **Qualitative data** refer to descriptions of the characteristics of what is being studied. In psychological research this could be:
  - emotional state: happy/sad/angry, etc.
  - difficulty of task: easy/moderate/difficult/very difficult.
- **Quantitative data** refer to measurements – numerical information about the variables being studied. Most psychological research aims to gather quantitative data because we can perform statistical procedures on these and, provided the data are accurate and precise, we can determine whether our results are significant and our hypotheses can be supported.

SUPPORTING UNDERSTANDING

Data can also be *subjective* or *objective*.

- **Subjective data** are based on opinion and there is no external yardstick by which they are measured. If you asked all the people in your class how they feel about mathematics, you would collect a wide range of responses – all of which are correct because they are based on the individual's own feelings.
- **Objective data** are measured according to an identifiable external criterion. Each person using an objective measure correctly will obtain the same result. In simplest terms, if each person in the class measured the length and breadth of a desk, they would each obtain the same result. Many standardised measures are used to gain psychological information in an objective way. Any psychologist who administers one of these would obtain the same result for the same person under the same conditions.

FIGURE 1.8 Self-report surveys collect subjective data.

1.5 REVIEW

1 What is meant by the term *placebo effect*?
2 What is the experimenter effect?
3 How would you control for the experimenter effect?
4 How would you control for the placebo effect?
5 How would you control for the experimenter *and* placebo effects?
6 Complete the following table:

TYPE OF DATA	CHARACTERISTICS	EXAMPLE
Qualitative		
Quantitative		
Subjective		
Objective		

FIGURE 1.9 Hair colour is an example of nominal data that allows us to allocate individuals to groups.

SUPPORTING UNDERSTANDING

Scales of measurement

Psychologists aim to collect the most accurate data possible, so that they can perform precise statistical analysis on them.

In order of increasing precision, the scales of measurement used are:

NOMINAL SCALE	ORDINAL SCALE	INTERVAL SCALE	RATIO SCALE
LEAST PRECISE ←			→ MOST PRECISE

- **Nominal data:** If we separate individuals by a property that has no quantitative value and where there is no order implied, we are collecting nominal data. Examples include:
  - religion: Islam/Christianity/Hinduism/Buddhism/Sikhism/Judaism/other
  - type of school attended: state/Catholic/independent/Jewish/other religious denomination.
- **Ordinal data:** Where the data have a definite sequence, but the gap between one level and the next is not constant, we are dealing with ordinal data. Examples include:
  - Ages of people in your classroom. There is no question about who is the oldest (your teacher!), but the gap between the age of the teacher and the next oldest is several years, while the oldest student may be only a week older than the next oldest, who may have been born on the same day but ten minutes before the next oldest.
  - body mass of people in the room
  - cost of cars in a second-hand car yard.

An example of such a scale is temperature. If today is 30°C, does that mean that it is twice as hot as yesterday when it was 15°C? Of course not! If you were talking to an American friend, who measures temperature in degrees Fahrenheit, they would say today is 86° and yesterday it was 59° – obviously not the same differences you identified!

- **Ratio data:** Ratio measurement is the most precise and rigorous. This measure is the strongest of all and we can perform the most powerful statistical tests with this data. Zero means 'zero' – the property does not exist – and each interval is the same. Ratio scales include length in centimetres (0 means zero and 1–2–3 etc. are all the same interval). Other examples include velocity; mass; study score in VCE Psychology.

REVIEW 1.6

1 Complete the following table:

TYPE OF DATA	CHARACTERISTICS	EXAMPLE
nominal		
ordinal		
interval		
ratio		

2 List some examples of the following:
   a data that is objective and quantitative
   b data that is subjective and qualitative
   c data that is subjective and quantitative.
3 Is it possible to have data that is objective and qualitative? Explain your answer.

DATA COLLECTION

Throughout this book you will find many research studies described. These show all the ways in which experiments are designed and data is collected. This section gives a brief outline of each method of data collection and a reference to where you can find the detailed example in the text.

Case studies

- A case study involves researchers making detailed observations of an individual over a period of time.
  - Strength: A case study collects a great deal of detailed information that can be used to create research hypotheses (which must then be tested by rigorous experimental procedures to determine cause and effect).
  - Weaknesses: Case studies are very time-consuming.
- Findings cannot be generalised (until confirmed by experimental research).
  - Examples: Broca's studies of Tan and his other patients (see page 191).
  - Sperry and Gazzaniga's studies of split-brain patients (see page 200).

Observational studies

- Naturalistic observation: Observation of voluntary behaviours within the subject's natural environment.
  - Strength: Highly realistic – especially if the observer is not visible.
  - Weakness: Lack of ability to control the IV – must wait for naturally occurring variations in behaviour.
  - Example: Chapter 7: Broca's study of Tan.
- Controlled observation: Observation of voluntary behaviours within a structured environment such as a laboratory.
  - Strength: Control over environment enables more accuracy in observations.
  - Weakness: Participant behaviour may be changed by the environment.
  - Examples: Chapter 14: Thorndike's and Skinner's research on instrumental and operant conditioning.
  - Chapter 15: Bandura's studies of modelling.
- Clinical interview: Structured guidelines, but further questioning is used for clarification.
  - Strengths: Flexible; high in validity with skilled interviewer.
  - Weakness: Rely on the objectivity of the interviewer.
  - Example: Unit 4 Area of Study 2 – Mental health: obtaining biopsychosocial data to diagnose mental health conditions.

Did you know?

Questionnaires, surveys and all tests need to be both *reliable* and *valid*. **Reliability** refers to the extent to which a measure could be expected to produce the same result with the same subject(s) under the same conditions on other occasions.

Validity refers to the extent to which an instrument measures what it is supposed to measure.

Self-reports - Questionnaires

All questionnaires are methods of collecting written responses from participants.

- Surveys: May be question and answer or response to Likert-type scales (rating scales).
  - Strengths: Easy to replicate, easy to score; Likert scales provide a means of quantifying subjective data.
  - Weakness: May be open to bias if participant is trying to appear in a particular way.
  - Example: Unit 4 Area of Study 2 – Mental health: obtaining biopsychosocial data to diagnose mental health conditions.

REVIEW 1.7

1 Complete the following table for observational data collection methods.

METHOD OF OBSERVATION	PROCESS	STRENGTHS	WEAKNESS	EXAMPLE
Naturalistic observation				
Controlled observation				

Drawing conclusions from research: Statistics in psychology

Obviously, this is what research originally sets out to do – to find out something useful about the population of interest.

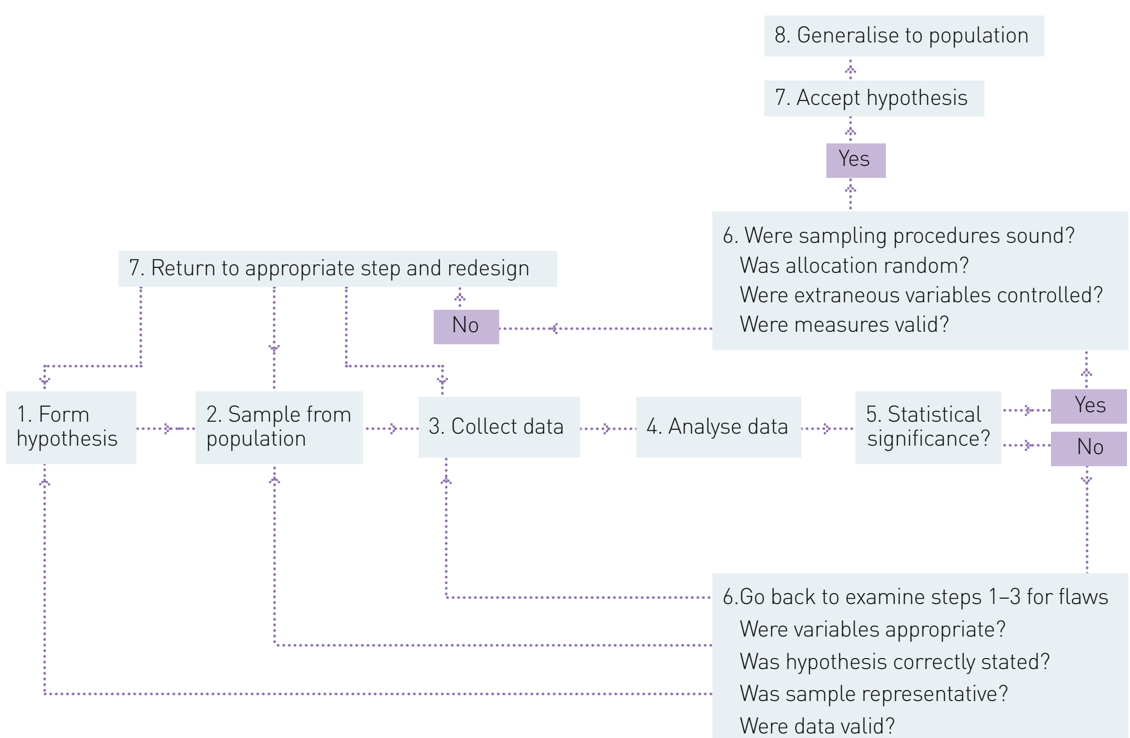


FIGURE 1.10 Decision-making in research

Generalisation of results occurs after the research is complete. For this to be possible, the following criteria must be met:

- The results show statistical significance ($p \leq 0.05$).
- All sampling procedures were appropriate.
- All experimental procedures were appropriate.
- All measures were valid.
- All possible confounding variables were controlled.

The good news is that in psychology, although we use statistics, we never have to calculate more than the very simplest of them. Computer programs and calculators do it all for us!

It is very useful, however, to know how these statistics work and what they mean.

DESCRIPTIVE STATISTICS

Descriptive statistics tell us about the 'shape' of the data set – literally describing the shape of the curve that graphs the distribution of data. Descriptive statistics do not allow us to draw any conclusions or inferences and do not indicate significance.

When we collect data, it comes in a totally unorganised form. For example, Julie rolled a die 80 times and recorded the number shown on each throw: 1, 3, 6, 5, 2, 1, 6, 1, 5, 2, 1, 2, 5, 4, 3, 6, 5, 2, 3, 4, 1, 4, 3, 2, 5, 1, 6, 2, 3, 1, 5, 5, 2, 3, 5, 4, 1, 3, 5, 3, 6, 3, 1, 6, 6, 3, 3, 4, 3, 3, 6, 3, 1, 3, 4, 6, 2, 4, 6, 3, 4, 5, 4, 6, 2, 3, 4, 5, 5, 4, 2, 1, 5, 4, 5, 6, 1, 6, 2, 5.

How can we sort out this data?

Placing the data into a frequency table will make it much easier to perform simple calculations on it. Compare the dataset above with Table 1.2. Which would you prefer to work with?

TABLE 1.2 Frequency table

NUMBER ON DIE	FREQUENCY
1	12
2	11
3	17
4	12
5	15
6	13

Often we need to calculate what percentage of a dataset is represented by a certain score. This is easy to do using the formula:

$$\frac{\text{Number of times the score occurs}}{\text{Total number of scores in dataset}} \times 100$$

If we wished to discover what percentage of rolls scored 6, the calculation is

$$\frac{13}{80} \times 100 = 16.25\%$$

INVESTIGATE 1.4

CALCULATING PERCENTAGES

Calculate the percentages for each number rolled. Add up all the percentages. What number will you have as your answer?

NUMBER ON DIE	FREQUENCY	PERCENTAGE
1	12	
2	11	
3	17	
4	12	
5	15	
6	13	16.25
Total	80	

Representing the data

The frequency table made the data better organised but it still doesn't tell us much. So we can use a **histogram** or a **frequency polygon**, which are graphical representations of how often each score appears, to get a clearer picture of how the numbers rolled on the dice. We could also show the data as a **pie chart**. It is always important to use the type of graph that communicates the information clearly and accurately.

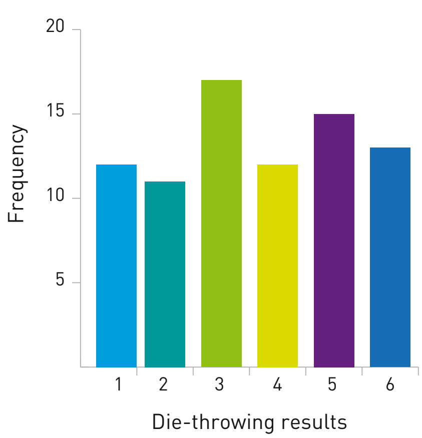


FIGURE 1.11 Histogram showing number of occasions each number was thrown in 80 rolls of one die

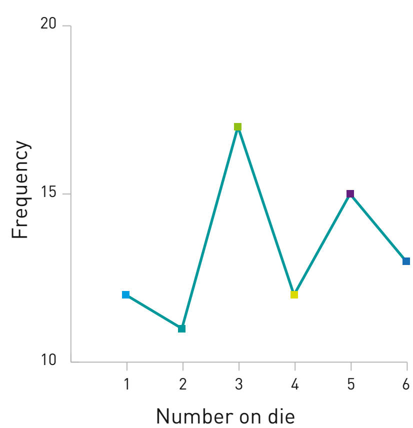


FIGURE 1.12 Frequency polygon showing number of occasions each number was thrown in 80 rolls of one die

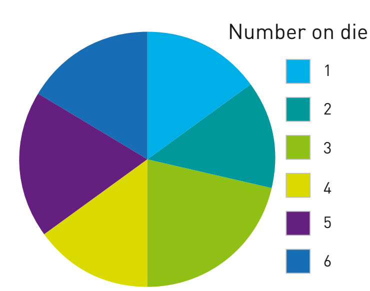


FIGURE 1.13 The pie chart makes it easier to register relative proportions.

Where one variable is continuous (meaning that it can have any value within a certain range), such as body mass, age in months or IQ, we can express it in a table or on a line graph. For example, suppose your psychology teacher sets you a group classwork assignment and you want to find what size of group is the most efficient.

TABLE 1.3 Time taken to complete class work for different-sized study groups

GROUP SIZE	TIME TAKEN TO COMPLETE (HOURS)
2	5.0
3	3.0
4	2.5
5	2
6	2.5
7	5.0

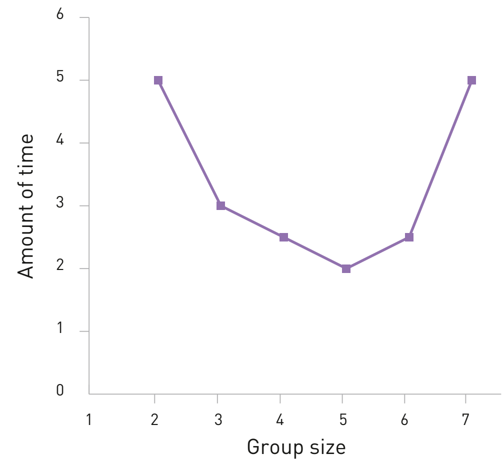


FIGURE 1.14 Time taken to complete class work for different-sized study groups

This data presented as a line graph is shown in Figure 1.14.

THE NORMAL CURVE

When all scores in a set of data are plotted in a graph, psychologists hope that they will form a **normal curve** – also known as a *bell curve* because of its shape (Figure 1.15).

This is because statistical procedures can be applied to the bell curve without further manipulation of the data.

Measures of central tendency

Measures of central tendency tell us how the data are clustered near the central point of the dataset. You will notice that for this curve, the three measures – **mean**, **median** and **mode** – are all at the same point.

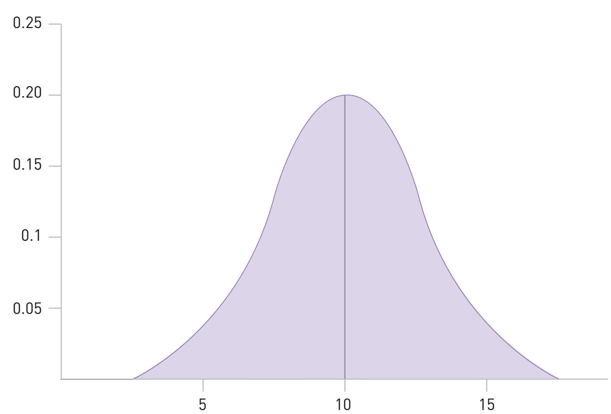


FIGURE 1.15 The normal (or bell) curve

TABLE 1.4 IQ scores of 12 students in a Grade 6 class

STUDENT	IQ SCORE	STUDENT	IQ SCORE
John	88	Hanna	111
Robert	94	Jacob	111
Kiet	99	Adelina	119
Luke	102	Ahmed	125
Kerry	105	Arisa	125
Shelley	111	Akash	130

The dataset in Table 1.4 represents the IQ scores of 12 children in a Grade 6 class. Using the data, we can calculate these three measures:

- **Mean** – the average of all the scores, calculated by adding up all the scores and dividing that total by the number of scores.
  - 88 + 94 + 99 + 102 + 105 + 111 + 111 + 111 + 119 + 125 + 125 + 130 = 1320
  - $\frac{1320}{12} = 110$
  - The mean IQ score for this group of children is 110. We write this as $M = 110$ or $\overline{X} = 110$
- **Median** – the score exactly halfway between the lowest and the highest score. For this dataset the median is.
  - $\frac{(88+130)}{2}$
  - $\frac{218}{2} = 109$
- **Mode** – the most commonly occurring score in the dataset. For this dataset the mode is 111.

SUPPORTING UNDERSTANDING

Measures of variability (dispersion)

Measures of dispersion tell us about how scores are spread out. When used along with measures of central tendency, they tell us a great deal about the features of the dataset.

Three such measures are *range*, *variance* and *standard deviation*.

- **Range:** The most basic of these measures. Range is simply the difference between the highest score and the lowest score in the dataset. In the IQ scores above, the range would be 130 – 88 = 42.
  - This is not a very informative measure as it gives no indication of how the scores are spread along the range.
- **Variance:** Variance is a more useful measure than range because it uses information from each score in the dataset and gives us a measure of how much, on average, the scores differ from the mean.
  - But there is a problem! Some of the scores are higher than the mean (positive difference) and some are lower (negative difference). So if we just take the average difference, the negatives and positives will tend to even out and the 'mean difference' that we calculate will be incorrect. The way we overcome this is to square the differences, so that all figures are positive. (Remember, $-X$ times $-X = +X^2$.)
  - Calculating the variance in our set of IQ scores, with a mean of 110, we find the data in Table 1.5.
  - For the set of scores in Table 1.5, the mean variance is 157. This score is an indication of the spread, but it is very hard to compare it with the original IQ scores as it is in squared units which don't mean much, so we need to go one step further and calculate the standard deviation.
- **Standard deviation:** The standard deviation is a very useful measure that tells us how far, on average, scores are different from the mean. This is done by taking the square root of the mean variance. So in this case, the standard deviation is $\sqrt{157} = 12.5$.

–

TABLE 1.5 Variance of IQ scores in Grade 6 class from Table 1.4

SCORE	DIFFERENCE FROM MEAN	SQUARED DIFFERENCE FROM MEAN (VARIANCE)
88	−22	484
94	−16	256
99	−11	121
102	−8	64
105	−5	25
111	+1	1
111	+1	1
111	+1	1
119	+9	81
125	+15	225
125	+15	225
130	+20	400

In a normal curve, a certain set percentage of scores will fall within one, two, three or four standard deviations of the mean, as shown in Figure 1.16.

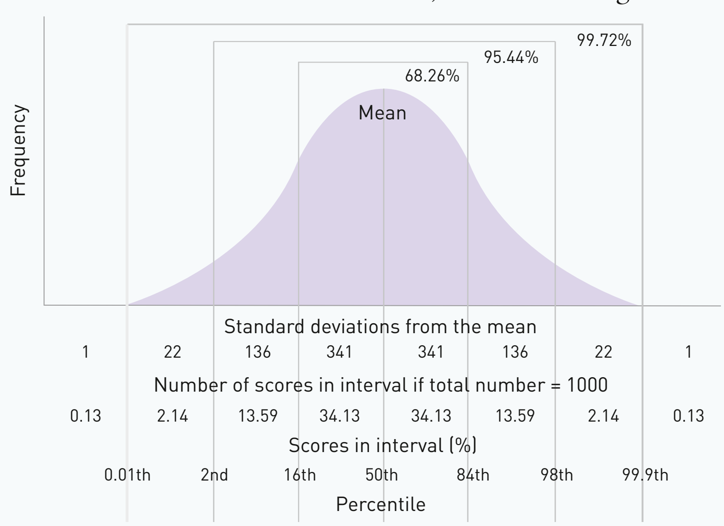


FIGURE 1.16 Distribution in a normal curve, showing percentiles by standard deviation

Inferring from data

Inferential statistics are statistical procedures that enable researchers to decide whether changes in the IV have caused changes in the value of the DV.

As we have seen, psychological research is always testing hypotheses – and all our efforts in research design aim to make sure that our conclusions are accurate.

After the experiment, the researcher needs to decide whether the results could be due to chance alone – or if there is a cause-and-effect relationship between the IV(s) and the DV(s).

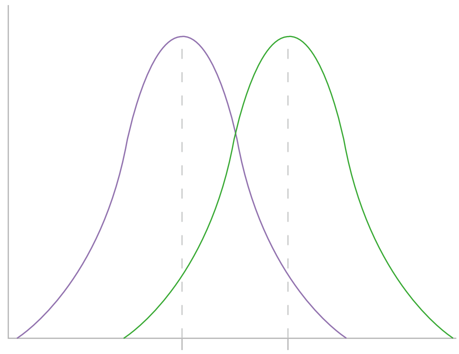


FIGURE 1.17 While the control group and the experimental group have different means, the significance of the difference depends on the sample size.

To do this, the researcher calculates the mean score for the E-group and the C-group and uses **inferential statistics** to decide whether the difference is **statistically significant** or is likely to have been caused by pure chance.

Obviously in Figure 1.17, the means are different. The question is, are they different enough to show that the IV has caused a significant change?

In Figure 1.17, the E-group mean is higher than the C-group mean, but is this statistically significant? This will depend on the size of the sample as well as the difference. The *larger* the sample, the *less* difference is needed to reach statistical significance.

The inferential tests will give a *probability* that the difference is caused by chance. This is expressed as a ***p*-value** where $p = 0.03$ means that there are three chances in 100 (3%) that this difference would be achieved by chance alone.

Psychologists are generally prepared to accept that a difference is statistically significant if the difference could have been caused by chance alone on five or less times in 100. This is stated as $p \leq 0.05$.

INVESTIGATE 1.5

P-VALUES

The following *p*-values have been found after different research procedures:

$p = 0.01$ $p = 0.10$

$p = 0.05$ $p = 0.50$

$p = 0.005$ $p = 0.02$

1 Put them in order from *lowest* to *highest* in terms of the probability that the results are due to chance.

2 Indicate which results are statistically significant (SS) and which are non-significant (NS).

STUDENT'S *T*-TEST

One of the simplest inferential techniques is called Student's *t*-test. 'Student' was actually a chemist named William Sealy Gosset who was working for the Guinness brewery in Dublin, Ireland in 1908. Gosset invented the *t*-test as a cheap and easy way of monitoring the quality of Guinness Stout! His employers were afraid of other brewers also being able to use statistical methods for their quality control and Gosset's identity had to be kept secret so he published his work under the name of 'Student'!

APPROPRIATENESS OF CONCLUSIONS AND GENERALISATIONS BASED ON RESULTS

A **conclusion** is the final decision about what the results mean. This conclusion must be stated in terms of the original hypothesis. So a conclusion would be that the hypothesis is *rejected* or *supported*.

Psychologists never say that a hypothesis has been ‘proven’ or ‘disproven’. After all, there may be another hypothesis that explains the relationship even better than the one that was tested.

A **generalisation** is a judgment about the extent to which the research findings can be applied to the population represented by the sample. The ability to generalise from a sample relies on all the following conditions being met:

- the sample must represent the population of interest
- the results must reach statistical significance
- the effects of all potentially confounding variables must have been controlled.

1.8 REVIEW

For each description below, indicate whether the generalisation of findings is appropriate. If there are difficulties, indicate whether it is with internal or external validity.

1 Professor Brown hypothesises that damage to the left frontal lobe of the brain reduces memory ability for two-dimensional figures. He chooses a valid measure of visual-spatial memory and assesses 100 brain-damaged patients and 100 normal (undamaged) controls.
   → He calculates the mean score (percentage) for the two groups as follows: brain-damaged group – 57 per cent; control group – 83 per cent.
   → He performs a *t*-test and discovers that, for this difference, $p = 0.04$.
   → He concludes that the difference does not reach statistical significance and rejects his hypothesis.

2 Kristina is researching the effects of sleep deprivation on memory. She intends to use an independent groups design, so she devises a comprehensive survey and asks her friends to send it to all the people listed as their ‘friends’ on Facebook, all of whom are between 18 and 25 years of age. She receives 300 responses in a few days and is delighted with this number of participants.
   → Kristina calculates $p = 0.03$ and concludes that, for adults between the ages of 18 and 25 years, sleep deprivation is related to decrease in memory ability.

3 Myra has a theory that driving a car becomes an automatic process at an earlier age for boys than for girls. She asks 200 volunteer participants from München University to undertake a task in which they drive a manual car around an obstacle course while they were reciting the 5, 7 and 9 times tables aloud. Independent observers score the participants on their driving ability.
   → When Myra calculates the results, she discovers that, when calculated on an age-corrected basis, boys score higher than girls by an average of 26 per cent. This is shown by a *t*-test to have a value of $p = 0.06$.
   → Myra concludes that her hypothesis is supported and that for students at München University, driving a car becomes an automatic process at an earlier age for boys than for girls.

SUPPORTING UNDERSTANDING

Measures of relationship

Correlational studies are intended to identify and describe the relationship between two variables. Unlike the experimental method, the correlational method makes no attempt to manipulate variables. Rather, the intent is usually to establish the *strength* and *direction* of any correlation that may exist between the two variables.

- **Correlation:** A correlation is a statistical measure of how much two variables are related. A correlation does not show a cause-and-effect relationship; it simply describes how they vary in relation to each other.
- **Positive correlation:** A positive correlation is when two variables change in the same direction – that is, as one increases, so does the other; or as one decreases, so does the other. For example, we might expect to find a positive correlation between hours spent studying each week and study scores in VCE – as the number of hours spent studying each week increases, the average study score in VCE will increase.
- **Negative correlation:** A negative correlation is when two variables change in the opposite direction – that is, as one increases, the other decreases. For example, we might expect to find a negative correlation between hours spent playing online games and study scores for VCE – as the number of hours spent playing online games increases, the average study score in VCE will decrease.
- **Strength of correlation:** Correlation also shows the strength of the relationship. This is indicated by a correlation coefficient, expressed as a decimal number in the range of –1.0 to +1.0.
  - The (+) or (–) sign before the number shows whether it is a positive or negative correlation. The number following the positive or negative sign indicates the strength of the correlation. Correlation coefficients of +1.0 or –1.0 show perfect positive or perfect negative correlations respectively. As one variable increased by one unit, the other variable would increase by one unit (perfect positive correlation) or decrease by one unit (perfect negative correlation). A correlation coefficient of 0.0 indicates that the two variables are not related in any way.

negative correlation | positive correlation

high | moderate | low | low | moderate | high

-10 -0.9 -0.8 -0.7 -0.6 -0.5 -0.4 -0.3 -0.2 -0.1 0 +0.1 +0.2 +0.3 +0.4 +0.5 +0.6 +0.7 +0.8 +0.9 +1.0

- **Scatter diagrams (scatter plots):** Correlational data are often represented graphically by a scatter diagram. A scatter diagram shows the values of the two variables for each participant in the sample by representing the intersection of those two values with a dot on a graph.

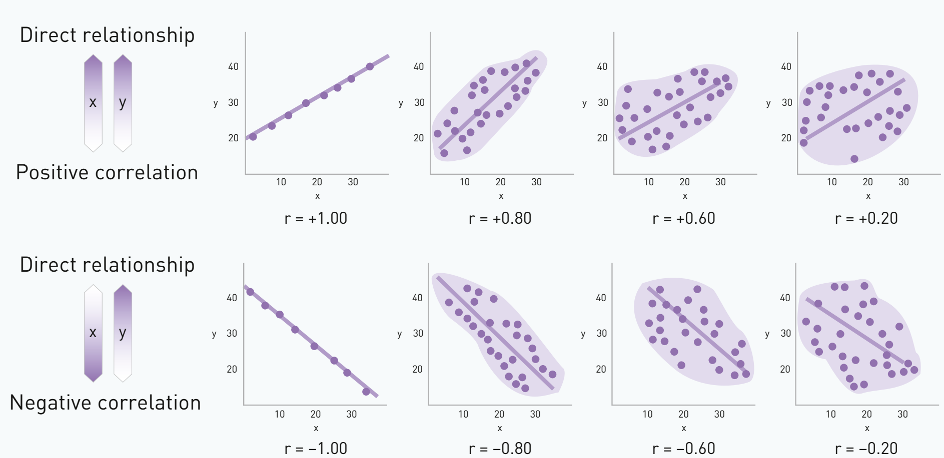


FIGURE 1.18 Scatter diagrams showing relationship and correlations. The scatter diagrams show various strengths and directions of correlation, from perfect positive correlation to perfect negative correlation.

Ethical considerations in psychological research with human participants

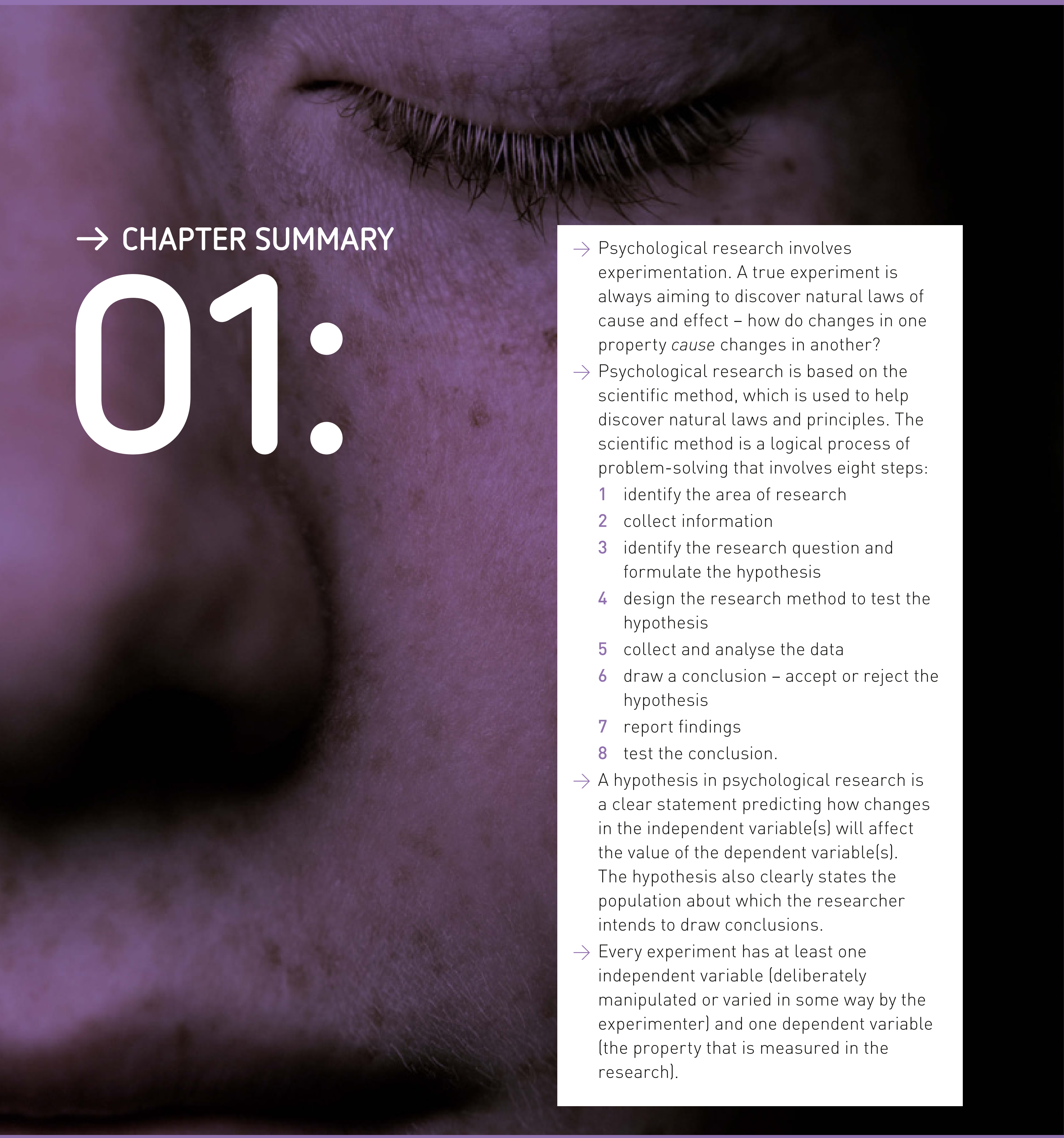
The Australian Psychological Society publishes a 'Code of Ethics' for psychologists and this has been adopted by the Psychology Board of Australia to apply to all psychologists in Australia.

- **The role of the experimenter:** The researcher must always act in a professional manner, making sure that the best interests of the participants, and of society in general, are met.
- **Participants' rights (respect for participants):** Researchers must always maintain respect for the participants. Participants' rights include those listed below.
  - **Confidentiality (privacy):** This means that participants must not be identified in any way in terms of test results, their involvement in the study or any other confidential data. Data needs to be stored and disposed of using secure procedures. The means by which confidentiality is to be established and maintained should be described to the participants at the beginning of the study.
  - **Voluntary participation:** Participants have the right to refuse to take part in a study. There must not be any pressure to take part in a study, nor should they be tricked into taking part by deception.
  - **Withdrawal rights:** Participants have the right to leave a study at any stage, regardless of the possible effects on the results. They also have the right to withdraw their results after the study has been completed. This must be explained to the participants before beginning the study.
- **Informed consent:** Participants must be given information about a study before they agree to take part. For participants who are either too young or too intellectually disabled to give their consent, their guardian must be given the information before giving consent on their behalf.
- **Deception in research:** This is only permitted if the results would be confounded if the participants had much information before taking part in the study. The researcher must ensure that participants do not unexpectedly suffer distress; the study must be stopped immediately if this occurs. Participants must be debriefed when the study is complete.
- **Debriefing:** Debriefing takes place after completion of the study and participants are told the results and conclusions of the study. Any erroneous beliefs about the study are corrected, especially if there was any deception involved. Participants are informed of the availability of counselling if they feel the need.

FIGURE 1.19 Monash University – one of the world's top 50 universities. All universities conducting research will have a Human Research Ethics Committee.

1.9 REVIEW

1 What is the overriding ethical consideration in psychological research?
2 List those ethical considerations that fall into the category of *participants' rights*.
3 What is meant by 'the role of the experimenter'?
4 What must be included in 'informed consent procedures'?
5 When does debriefing take place and what does it involve?
6 When is 'deception' permitted in research? What provisions must be made when deception is to be used?



→ CHAPTER SUMMARY

01:

- Psychological research involves experimentation. A true experiment is always aiming to discover natural laws of cause and effect – how do changes in one property *cause* changes in another?
- Psychological research is based on the scientific method, which is used to help discover natural laws and principles. The scientific method is a logical process of problem-solving that involves eight steps:
  1. identify the area of research
  2. collect information
  3. identify the research question and formulate the hypothesis
  4. design the research method to test the hypothesis
  5. collect and analyse the data
  6. draw a conclusion – accept or reject the hypothesis
  7. report findings
  8. test the conclusion.
- A hypothesis in psychological research is a clear statement predicting how changes in the independent variable(s) will affect the value of the dependent variable(s). The hypothesis also clearly states the population about which the researcher intends to draw conclusions.
- Every experiment has at least one independent variable (deliberately manipulated or varied in some way by the experimenter) and one dependent variable (the property that is measured in the research).

- An extraneous variable is a variable other than (extraneous to) the independent variable that could cause changes in the value of the dependent variable.
- An extraneous variable becomes a confounding variable if it causes a systematic variation in the value of the DV (acts like a second IV)
- In participant selection, a sample is chosen to represent the population. Two procedures used to make sure that the sample is representative are random sampling and stratified sampling (stratified random sampling).
- The basic experimental method uses two different groups called the experimental group (E-group) and the control group (C-group). Members of the experimental group are exposed to the independent variable. The purpose of the E-group is to show the effects of the independent variable on the value of the dependent variable. The control group consists of the participants who are not exposed to the independent variable – they do not receive the treatment.
- The placebo effect refers to participants' behaviour being influenced by their expectation of how they should behave. The placebo effect can be eliminated by using a single-blind procedure in the experimental process.
- The experimenter effect refers to the outcome of an experiment being unintentionally (or intentionally) influenced by the experimenter, treating the members of E-group and C-group differently. The experimenter effect can be addressed by using a double-blind procedure in the experimental process.
- There are various types of data:
  - qualitative data – refer to descriptions of the characteristics of what is being studied.
  - quantitative data – refer to measurements, numerical information about the variables being studied.
- Collection of data is completed through case studies, observation, self-report questionnaires.
- Generalisation of results to the population occurs after the research is complete, provided:
  - results show statistical significance
  - all sampling procedures were appropriate
  - all experimental procedures were appropriate
  - all possible confounding variables were controlled
  - both internal and external validity has been established.
- The well-being of participants in psychological research must be safeguarded. The over-riding principle in all psychological research is that there must be no physical or psychological harm to participants.
  - Researchers must always maintain respect for the participants.
  - Participants must not be identified in any way.
  - Participants have the right to refuse to take part in a study.
  - Participants have the right to leave a study at any stage.
  - Participants must be given information about a study before they agree to take part.

→ ESSENTIAL EXAM KNOWLEDGE

KEY TERMS

For the exam you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate.

case study
conclusion
control group
counterbalancing
dependent variable
double-blind procedure
ethical principles
confidentiality
debriefing
deception in research
informed consent
voluntary participation
withdrawal rights
experimental design
independent groups
matched participants
repeated measures
experiment
experimental group
experimenter effect
generalisation
independent variable
measures of central tendency
mean
median
mode
normal curve
observational studies
operationalisation of variables
order effects
participant effect
participants' rights
placebo (& placebo effect)
population
probability (*p*-value)
qualitative data
quantitative data
questionnaire
random allocation
sample
convenience sample
random sample
stratified random sample
stratified sample
scientific method
self-reports
single-blind procedure
standardised instructions and procedures
statistical significance
variables
confounding variable
controlled variable
extraneous variable

KEY IDEAS

For the exam you must know:

- the purpose of the scientific method
- different variables involved in research (IV, DV, extraneous, controlled, confounding)
- procedures for operationalisation of variables
- statements of research hypotheses
- procedures for controlling for possible counfounds
  - sampling procedures
  - allocation procedures
  - single-blind procedures
  - double-blind procedures
  - counterbalancing
- experimental design – advantages and disadvantages of
  - independent groups
  - matched participants
  - repeated measures
- methods of data collection
  - case studies
  - observational studies
  - self-reports
  - questionnaires
- statistics
  - measures of central tendency
  - probability (p-values)
  - conclusions
  - generalising to the population
- ethical considerations
  - participants' rights (confidentiality, voluntary participation, withdrawal rights, informed consent procedures, debriefing)
  - use of deception in research

- research methods
  - you will be expected to apply your knowledge of research methods to a specific research scenario that will be described in Section C of the examination.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

Questions 1, 2 & 3 refer to the following information:

A researcher has been investigating whether excessive time spent playing online games causes a reduction in academic success at school. He compares the memory skills for learning a list of 40 botanical names of plants of students who spent more than five hours per week playing games with the memory skills of students who spent less than five hours per week playing games. When a test of significance was run, the difference in the mean scores had a statistical significance of p = 0.02. He claimed that this showed that playing online games causes reduced academic success for students.

1 Was the researcher correct? Why?
  - a Yes, because the results reached statistical significance.
  - b No, because $p = 0.02$ is not statistically significant so no such conclusion can be drawn.
  - c No, because school examinations are not a valid measure of academic achievement.
  - d Unlikely, because he had not matched participants on any other variables so the results were likely to be confounded.

2 In this research the *independent variable* is:
  - a whether participants spent more or less than five hours per week playing online games
  - b students who played online games or students who did not play online games
  - c academic success or academic failure
  - d academic success; hours students spent playing online games.

3 In this research the *dependent variable* is __________ operationalised as __________.
  - a excessive time spent playing online games; number of hours per week spent playing online games
  - b students who play online games; over five hours per week spent playing online games
  - c academic success; average percentage score in school examinations
  - d academic success; score on test of memory of 40 botanical names of plants.

4 Empirical research is the process by which psychologists and other scientists collect and analyse data. They can then make informed statements about properties of the population. In this sense, the word *population* refers to:
  - a all the people who live in a certain area
  - b all the people of a certain age
  - c all the people about whom the researcher wishes to draw conclusions
  - d all the people who took part in the experiment or research.

5 Inferential statistics are statistical procedures that allow us to:
  - a prove or disprove a hypothesis
  - b draw conclusions from data
  - c describe the properties of the data gathered
  - d manipulate data and calculate standard scores.

6 Which of the following shows the highest level of statistical significance?
  - a $p = 0.50$
  - b $p = 0.055$
  - c $p = 0.05$
  - d $p = 0.005$

7 The purpose of using different experimental designs is to try to reduce the influence of confounding variables, but each design may have its own problems. The problem of the sample becoming biased because of a change in the characteristics of the sample during the research is greatest in which design?
   a repeated measures
   b independent groups
   c matched pairs
   d independent measures.

8 The purpose of the experimental group in research is to:
   a ascertain the effects of the dependent variable
   b eliminate the effects of the dependent variable
   c ascertain the effects of the independent variable
   d eliminate the effects of the independent variable.

9 The best definition of a random sample is:
   a a group of participants selected from the population by picking names at random from the phone book
   b a group of participants selected from the population by putting all the names in a hat and drawing them out at random
   c a group of participants selected from the population in such a way that each member of the population has an equal chance of selection
   d a group of participants selected from the population by means of a random number generator on a computer.

10 What type of research design involves testing the same participants more than once?
   a repeated measures
   b cross-sectional
   c independent groups
   d matched participants

11 Ashley tests the same participants of different ages for a number of years. He then compares participants born in different years to one another when they were a certain age. The differences among the same-age participants are more likely to be due to:
   a age rather than cultural change
   b cultural change rather than unique historical events
   c cultural change rather than age
   d age rather than the environment

Questions 12 & 13 refer to the following information:

Professor Plum is conducting some research to investigate how the human brain changes its responses when a person has been without sleep for 14 hours, compared with its responses one hour after awakening from a full night's sleep. To investigate this, he gives each of his first-year university psychology students a card and instructs them to attend the experimental session and hand in the numbered card, which will prevent them being penalised 5 per cent from their semester mark.

12 Which ethical principle is Professor Plum violating in terms of the rights of participants in research?
   a voluntary participation in research
   b informed consent from participants
   c confidentiality of participant information
   d no physiological or psychological harm to participants.

13 Later in the year, another researcher wishes to do further research and feels that the data collected by Professor Plum will be useful. The kind professor gives his colleague a list of the students and the data they collected. Which *further* ethical consideration(s) of participant rights has/have now been violated?
   a voluntary participation in research
   b informed consent from participants
   c confidentiality of participant information
   d both informed consent and confidentiality of participant information.

14 A random sample is needed in order to:
- a select subjects to take part in research so that there are equal numbers of males and females
- b ensure that there is no experimenter bias
- c ensure that experimental and control groups are similar in terms of participant variables
- d ensure that different characteristics within the population are also found within the participants in the research.

15 Professor Peabrain is researching the effects of increased vitamin intake through drinking carrot juice on the functioning of the rods in the eye. He gives his experimental group 125 ml of carrot juice each day while he gives the control group carrot juice that has been boiled and cooled so that the vitamins are inert. The purpose of the control group in this experiment is to:
- a show the effects of the independent variable
- b control or eliminate the effects of participant variables
- c form a basis for comparison with the experimental group
- d show the effects of the dependent variable.

16 Doctor Jeckyll is trying to discover the way in which a person's visual perception is affected by their expectations. To do this without biasing the participants' answers, he informs participants that they are doing an experiment investigating their visual acuity. This would be ethical only under the following circumstances:
- a Dr Jeckyll has permission from the ethics committee of his university
- b Dr Jeckyll has permission from the ethics committee of his university and has put appropriate debriefing and counselling procedures in place
- c Dr Jeckyll has put appropriate debriefing and counselling procedures in place
- d deceit in psychological research is never ethical.

17 The best definition of a random sample is:
- a a group of participants selected from the population by choosing people in the street on a random basis
- b a group of participants selected from the population by putting all the names in a rotating barrel and drawing them one at a time
- c a group of participants selected from the population in such a way that each member of the population has an equal chance of selection
- d a group of participants selected from the population by means of a random number generator on a scientific calculator.

Questions 18, 19 & 20 refer to the following information:

A researcher is investigating the effects on the sleep cycle of subjects using a lavender-scented pillow, which she believes will decrease nightmares. She has two groups of subjects. Subjects in one group have lavender-scented pillows and in the other they have pillows scented with other herbs. The researcher analyses subjects' dreams for negative content the next day. The subjects are not aware of which herbs are thought to reduce nightmares and the researcher is not aware of which subjects are using lavender and which are using other herbs.

18 The researcher is using:
- a a single-blind design to eliminate the placebo effect
- b a single-blind design to eliminate subject expectations
- c a double-blind design to eliminate experimenter bias
- d a double-blind design to eliminate placebo and experimenter effects.

19 Which of the following ethical guidelines has *not* been covered by the researcher?
- a confidentiality of participant information
- b informed consent from participants
- c voluntary participation in the research
- d withdrawal rights for participants.

20 What additional procedure should the researcher follow with this sample?

a She must obtain consent from participants' parents or guardians if participants are less than 21 years of age.

b She must obtain consent from participants' parents or guardians if participants are less than 18 years of age.

c She must obtain consent from participants' parents or guardians if participants are less than 16 years of age.

d She must obtain consent from participants' parents or guardians if participants are less than 14 years of age.

SHORT ANSWER

21 It is thought that adolescents will sleep for longer periods after they have spent the day studying or in intense physical activity, rather than after a normal day's activity. A researcher wished to study this.

a In this case, why would an independent groups design be less appropriate than a repeated measures design?

2 marks

b In this case, name and describe a process that could be used to eliminate order effects.

3 marks

22 a What is the meaning of the ethical consideration of *withdrawal rights* in psychological research?

1 mark

b What is meant by the ethical requirement of *confidentiality* in psychological research?

1 mark

Questions 23 to 29 refer to the following description of research:

Richard wished to compare the mood of Year 6 children after they had role-played being a victim of bullying (Condition 1) with their mood after they had role-played helping an injured person (Condition 2).

He decided to measure mood on a scale of 1 to 10, with 1 being 'depressed' and 10 being 'elated'. He obtained the figure by giving a 40-item 'mood test' from the Internet.

He took his measurements with the first 30 children on the school's alphabetical roll. The role-plays took place on Monday afternoons, one week apart. He made sure that half the children role-played Condition 1 the first week and Condition 2 the second, with the other half role-playing the conditions in the opposite sequence.

Richard's results showed that the mean mood score for Condition 1 was 3.4 and the mean mood score for Condition 2 was 7.2. This difference was statistically significant.

23 a What was the population in this research?

1 mark

b Was Richard's sampling procedure appropriate? Explain your answer.

3 marks

24 a What was the independent variable in this research?

1 mark

b What was the dependent variable in this research?

1 mark

25 How was the dependent variable operationalised?

1 mark

26 State an appropriate experimental hypothesis for this research.

2 marks

27 a What experimental design was used in this research?

1 mark

b Why did Richard make sure that 'half the children role-played Condition 1 the first week and Condition 2 the second, with the other half role-playing the conditions in the opposite sequence'? What name is given to this procedure?

3 marks

28 In calculating the statistical significance, Richard found a value of $p = 0.5$. Exactly what does this mean?

2 marks

29 Would it be appropriate for Richard to generalise his conclusions to all Year 6 students in the school? Explain your answer.

3 marks

Report writing for VCE

If you read through some psychological journals, you will see that there is a regular format followed by all the authors – all must follow the American Psychological Association guidelines, even in Australia. Each paper has the following sections: Abstract; Introduction; Method; Results; Discussion; and References.

The headings are always set out in the same way, starting with a capital letter and centred on the line.

- **Abstract:** The abstract will be on a page of its own. It is written last and summarises the whole of the rest of the paper. It should be written as a single paragraph, and will be no more than 150 words long in a report on a VCE Research Investigation.
- **Introduction:** In a journal article the Introduction does not have a heading. The introduction must:
  - state the research aim and explain the main concepts involved in the research
  - define all terms used in the research
  - summarise previous relevant research and explain why the research was considered necessary
  - state the independent variable and the dependent variable and indicate how they are operationalised
  - state the research hypotheses it is testing.
- **Method:** The Method section is intended to allow other people to understand your methodology and be able to replicate it. The Method can be subdivided into: participants, measures and procedure.
  - Give details of the age, sex, years of education or other common characteristics of participants in the sample.
  - The tests and measures used must be described in detail. Any evidence of their validity or reliability should be quoted. Sources must be acknowledged.
  - In the procedure section, the method used is described in detail, from the selection of the subjects to the exact method. A future researcher should be able to reproduce your method. If procedures such as counterbalancing have been used to control extraneous variables, this is where they are described.
- **Results:** Step by step, hypothesis by hypothesis, the results found must be shown. There must be no discussion in the Results section. There must be a table of descriptive statistics, showing who the participants were, and their scores on any tests or measures. Analytical statistics must show any significance in the differences identified between either 'before' and 'after' or 'experimental' and 'control' conditions.
  - Where appropriate, the information should be expressed visually, as a graph. A graph must always be preceded by a table which shows the graphed information in detail and must be appropriate to the type of information it is intending to illustrate. It must include labelling of axes, title, constant intervals on axes (unless it is a logarithmic graph) and origin point at zero where possible.
- **Discussion:** The discussion is based on the hypotheses which were the final part of the introduction.
  - Each hypothesis must be accepted or rejected in specific terms. If the hypothesis is supported, then no explanation is needed. If the hypothesis is rejected, it is necessary to explain why there was an error of judgment. An alternative hypothesis should be suggested and rationalised. The importance of the findings must be explained – what they mean and how they can be applied to the real world.
  - If the hypothesis has been supported (we **never** say proven) and all experimental procedures have been appropriate, then the conclusions can be **generalised** to the population represented by the sample.
  - Comments should identify any weaknesses in the current research and suggest further research in this area.
- **References:** The method of acknowledging sources of data and citing all materials used is extremely precise.
  - For citing a journal article, the convention is:
    - Author's name, and initial(s)., (Date). Title of the paper with no capitals or underlining. *The Name of the Journal with Capitals and Underlined or Italicised*. Volume number. Article pages from–to.
  - For citing a book, the convention is:
    - Author's name, and initial(s)., (Date). *Title of the Book With Capitals and Italics or Underlining*. Publisher: City.

STUDENT INVESTIGATION RUBRIC

CRITERION	0 TO 1
1 Title A relevant and appropriate title that captures the purpose of the investigation and incorporates the variables, including the IV and DV (if relevant).	Title reflects the purpose of the study and incorporates the variables (IV and DV if relevant)
2 Abstract Presents an abstract that includes statement of the aim, hypothesis (if relevant), summary of the methods (research design, participants, procedure), summary of results, conclusion and generalisations.	Summary of study is unclear and does not include the necessary elements. Reporting of results is incorrect or absent. Conclusion and/or generalisation is absent/ incorrect.
1 Introduction: Questioning and predicting Present introductory (background) information that leads to questions that are unambiguous, specific and confined and can be investigated scientifically.	Background material is unclear, inappropriate or not shown.
2 Introduction: Questioning and predicting Formulate aim and research hypothesis and identify and operationalise variables (if appropriate)	Aim, research hypothesis and/or variables are unclear, inappropriate or not shown.
2 Method: Planning and conducting Plan, select and use appropriate research investigation methods and materials and systematically collect reliable data	The research method, materials and/or procedure are unclear, inappropriate, incomplete or not shown.
3 Method: Planning and conducting Appropriately select participants and plan and conduct investigation within ethical guidelines	Participant selection and/or participant details are unclear, inappropriate, incomplete or not shown.
4 Results: Processing and analysing data and information Display and analyse patterns in data, including describing the data, relationships between variables (if appropriate) and identifying inconsistencies in data	Display of data and/or analysis of results are unclear, inappropriate, incomplete or not shown.
5 Discussion: Processing and analysing data and information Analyse results in terms of the aim and research hypothesis (if applicable). Use knowledge of psychological concepts and background information to draw conclusions that are consistent with evidence.	Discussion of results in terms of the aim and support for the research hypothesis (if applicable) and/ or connection to the psychological concepts and background information are unclear, inappropriate, incomplete or not shown.
6 Discussion: Evaluating Evaluate conclusions, including identifying possible extraneous variables and describe specific ways to improve the quality of the data to minimise the effects of extraneous variables.	Evaluation of the conclusions is irrelevant, unstructured or not shown.
7 Discussion: Evaluating Express the significance of these findings and offer suggestions for future research	Implications of these findings are irrelevant, inappropriate or not shown.
8 Communicating Communicate psychological ideas and information, including constructing evidence-based arguments and using appropriate psychological language, theoretical models and previous research.	Report lacks logical structure and/or relevant psychological information to communicate ideas.
9 Referencing Cite and reference sources of information within body of text and reference list according to APA format (if relevant).	Sources of information are inaccurately referenced or not shown.

2 TO 3	4 TO 5	TO 7
Summary of study lists the main features of each section of the investigation report.	Summary of study is concise and includes all the elements. Method clearly outlined with information about the sample, hypothesis (if applicable) and correct interpretation of results and ability to draw conclusions and generalisations.	
Introduction identifies relevant background information and defines key psychological terms/ concepts.	Introduction describes relevant background information and explains key psychological terms/concepts that lead to the reasons for this investigation and clear research question(s).	Introduction reflects on relevant background information and integrates psychological terms/ concepts to provide reasons for this investigation and clear research question(s).
Aim and, if appropriate, hypothesis are stated and variables are identified.	Aim and, if appropriate, research hypothesis are clear and accurate, variables are identified and operationalized.	Aim is clear and, if appropriate, accurate, research hypothesis accurately identifies IV, DV and population and predicts a directional outcome and variables are identified and operationalized.
The research method, materials and procedure are listed and ethically sound.	The research method, materials and procedure are appropriately designed, named and described and ethically sound.	The research method, materials and procedure are appropriately designed, explained and justified and ethically sound.
Participant selection and details are named and ethical guidelines clearly followed.	Participant selection and participant details are described in detail and ethical guidelines are clearly followed.	
Summary of data is displayed and listed.	Data is accurately displayed and patterns in the data are evident and explained.	Data is accurately and clearly displayed, analysis of the patterns revealed in the data is comprehensive and accurate.
A statement indicating whether the results support or refute the research hypothesis (if applicable) or linked to the aim is given and consistent with the evidence.	Results are discussed in terms of support for the research hypothesis (if applicable) and aim. Conclusions are drawn in light of psychological concepts and background information and the evidence.	Results are analysed in terms of support for the research hypothesis (if applicable) and aim. Insightful conclusions are drawn in light of psychological concepts and background information and the evidence.
Limitations of the study are named. Generalisation of results listed.	Conclusions are evaluated, with possible extraneous variables explored in terms of the way they may have impacted on results and how they could be minimised in future. Appropriate generalisations are given.	Conclusions are comprehensively evaluated, with strengths and limitations/ problems with this investigation analysed. Appropriate generalisation of the results is explored.
Implications of these findings and suggestions for future research are listed.	Implication of results, including possible generalisation and application of findings and suggest directions for future research.	
Logical structure is used to communicate psychological ideas in an appropriate manner suitable for the intended audience.	Focussed and logical structure is used to communicate psychological ideas and information in a clear and concise manner suitable for the intended audience.	
Sources of information are correctly referenced and cited using APA format.		

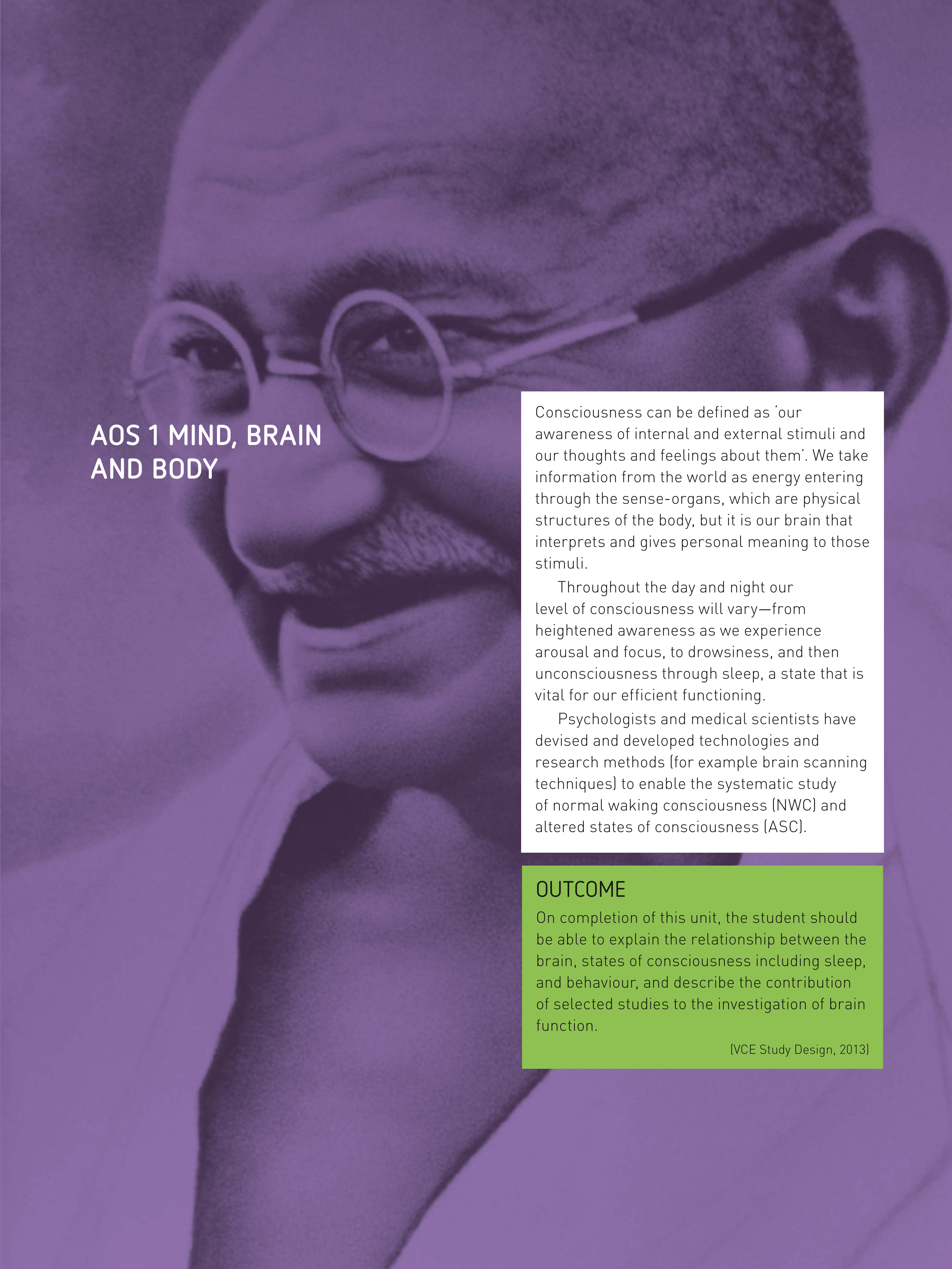
UNIT 03: THE CONSCIOUS SELF

What is it that makes you the person you are? What makes us different from each other and different from other animals? What makes us unique even though we are universal human beings and members of specific groups and cultures? Psychologists now have taken up this question and seek to understand the interactions between the brain and the mind through examining the physiological and psychological basis of mental processes and behaviours.

In Unit 3, we look first at the mind, the brain and the body and how the physical features of the brain and nervous system and the biochemical processes of the body and brain enable us to think, plan, learn and communicate.

Each day we cycle through many states of consciousness, from heightened awareness to drowsiness and sleep. In this unit, we learn about the vital process of sleep: without sleep, we die; with too little, we are dysfunctional! Medical scientists and psychologists have developed (and continue to develop) ways to help study sleep and altered states of consciousness.

Next we look at the amazing property of memory and examine the biochemistry and the psychology of how we remember, how we forget and how we can influence the extent to which we are able to maximise and minimise these processes respectively.



AOS 1 MIND, BRAIN AND BODY

Consciousness can be defined as 'our awareness of internal and external stimuli and our thoughts and feelings about them'. We take information from the world as energy entering through the sense-organs, which are physical structures of the body, but it is our brain that interprets and gives personal meaning to those stimuli.

Throughout the day and night our level of consciousness will vary—from heightened awareness as we experience arousal and focus, to drowsiness, and then unconsciousness through sleep, a state that is vital for our efficient functioning.

Psychologists and medical scientists have devised and developed technologies and research methods (for example brain scanning techniques) to enable the systematic study of normal waking consciousness (NWC) and altered states of consciousness (ASC).

OUTCOME

On completion of this unit, the student should be able to explain the relationship between the brain, states of consciousness including sleep, and behaviour, and describe the contribution of selected studies to the investigation of brain function.

(VCE Study Design, 2013)

→CHAPTER 02:

NORMAL WAKING CONSCIOUSNESS AND ALTERED STATES OF CONSCIOUSNESS

Consciousness relates to our awareness of our thoughts, feelings, perceptions and surroundings at any ONE moment in time. It creates our reality (what we believe to be real) and our sense of self. This chapter examines different states of consciousness – from when you are alert, to being not fully aware or even lacking awareness altogether. Consciousness can deliberately be altered through activities such as meditation and the use of drugs such as alcohol, or it can be altered naturally through activities such as daydreaming and sleep.

KEY KNOWLEDGE

Concepts of normal waking consciousness and altered states of consciousness, including daydreaming 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.

(VCE Study Design 2013)

States of consciousness

CHAPTER OVERVIEW

Normal waking consciousness	Characteristics of normal waking consciousness > Level of awareness > Content limitations > Attention > Controlled and automatic processes > Perceptual and cognitive distortions > Emotional awareness > Self-control > Time orientation
Altered states of consciousness	Characteristics of altered states of consciousness > Level of awareness > Content limitations > Controlled and automatic processes > Perceptual and cognitive distortions > Emotional awareness > Self-control > Time orientation Daydreaming Why is daydreaming considered to be an altered state of consciousness? Alcohol-induced states

Are you conscious? If you are reading this, the answer is most definitely yes! You probably already have a good idea about the meaning of the word ‘conscious’ and, indeed, the word ‘unconscious’. In everyday conversation, we tend to use ‘conscious’ interchangeably with the word ‘aware’. For example, how aware are you at this moment? Your answer is likely to include how alert you feel, what you are currently thinking, what emotions you are experiencing, what sensations you perceive and what you are noticing about your surroundings. Your answer is obviously very subjective – it depends on what you are experiencing at this point in time and is often difficult to describe to others as well as being difficult for others to completely comprehend your experience. Studying conscious is complex and presents a number of challenges.

The chapter begins with a brief introduction to consciousness. In the rest of this chapter, we will explore the notion of normal waking consciousness and compare it to altered states, with particular focus on daydreaming and alcohol-induced states. In later chapters, we will discuss sleep and link consciousness to cognitive processes and the role of the brain.

SUPPORTING UNDERSTANDING

What is consciousness?

Consciousness can be defined as the awareness of our own thoughts, feelings and perceptions (internal events) and our surroundings (external stimuli) at any given moment. It includes all the experiences that we are consciously aware of at any particular time. It creates our reality (what we believe to be real and happening at this moment) and is central to our sense of self. Our sense of self is developed through being aware of what we are doing, why we are doing it and the awareness that others are probably observing, evaluating and reacting to what we are doing. Take a look around you. Can you describe your surroundings? Are you aware of what is going on in your environment? How do you feel about it?

Others cannot directly know what you are thinking, feeling or perceiving, and most of us have some difficulty conveying our thoughts, feelings and perceptions to others. Our own conscious experience is personal and private, and it is difficult to measure accurately or compare with other people's.

States of consciousness

Right now you are paying attention to the words on this page, but what were you focusing on a moment ago? Maybe you were daydreaming, making plans for the weekend or waking up from sleep – or were you arguing with your parents? All these different mental activities represent different states of consciousness.

Our level of awareness of internal events and external surroundings varies throughout the day. You will have times when you are alert (such as during your psychology class, of course!) and others when you are feeling quite drowsy. Consciousness can be thought of as operating on a continuum from a high level of consciousness or awareness through to the point of being unconscious (being totally unaware). The more aware we are of our thoughts, feelings, perceptions and surroundings, the higher the level of consciousness. The level of awareness of internal events and external surroundings is known as a **state of consciousness (SOC)**.

Early psychology

William James (1842–1910), a great American psychologist, wrote one of the most influential psychology textbooks, *Principles of Psychology,* in 1890. It took almost 12 years to write and is still widely read in print and online today.

William James was trained as a medical doctor and initially taught physiology and anatomy at Harvard University. He drifted into psychology and pioneered a psychology course. He ended his career studying philosophy. Like Descartes, he was religious. James believed that it was too simple an idea to infer that small changes in the brain cause complex human behaviours and called this idea 'psychology without a soul'.

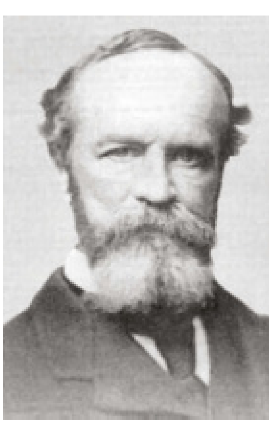


FIGURE 2.1 American psychologist William James (1842–1910)

James studied the conscious experience. He loved fishing, and was supposedly at his favourite fishing spot when he created the analogy of consciousness with a stream. He noted that our conscious experience is unbroken and continuous, despite constantly shifting and changing. James coined the phrase '**the stream of consciousness**' and viewed consciousness as an ever-changing stream of thoughts that can shift smoothly and effortlessly from one moment to the next, just like water flowing in a stream.

According to James, our conscious experience:

- is *continuous*: it is never empty; thoughts are not isolated and can flow easily from one topic to another without interruption
- is *ever-changing*: it rarely travels along one line of thought and constantly changes as we become aware of new information
- is a highly *personal experience*: it relies on our own thoughts, feelings and perceptions
- is *selective*: we can usually choose to focus on some things and ignore others; we can focus on *internal* events (thoughts, feelings and perceptions) and/or *external* surroundings
- is *active*: consciousness has a purpose to allow us to function in our world.

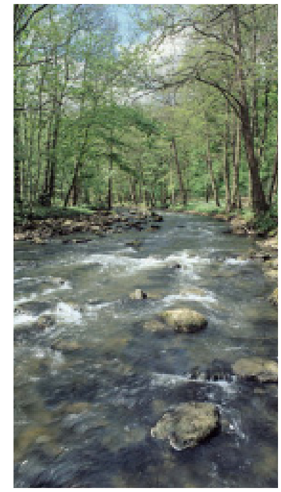


FIGURE 2.2 James likened consciousness to a stream of ever-changing thoughts that flow smoothly from one to the next.

> 'Consciousness … does not appear to itself chopped up into bits … a "river" or a "stream" are the metaphors by which it is most naturally described … as the brain changes are continuous so do all these consciousnesses melt into each other like dissolving views. properly they are but one protracted consciousness, one unbroken stream.'
>
> William James (1890)

When you looked out of the window earlier, you might have focused initially on the question. You were conscious of the question and thought of the type of animals that could be outside. Maybe you wondered about what they could be doing (eating, following each other around, fighting). Your consciousness might then have shifted to a conversation you had at recess with a friend. Then you might have wondered what you would buy at the canteen to eat for lunch. Next, you could have focused on the other students in the class to see if they were still looking out the window. Then a thought about how uncomfortable your shoes were might have crossed your mind. Finally, you might have wondered what the original question was again and tried to focus on zoo animals! In the above scenario, your consciousness focused on internal and external events and consisted of an ever-changing stream of thoughts that shifted from one moment to the next with relative ease. It drifted along the stream at different paces.

James' work on consciousness is still highly regarded by many as having a tremendous impact on psychology. There has been a resurgence of studying human consciousness since the 1960s and today it is generally accepted that the human mind (consciousness) is a characteristic of being human and that without the brain consciousness is not possible. Consciousness pinpoints a large difference between computers and humans. We can focus our attention on events, such as becoming consciously aware of our thoughts and feelings, or we can look outwards and become consciously aware of our environment. Computers lack this ability; they cannot understand what is happening in the same manner as we do. Essentially, being human encompasses the complexities of our mind, brain and body, the title of Unit 3, Area of Study 1.

William James: 'The stream of consciousness'

Go to Investigate 2.1 and attempt to complete it. Pay attention to your thoughts for five minutes while you do so. What did you think of? Did your mind keep track and focus on the question? The odds are that it didn't – your thoughts probably wandered at times.

INVESTIGATE 2.1

OUT THE WINDOW!

1 On an A4 sheet of paper, draw a stream or river.
2 Stand up and look out the window.
3 Imagine that some animals have escaped from the zoo and you can see them out the window.
4 For two minutes, think about what the consequences of this would be, e.g. what could it look like outside this window?
5 Pay attention to your thoughts and write brief points down on paper, making sure the order of your thoughts as they flow from one to another is evident. You might like to share some of your thoughts with the class.

Questions to consider:

- What types of animals did you imagine? What were they doing?
- Did your thoughts wander off track or did they focus on answering the question?
- Was it easy, almost automatic and involuntary, to shift your awareness from one event to another?
- At times, did you find yourself concentrating on internal events (e.g. whether or not you are hungry, what homework you need to do tonight, how psychology is a great subject to study)?
- At times, did you find yourself concentrating on your external surroundings (e.g. what other students are doing, a noise outside the room, people walking outside)?
- Read about William James. While initially you were forced to think about a question, the activity went for long enough for it to be part of a stream of consciousness. Explain how this activity relates to James' notion of 'stream of consciousness'.Figure 2.1 American psychologist William James (1842–1910)

FIGURE 2.3 During NWC, you experience a real sense of time and place.

Normal waking consciousness

Think about how aware you are of your thoughts and feelings and what is happening around you at the moment. You have a real understanding of where you are, what time it is, what you are thinking, how you are feeling and who you are with. That is, you are experiencing normal waking consciousness – a state that is relatively organised, meaningful and clear. **Normal waking consciousness (NWC)** can be loosely defined as the states of consciousness you experience when you are awake and aware of your thoughts, feelings and perceptions from internal events and the surrounding environment. During normal waking consciousness, you experience a real sense of time and place. Your experience during normal waking consciousness creates your reality and provides a baseline from which to judge all other states of consciousness.

Throughout the day, and even throughout a lesson, your level of awareness will vary. You may focus intently on reading your textbook but later feel a bit drowsy and find yourself distracted by noise in the corridor outside. These changes are part of normal waking consciousness.

Characteristics of normal waking consciousness

The following characteristics help determine whether you are experiencing normal waking consciousness.

LEVEL OF AWARENESS

Awareness relates to how conscious or aware you are of internal (within your body) and/or external (within your environment) events. A number of levels of awareness exist during normal waking consciousness. It is not unusual to swap 'consciousness' with the term 'awareness' since they are linked together. Your level of awareness influences the other characteristics of consciousness.

Different levels of awareness can be viewed as a **continuum of awareness,** ranging from deep unconsciousness to heightened awareness, as shown in Figure 2.4. Normal waking consciousness tends to occupy middle part of the continuum (the awake to alert zone), with reduced awareness as an altered state of consciousness below and heightened awareness as an altered state of consciousness above.

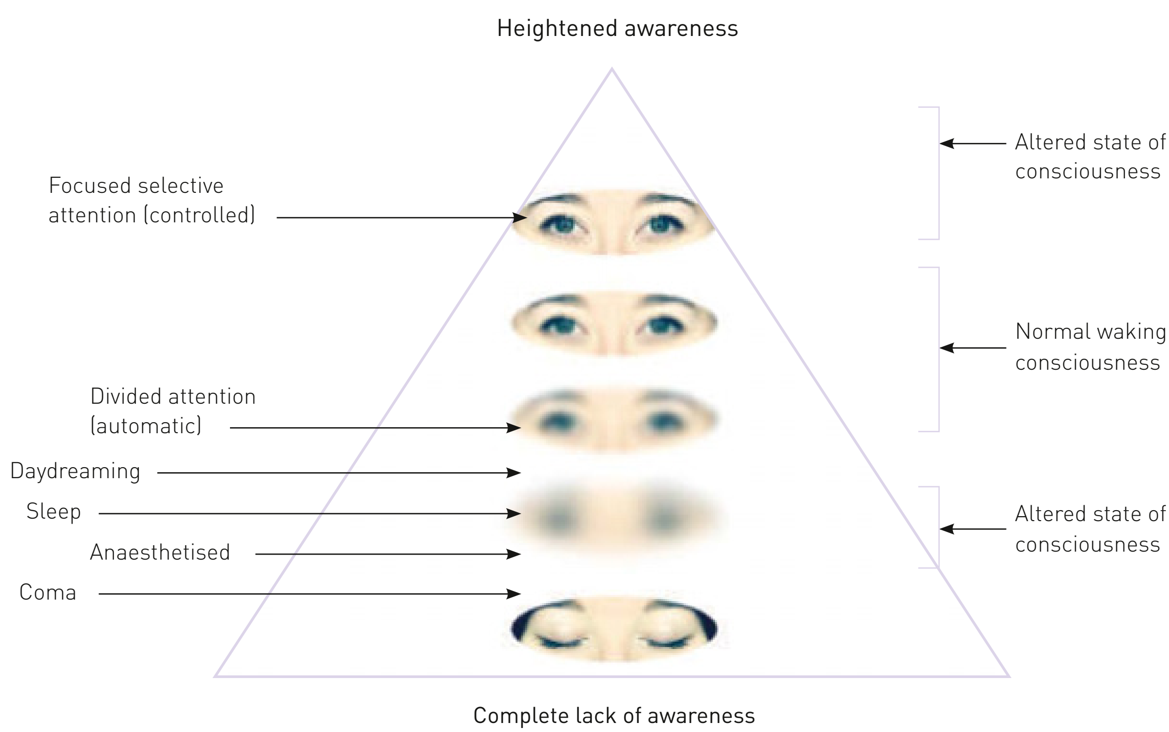


FIGURE 2.4 The continuum of awareness

INVESTIGATE 2.2

LEVELS OF AWARENESS

Study the following pictures. Place the pictures in an order along a continuum, from total awareness to complete lack of awareness. Are some easier to place on the continuum than others? Explain.

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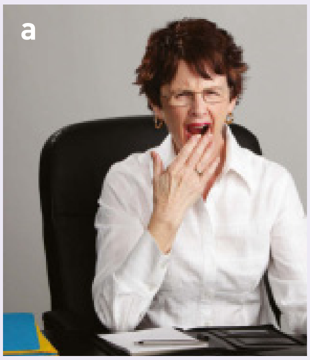
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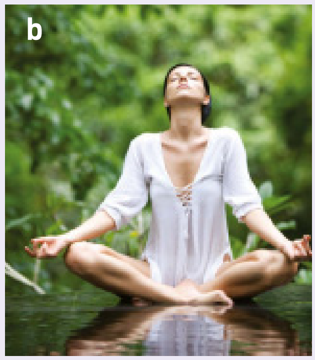
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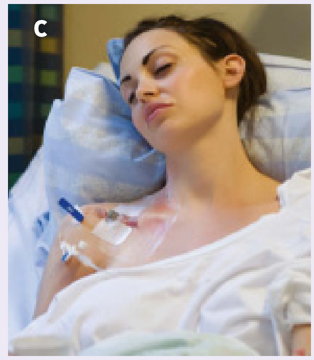
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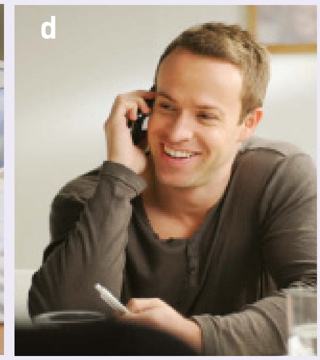
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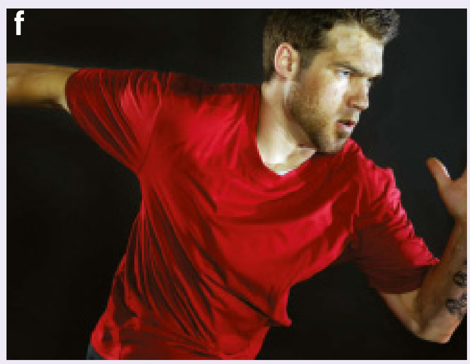
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CONTENT LIMITATIONS

During normal waking consciousness, we mainly control what we focus our attention on, and our thoughts tend to be organised and logical. For instance, to read this page you must focus your attention on the page and be able to see the print. You need to think logically and limit your attention to what is written in order to fully understand. The content (type of information) of normal waking consciousness is therefore generally *more limited* (restricted) than the content of consciousness during an altered state. Our thoughts tend not to be as creative, bizarre, unrealistic or impossible compared to our thoughts during an altered state of consciousness.

ATTENTION

Try this: sit quietly in your seat. Think about the information you are sensing from your environment. What do you perceive? Now, focus on the pressure on your feet from your shoes. Can you feel the pressure? What about the pressure on your bottom from sitting on your seat? It is likely that you were not consciously aware of the pressure before reading this – the book prompted you to attend consciously to this information.

At any given time, an enormous amount of information is available from our senses, memories and other cognitive processes. It is impossible to attend to all of this information, and your attention can be focused on events that are taking place in the environment (*external*) or inside our minds (*internal*) and attention can shift *consciously* or *unconsciously*.

Attention relates to the information that you are *actively processing*, either consciously or even outside your conscious awareness. Attention overlaps with consciousness, as what you are consciously aware of is often also the focus of attention. For example, try recalling what you ate for dinner last night. The answer requires attention in order to reach your conscious awareness. Another example, such as typing your name on a keyboard, is likely to require little conscious awareness. In this case, you are actively processing the task but not at a conscious level.

A range of stimuli can attract our attention, including:

- novel stimuli (such as something new or unusual),
- changes in stimulation (such as the volume on a radio suddenly increasing), and
- something that is personally meaningful to us (such as our name being mentioned across a crowded room) or important to us to attend to at the time.

INVESTIGATE 2.3

ARE YOU PAYING ATTENTION?

Go to The Awareness Tests UK website. View the video clip 'Basketball Awareness Test' and follow its instructions.

1 Did you get the correct answer? How many members of your class got the correct answer?
2 Was your attention limited while watching the clip? Why?
3 Link your experience to content limitations and attention in normal waking consciousness. Was the information in your consciousness limited to what you were paying attention to?

Attention may be broadly classified into the following types:

A: Selective attention

Content limitations during normal waking consciousness are due mainly to **selective attention**. Selective attention refers to the *limitations* placed on how much we can focus at any given moment on one stimulus or event to the exclusion of others. It is usually difficult to attend to more than one event at the same time. Therefore you may not notice (consciously attend to) other events happening at the same time.

B: Selective inattention

We can also avoid attending to information that may be relevant but emotionally upsetting. This is known as *selective inattention*. Diverting our attention away from our consciousness can be helpful (such as trying not to think about how nervous you are about a SAC) or unhelpful (such as trying to ignore a bad cough that may turn into pneumonia).

C: Divided attention

At the top of the consciousness continuum (higher level of awareness), a higher level of attention is required and this tends to be selective. As you move down the

FIGURE 2.5 Keeping your eyes on the ball is an example of selective attention.

continuum, you become less aware and attention tends to be divided. **Divided attention** refers to the capacity to attend to and perform two or more activities at the same time. This is generally only possible if the tasks can be performed with very little mental effort. For example, we can talk as we walk or type as we read. However, divided attention has its limits. It is harder to perform two or more tasks simultaneously when they require similar mental skills and more than one is a complex (controlled) process.

For example, have you ever been on the telephone and engaged in a conversation with someone in the room at the same time? A conversation requires your full attention and doing both similar and complex tasks at once is difficult. You need to shift your attention back and forth between both tasks – it is likely you cannot do both at the same time. If you try to do this, the person on the phone will probably realise that you are not paying full attention to their conversation. Divided attention is not possible.

In summary, performance on tasks that require divided attention is usually poorer when:

- the tasks are similar,
- are not well-practised, and
- are difficult or complex.

How can psychologists study divided attention?

Psychologists have used a range of techniques to study attention including *dichotic listening tasks*. A well-known experiment that tested divided attention was conducted by Shaffer (1975). We cannot fully attend to two separate messages delivered simultaneously through two earphones. Proficient typists performed a test in which they had to type the information being presented via headphones in one ear while performing a second task at the same time. This second task included two different conditions:

- condition 1: a shadowing task in which unrelated information was presented via headphones to the other ear. The typist had to say aloud the information presented in this ear
- condition 2: a reading task in which the typist had to read aloud visual information that was presented to them.

In both cases, the typists' performance on the test was poorer compared to their performance when carrying out the three tasks separately. Shaffer suggested that performance was poorer because of the similarity of the tasks. In the first condition, the material was similar in the way it was presented (a listening task) and thus interfered with the ability to receive the auditory information. The second condition interfered with the typists' ability to produce the typed information – both required verbal and written skills.

There have been some dichotic listening studies that have reported astonishing findings of people being able to carry out two tasks at once extremely well. Skilled pianists (Allport *et al.* 1972) were asked to sight-read music while listening to continuous speech (shadowing task). The pianists' music performance was not affected by the shadowing task.

FIGURE 2.6 We are not very good at attending to two separate messages delivered simultaneously through two earphones.

Do we only process information we consciously attend to?

Active processing of information can take place outside our conscious awareness. Have you ever been deeply engrossed in a conversation and tuned out to everything else that is happening in the room? Suddenly, you hear your name mentioned across the room and you immediately look up and focus on the person who spoke your name. This is known as the *cocktail party phenomenon* and shows that much more information is processed in our consciousness than that to which we initially attend. Therefore, consciousness may not be limited to what you are attending to at the time.

SUPPORTING UNDERSTANDING

Change blindness

Change blindness is a failure to notice a large change that takes place in full view in a visual scene. Change blindness takes place when the change is simultaneous with some kind of brief disruption in vision.

Change blindness is a recent discovery and area of interest for cognitive psychologists. It initially appears to be a simple phenomenon but the reasons why it occurs are complex and are being investigated and debated. Currently, the most accepted theories relate to *attention* and *memory*. Often we think that there has been a change but cannot remember exactly what the change is, even though the change is significant. This is likely to relate to poor memory of the initial scene.

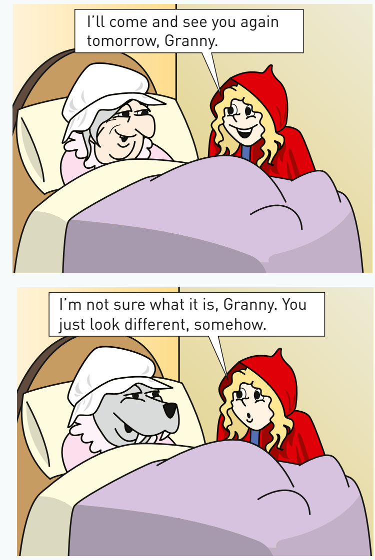


FIGURE 2.7 When there is a significant disruption between visual scenes, we are unlikely to detect significant changes.

Change blindness is *not* inattentional blindness! Both terms are related but they are different phenomena.

Change blindness is when significant changes in the visual world go unnoticed, while inattentional blindness is when entire objects or events go unnoticed without a visual disruption or significant change from one scene to the next. Revisit Investigate 2.3 Are you paying attention? – this is an example of inattentional blindness because attention (selective attention) was on another event, not on the unnoticed and unexpected event.

Change blindness depends on failure to store the memory of a scene in the first place, or failure to compare the memory from one scene to the next. Inattentional blindness does not rely on memory – it is the failure to detect an unexpected object or event that is fully visual on one visual scene.

Are you susceptible to change blindness? Search online for and carry out at least two tests of change blindness.

CONTROLLED AND AUTOMATIC PROCESSES

As someone who has been writing for years, when you write a sentence you pay attention to the meaning of the sentence or the spelling of a word rather than the process of forming (drawing) each letter. The act of writing each letter or word is automatic, with little mental effort or conscious awareness. **Automatic processes** require very little awareness or little mental effort to be performed well and they generally don't interfere with other automatic or controlled processes. In other words, automatic processes require little attention and little thought and can allow you to do two things at once. Automatic processes become procedural memories (discussed in Chapter 9).

FIGURE 2.8 Learning to drive is a complex process. With practice, the basic skills of driving become automatic.

Another example of an automatic process is texting on a mobile phone. Many people are well-practised and know exactly where the buttons are, so can create the message with ease. For them, texting is a simple task that requires little mental effort.

Compare this to someone who is learning how to write text messages. The person must concentrate on how to create the message – it requires their full attention. For this person, texting is a complex task as it is yet to be learnt or mastered and requires greater mental effort. It is an example of a **controlled process**. Controlled processes require full awareness and mental effort to focus attention on the required task. This person needs to be consciously aware of what they are doing and think about doing the task. They are unable to complete another controlled process at the same time as both require full attention and therefore will interfere with each other.

Learning how to drive provides a very good example of how an activity can become automatic. At first, you can feel awkward and experience difficulties monitoring your hands and feet, especially if you are learning to drive a manual vehicle. At this stage, operating the car requires your full attention because it is a controlled process. You might even find it hard to talk to your instructor or read road signs. As your skills develop, you will find it easier to steer, indicate, check the rear-view mirror and change gears. Finally, you will find yourself doing these things automatically and be able to concentrate on the traffic and other driving conditions. The basic skills of driving the car are now automatic processes.

Think about your favourite elite athlete or musician. Through years of practice, they have learnt to perform extremely complex skills with minimum conscious awareness, as controlled processes have become automatic. These people will probably tell you that thinking too much about the automatic task can actually hinder performance. In fact, talented American baseball player, Yogi Berra, summed this up in his well-known statement, 'You can't think and hit at the same time.'

Attention relates to our ability to undertake controlled and automatic processes.

- *Controlled processes require selective attention* – a person must actively focus attention in order to successfully complete the task.
- *Automatic processes enable us to have divided attention* – if a task requires little mental effort and attention, we can often engage in other tasks at the same time.

TABLE 2.1 The differences between automatic and controlled processes

	AUTOMATIC PROCESS	CONTROLLED PROCESS
Amount of conscious awareness	Requires little, if any, conscious awareness	Requires full conscious awareness
Attention	Requires little attention or mental effort (enables us to have divided attention)	Requires selective attention (must actively focus attention on the task)
Task difficulty	Simple (easy) or mastered tasks	Usually complex (difficult) or novel (new or yet to be mastered) tasks

INVESTIGATE 2.4

MEDIA RESPONSE: ON THE PHONE? GET OFF THE ROAD!

The use of mobile phones, either hand-held or hands-free, is banned for L-plate and P1-plate drivers. It is also illegal for all drivers to touch a mobile phone while in control of a motor vehicle, even when stopped at traffic lights.

Go to the TAC website. Search for, download and read the brochure 'Let's talk mobile phones and driving'.

Is this law fair? Is driving while using a mobile phone dangerous? Obviously, physically touching a mobile phone is dangerous – a driver has to take a hand off the steering wheel and eyes off the road. Therefore, it is physically impossible to carry out the tasks simultaneously. But what about the use of hands-free mobile phones for inexperienced drivers?

Prepare a supporting document that justifies the banning of mobile phones while driving laws. Outline the laws and the reasons for implementing them. Using psychological terms, relate your argument to the relevant characteristics of normal waking consciousness.

What other laws exist that are applicable for inexperienced drivers only? Can these laws be justified using the same psychological reasoning? Discuss.

PERCEPTUAL AND COGNITIVE DISTORTIONS

Perception is the process of organising sensory input and giving it meaning. During normal waking consciousness, our perceptions are usually clear and rational. We can make sense of sensory input and have a real awareness of our internal state and any external stimuli.

Cognition is a broad term that relates to mental activities such as thinking, problem solving, language and reasoning. During normal waking consciousness, we have a sense of reality. Our thoughts are usually rational, clear and meaningful. We are capable of cognition – i.e. problem solving, analysis and reasoning.

During normal waking consciousness, the brain actively stores information in *memory* and retrieves it from memory for use in thinking. Memory is a vital component of normal waking consciousness as it is involved in nearly every activity we undertake. We can generally access our memories and remember events and experiences processed into long term memory in this state. We will discuss the importance of memory in more detail in Chapter 8.

EMOTIONAL AWARENESS

During normal waking consciousness, we are generally aware of our feelings and show a range of emotions that are normal for us and appropriate for the situation. We can usually monitor our emotions and even hide our true feelings from others.

SELF-CONTROL

Consciousness allows us to direct our thinking and monitor our impulses and behaviours. During normal waking consciousness, our ability to maintain self-control is usually maintained. We can plan and monitor what we say and do. We tend to be quite reserved and avoid doing anything that we think is risky or embarrassing.

TIME ORIENTATION

During normal waking consciousness, we usually have a good awareness of the passage of time. Time is perceived as moving at the 'real' time. For example, when it feels as if 10 minutes has passed, about 10 minutes has actually passed. We understand where we are in time (night or day, year and hour) and are able to focus on the past, present and future.

2.1 REVIEW

1 Where does normal waking consciousness tend to lie on the continuum of awareness? Where are you more likely to find an altered state of consciousness?
2 **a** Define 'normal waking consciousness'.
  b Are there different states of consciousness within normal waking consciousness? Explain your answer.
3 Think of a task that you find easy to perform. Does this task require selective attention? Explain your answer with references to controlled and automatic processes.
4 In terms of self-control, how do we tend to behave during normal waking consciousness?
5 In terms of controlled and automatic processes, explain why learner drivers must log 120 hours of supervised driving time.

Altered states of consciousness

During normal waking consciousness, we experience a real sense of time and place. We understand where we are, what we are doing, when we are doing it and why we are doing it. If we deviate from the normal baseline, we experience an **altered state of consciousness (ASC)**. Therefore, an altered state of consciousness can be defined as any state of consciousness that deviates from normal waking consciousness, in terms of marked differences in the level of awareness, perceptions, memories, thinking, emotions, behaviours and sense of time, place and self-control. As such, this could include states produced by the learnt technique of meditation, psychological drugs (including alcohol), fever, psychosis (a serious condition where the sense of reality is lost) and even daydreaming and sleep. Altered states are often culturally significant and can happen through religious experiences. An altered state of consciousness can be induced deliberately or occur naturally.

INVESTIGATE 2.5

RESEARCH INVESTIGATION: SHEEP DASH! GAME

Search for the Sheep Dash! game on the BBC website. It measures your reaction time. Your level of alertness depends on your state of consciousness at the time and therefore will affect your reaction time.

Play this game under different conditions, e.g. at a time when you:

- are drowsy (e.g. after lunch or on a hot afternoon)
- are alert (e.g. mid-morning)
- have woken up during sleep (e.g. set the alarm clock for 3 a.m.)
- have recently had caffeine or sugary food (e.g. chocolate).

Before playing the game, rate your state of consciousness by completing the information in a table like the one below.

To measure awareness, use the scale: 1 = asleep, 2 = drowsy, 3 = relaxed, 4 = intense, 5 = hyper-aroused.

To measure heart rate, tilt your head up and place two fingers against the carotid artery on one side of your neck. Count the pulses for 30 seconds, then multiply this by two to get the number of beats per minute.

Other physiological measurements such as body temperature, blood pressure and respiration rate may also be measured.

DATE	TIME	LEVEL OF AWARENESS	HEART RATE	CONDITIONS (INCLUDE ACTIVITY PRIOR TO THIS ONE THAT MAY ALTER YOUR STATE OF CONSCIOUSNESS, E.G. SLEEP, MEAL, SPORT, CONCERT)	SHEEP DASH! REACTION TIME

Questions to consider:

1. Under what condition(s) was your reaction time the fastest? Slowest?
2. Did you find evidence that your level of awareness influenced your reaction time?
3. Was there an association between your level of awareness and your heart rate?
4. What are *order effects* and how could order effects influence your results? (See Chapter 1)
5. Were there any environmental conditions (potentially confounding variables) that may have affected your performance during one of the trials?

2.6 INVESTIGATE

HOMER'S ALTERED STATE OF CONSCIOUSNESS

Probably the easiest way to understand the characteristics of normal waking consciousness is to consider the characteristics of altered states of consciousness.

Watch the first five minutes of *The Simpsons* Season 14 Episode 2: 'How I spent my Strummer Vacation'.

1 Make a list of the various ways Homer tried to alter his state of consciousness. Categorise these altered states of consciousness as *drug-induced* or *non-drug-induced*.
2 List the various effects that Homer experienced while in an altered state of consciousness. Categorise these changes in terms of:
   > perception – sight, hearing, smell, taste, touch
   > thinking – including problem-solving, reasoning and understanding
   > memory
   > emotions
   > behaviours – including self-control, coordination, balance and speech
   > perception of time – e.g. understanding the amount of time that has passed
   > awareness of the environment.
3 Discuss how these changes in an altered state of consciousness compared with the characteristics of normal waking consciousness.

Characteristics of altered states of consciousness

Think of a time when you were sick with a high fever. What did you experience? Did you lose track of where you were and what was happening around you, your sense of time and the ability to think clearly?

Now think of a time you have been at a party with lots of people, loud music and flashing lights. Did you 'absorb' yourself into the scene? If so, did the time fly? Were you extremely happy and less inhibited than usual? If you answered yes, then you experienced an altered state of consciousness. You don't need drugs to deliberately alter your state of consciousness: an environment such as this one can do it for you.

Let's look briefly at the characteristics of an altered state of consciousness.

FIGURE 2.9 Being sick with a fever is an example of an altered state of consciousness.

LEVEL OF AWARENESS

Look back at the continuum of awareness (Figure 2.4). In an altered state of consciousness, your level of awareness either decreases or increases compared with normal waking consciousness. You become more or less aware of your perceptions and/or surroundings. When suffering from a fever, for example, you become less aware of what is happening in your environment. If you are experiencing heightened awareness, you can become more aware of certain events that are happening around you.

CONTENT LIMITATIONS

Your ability to pay attention to certain tasks can be increased or decreased compared with normal waking consciousness. In normal waking consciousness you can usually prevent yourself from focusing your attention on issues, thoughts or events that are unpleasant. During an altered state of consciousness, whether it is naturally occurring (such as sleep) or artificially induced (such as by drugs), your mental defences are lowered and the content of your thoughts and dreams may be both broader and deeper than in normal waking consciousness. The content of your consciousness when in an altered state of consciousness is often disorganised and senseless or bizarre and unusual or to the other extent, extremely narrow (limited) as you concentrate intently on one thing

Tasks that require selective attention may be impaired. It can also be very difficult to divide attention, even between automatic processes.

CONTROLLED AND AUTOMATIC PROCESSES

In an altered state of consciousness, you usually find it difficult to carry out controlled processes. Your ability to perform some automatic processes can also be impaired. In some altered states of consciousness, however, you may be so focused (high level of awareness) that you find some tasks easier.

FIGURE 2.10 Emotions can be heightened when experiencing an altered state of consciousness.

PERCEPTUAL AND COGNITIVE DISTORTIONS

Your perception of sensory input is often quite different in an altered state of consciousness compared with that experienced during normal waking consciousness. For instance, you may perceive colours as being more vivid or duller than how you see them during normal waking consciousness. You might not perceive pain or you might have a stronger reaction to it. Vision, hearing, touch, taste, smell and balance can all be affected in an altered state of consciousness.

There is a tendency for cognitive functions to become distorted during an altered state of consciousness. Thoughts may become disorganised, as evidenced during some dreams. Thinking may lack logic and problem-solving may be impaired. The memory of events that occurred during an altered state of consciousness might not be accurate and you might not even be able to recall them at all during normal waking consciousness. Furthermore, we may have difficulty remembering things that we normally remember in normal waking consciousness, such as a good friend's name or our telephone number.

EMOTIONAL AWARENESS

The way emotions are experienced is often different during altered states of consciousness.

Emotions can be heightened. This means they can become more intense, such as being much happier or sadder.

Emotions can be dulled to the extent that people feel emotionally numb. This can happen, for example, when someone is in a state of shock following a crisis or personal tragedy.

Emotions might also be inappropriate. There can be a lack of understanding of the emotional reality of the situation and a person can experience an inappropriate emotion.

SELF-CONTROL

Your ability to maintain self-control is often reduced during an altered state of consciousness. Your inhibitions are lowered and you might do things you would not do during a normal state of consciousness. You might be more open to suggestion, meaning that you are more likely to follow instructions with little resistance or thought about the consequences. However, this is not always the case; some people gain greater self-control in certain altered states of consciousness.

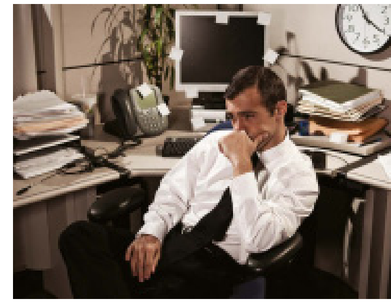


FIGURE 2.11 Time can seem to slow down when in an altered states of consciousness, such as when you are bored.

TIME ORIENTATION

Time tends to be experienced at a different speed when in an altered state of consciousness. For example, when woken from sleep after just one hour, you may be surprised that you haven't yet had an entire night's sleep. On other occasions, you can't believe that a whole night has passed when the alarm sounds to herald the start of another day of school. It may seem that you have only been asleep for an hour or so.

TABLE 2.2 Comparisons between normal waking consciousness and altered states of consciousness

CHARACTERISTIC	NORMAL WAKING CONSCIOUSNESS (NWC)	ALTERED STATE OF CONSCIOUSNESS
Level of awareness (awareness of internal and external events)	Awake and generally aware of internal and external events. A good sense of place, time and reality.	May be increased or decreased compared to NWC. Most often, level of awareness is lowered during an altered state but can be increased when a person experiences heightened awareness.
Content limitations (the amount of control you have to limit what you attend to)	More constrained and controlled. Can selectively process different parts of what is in consciousness.	May be more or less than in NWC. Usually less constrained or controlled, with reduced ability to process information but fewer limitations on content.
Controlled and automatic processes (your ability to effectively perform two or more tasks at once depending on the level of complexity)	Able to perform controlled and automatic processes, within normal limits. Attention is focused or highly selective and can be divided between tasks.	Usually less (although sometimes more) able to perform controlled processes and automatic processes. Usually less control over attention, which may be highly selective, but less able to be divided between tasks.
Perceptual and cognitive distortions (the degree of awareness and efficiency of your perceptions and cognitions, i.e. memory and thought processes)	Perceptions (including of pain) are realistic and normal. Effective control of memory processes: storage and retrieval. Thought processes are organised and logical.	Perception (including pain) may be altered. Memory processes may be disrupted or distorted: storage and recall may be more fragmented or less accurate. Thought processes are disorganised and less logical.
Emotional awareness (the experience of emotions, i.e. feelings)	Greater awareness of emotions and control of emotional awareness.	Less (although sometimes more) control of emotions, e.g. more or less affectionate, aggressive, anxious.
Self-control (the ability to maintain self-control, usually in terms of monitoring behaviours)	More control over actions and movements, e.g. you are able to make yourself walk in a straight line.	Usually less control over actions and movements, e.g. not able to make yourself walk in a straight line. Less control over emotions and thoughts but greater susceptibility to suggestion may decrease self-control.
Time orientation (your ability to correctly perceive the speed at which time passes)	Clear sense of time: e.g. the passage of time, including past, present and future.	Distorted 'sense' of time, e.g. time may appear to speed up or slow down.

REVIEW 2.2

Consider a time when you experienced each of the following:

- being sick with a high fever
- being at a party with lots of people, loud music and flashing lights.

1 For each experience, describe the characteristics of consciousness you experienced in terms of:
  - a your level of awareness
  - b your ability to perform controlled and automatic processes
  - c your content limitations
  - d your cognitive and perceptive distortions
  - e your emotional awareness
  - f your self-control
  - g your perception of time.

2 Do you think these experiences are examples of altered states of consciousness? Justify your answer.

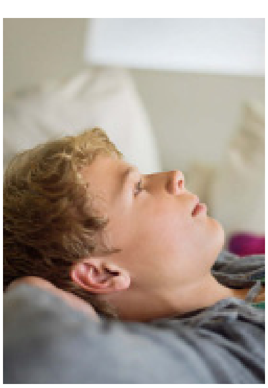
Our experiences in various altered states of consciousness differ remarkably from each other. The rest of this chapter takes a closer look at specific examples, including daydreaming and alcohol-induced altered states of consciousness.

Daydreaming

We **daydream** when we shift attention to our private thoughts, feelings and imagined scenarios, and daydreaming is regarded as an altered state of consciousness. Daydreams tend to be visualised thoughts that are usually positive and pleasurable.

We can daydream at any time. However, we are more likely to daydream when we are alone, stationary or in boring or routine situations. Often we daydream when we are waiting to fall asleep. Think of times when you have daydreamed – has it been during one or more of these situations?

Daydreams occur naturally and often we don't realise that we are daydreaming. Think of a time when you have been daydreaming and someone has had to ask you two or three times to 'snap out of it'. You probably didn't realise that you were 'in another world'.



We spend an enormous amount of time daydreaming – anywhere from a third to a half of our waking life. Daydreaming tends to take place in 90-minute cycles (Kripked & Sonnerschein 1973). In one study, Klinger (1978) monitored the thoughts of a number of people. Half of these thoughts were daydreams because they were fanciful, unconnected to the activity the person was completing, or both. He found the median time for each thought was 5 seconds, with the mean being 14 seconds, although many thoughts were longer than this. Extrapolating these results to someone who is awake 16 hours a day (therefore spending 8 hours asleep), that person experiences around 2000 daydreams per day (around 7 $\frac{3}{4}$ hours per day!).

Daydreaming is experienced throughout the lifespan, although it appears to be less frequent as we get older. In a large, 24-year longitudinal study, it was noted that, with age, there was a decrease of the frequency and intensity of daydreams in adulthood, with females showing greater decline (Giambria 1999).

Daydreaming has been associated with good mental health and stability. In one study, people who reported they took control of most of their daydreams tended to be in better psychological health than those who rarely took control (Lapidos 2008). Daydreams may also offer an insight into our personality, motives and concerns. By studying their nature and content, daydreams may provide a pathway to recognising and understanding a person's personality, motivation, fears and concerns.

There is some concern that modern technology is limiting our daydreaming time and perhaps our ability to think creatively. For example, while watching television and playing multimedia games keeps us entertained, we often become 'glued' to the screen and therefore tend not to daydream.

Most of us accept that daydreams are a normal part of life, although many people see daydreaming as a negative event. For example, have you ever been in trouble for daydreaming? Considering the list of the positive effects of daydreaming (see the Did you know? section opposite), it seems clear that daydreams are not necessarily the waste of time our society might suggest. 'Zoning out' can have benefits – spontaneous thoughts can make us feel vibrant, aware and engaged.

WHY IS DAYDREAMING CONSIDERED TO BE AN ALTERED STATE OF CONSCIOUSNESS?

Just like sleep, daydreaming is a natural and common phenomenon that we all experience. The characteristics of daydreaming include:

- a *lowered level of awareness*, especially of what is happening in our surrounding environment
- *fewer content limitations*. We can have bizarre, uncommon or unrealistic thoughts that don't need to be bounded by reality. Some serial killers have reported more frequent, recurring, violent fantasies before committing a murder. With daydreams, we can focus on one line of thought but the amount of control over what you want to attend to is decreased as your mind wanders off with other thoughts. This makes selective attention very difficult
- *difficulty performing controlled processes*. Our ability to effectively perform two or more tasks at once is lowered, if not possible, and controlled or difficult tasks are hampered. Daydreaming while driving can lead to accidents
- *likely perceptual and cognitive distortions*. Daydreaming in class may prevent us from learning about the content material, especially if we are daydreaming about something entirely different. Daydreaming decreases our awareness of our surroundings, so understanding what the teacher is saying at the same time is unlikely. Our perceptions can also be distorted. For example, we may become less aware of pain or a noisy environment
- *changes in emotional awareness*. Daydreams are more likely to be positive or pleasurable and this may enhance mood. Daydreaming to escape a boring or unpleasant situation can certainly do this. Conversely, unpleasant daydreams may depress mood. Daydreams may also flatten our response to emotional situations in the real world
- *changes in self-control*. While daydreaming, your thoughts are on internal events rather that what is happening around you. Monitoring your behaviour is unlikely. You could even dribble without noticing!
- *diminishing time orientation*. We lose our sense of time when daydreaming. Have you ever stopped daydreaming and wondered where the time has gone? Time can appear to move very fast or slow when daydreaming.

Did you know?

There are many positive effects associated with daydreaming, including:

- providing a safe way to fantasise about things that are impossible or have serious consequences in the real world
- overcoming boredom.
- enhancing creativity.
- planning effectively for future actions, conversations or social situations. Daydreams also allow us to relive past actions or conversations to help us learn from experience
- helping us reason, make decisions and solve problems.

REVIEW 2.3

1. Define daydreaming.
2. How often do we daydream?
3. When are we more likely to daydream?
4. Does daydreaming affect awareness? Explain your answer.
5. Why is daydreaming considered to be an altered state of consciousness?

Alcohol-induced states

The most common method of deliberately altering states of consciousness is through the use of psychoactive drugs. **Psychoactive drugs** are chemical substances that affect the nervous system and brain activity. As a result, they impact on our consciousness by altering thoughts, feelings, perceptions and behaviours. Psychoactive drugs generally target specific *neurotransmitters* – chemicals that allow communication between *neurons* (nerve cells) that are responsible for the function of our nervous system, including the brain (see Chapter 5).

In our society, psychoactive drugs include:

- *depressants* which decrease nervous system activity, e.g. alcohol, barbiturates (sleeping pills) and benzodiazepines (tranquillisers)
- *stimulants* which increase nervous system activity, e.g. caffeine, amphetamines, cocaine and ecstasy
- *opiates* which provide pain relief and cause mood changes, e.g. opium, morphine, codeine and heroin
- *hallucinogens* which cause hallucinations, a distorted sensory experience and loss of reality, e.g. LSD
- *marijuana* which produces an uninhibited euphoric state and impaired judgment and thinking.

Deliberately altering consciousness with alcohol is a widely accepted practice in our society despite the growing awareness of the dangers associated with this common drug. The psychological and physiological effects of alcohol can create long-term physical, social and personal problems. The effects can be devastating.

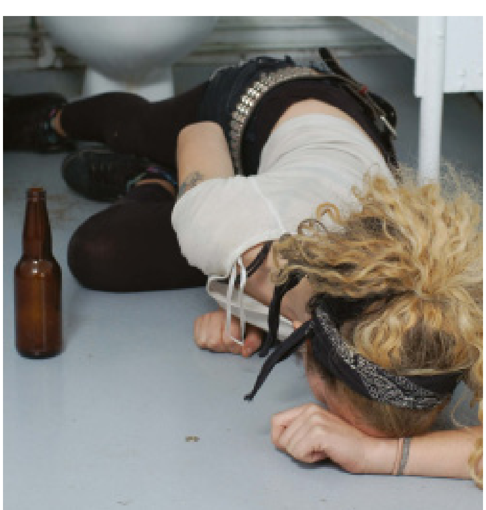


FIGURE 2.12 Altering consciousness with alcohol is common in our society despite awareness of the dangers.

Alcohol is a depressant – it slows or depresses the nervous system. Many people mistakenly believe that alcohol is an 'upper' or a stimulant. This misconception is probably because, in low doses, alcohol reduces inhibitions and may cause a feeling of relaxation and well-being. Thus, a person who has consumed alcohol may seem more stimulated, active and talkative than usual but this is most likely because of reduction of inhibitions. In high doses, alcohol depresses the nervous system so much that it slows down vital life processes and can cause blackouts, comas and even death. The relationship between percentage of blood alcohol concentration (BAC) and behaviour can be seen in Table 2.3. During adolescence, a time of great brain development, alcohol can have permanent negative effects. It is likely that you have seen advertisements that raise this issue.

TABLE 2.3 Relationship between blood alcohol concentration and behaviour, including driver performance

CATEGORY	BLOOD ALCOHOL LEVEL	GENERAL EFFECT ON BEHAVIOUR	EFFECTS ON DRIVER PERFORMANCE
Feeling of well-being	0.02–0.05	Lowered alertness Talkative Relaxed More confident	Difficulty seeing or locating moving lights Difficulty judging distances Tendency to take more risks Decreased ability to respond to several stimuli
At-risk state	0.05–0.08	Talkative Acts and feels self-confident Judgment and movement impaired Inhibitions reduced	Ability to judge distances is further reduced Sensitivity to red lights Slower reaction times Shorter concentration span Five times more likely to have an accident at 0.08 BAC than those not under the influence
Risky state	0.08–0.15	Speech slurred Balance and coordination impaired Reflexes and reaction times slowed Visual attention impaired Unstable emotions Nausea, vomiting Less cautious	Euphoria sets in Overestimation of one's ability leads to reckless driving Very poor peripheral vision Impaired perception of obstacles 10 times more likely to have an accident at 0.12 BAC than those not under the influence
High-risk state	0.15–0.30	Unable to walk without help Apathetic, sleepy Laboured breathing Unable to remember events Loss of bladder control Possible loss of consciousness including blackouts	Driving ability is extremely impaired, and with likely loss of consciousness, impossible.
Death	Over 0.30	Coma Death	Unconscious

INVESTIGATE 2.7

ALCOHOL-INDUCED ALTERED STATE OF CONSCIOUSNESS

Study Table 2.3 and answer the following questions:

1 Consider the likely effects of alcohol consumption and its effects on driving performance. Categorise each effect into one or more of the following characteristics of consciousness:
   - **a** level of awareness (awareness of internal and external events)
   - **b** controlled and automatic processes (ability to effectively perform two or more tasks at once)
   - **c** content limitations (amount of control you have to limit what you want to attend to)
   - **d** perceptual and cognitive distortions (awareness and efficiency of your perceptions and cognitions)

- **e** emotional awareness (experience of emotions)
- **f** self-control (usually in terms of monitoring behaviours)
- **g** time orientation (ability to correctly perceive the speed at which time passes).

A person cannot predict their BAC level based on how they feel. Even if they have developed a tolerance to the drug (and this could be a sign that it is adversely affecting their life), they will still have slower reactions and find it difficult to drive and cope with emergency situations.

2 Look at the effects again. Why do you think some people genuinely claim they are OK to drive when, in fact, they are not?

3 Why is an alcohol-induced state considered to be an altered state of consciousness? Include three examples from the table to explain how it differs from normal waking consciousness.

In Australia, alcohol is legal and highly accessible, although laws prohibit the selling of alcohol to those under 18 years of age. This is despite the huge negative impact that alcohol abuse has on our society. The effects of alcohol can be severe, e.g. irreversible memory disorder (Korsakoff's syndrome), enlargement and scarring of the liver (cirrhosis), impact on the teen brain, negative social consequences (dysfunctional home and work relationships, isolation, fights) and serious injury or death. These effects make alcohol, arguably, the most dangerous drug in our society.

Alcohol is consumed to purposely alter a person's state of consciousness. The degree to which a person experiences the effects of alcohol depends on a number of factors, including tolerance levels (alcohol is a drug of addiction), rate of consumption, gender, height and weight (York & Welte 1994). The characteristics of an alcohol-induced state include:

- *lowered level of awareness*. Alcohol depresses (slows down/relaxes) the nervous system. As a result, alcohol significantly decreases a person's level of awareness – they will be less aware of internal and external events. They will have difficulty concentrating and attending to everything that is going on around them. An intoxicated person is likely to attend to one thing at a time and be easily distracted.
- *more or less content limitations*. The content of an alcohol-induced altered state of consciousness is less restricted than in normal waking consciousness. The type of information that enters consciousness may be broader than in normal waking consciousness. Unrelated, obscure, irrational, illogical and even lateral thoughts are not uncommon, particularly as the ability to attend to and concentrate on a particular task is impaired. People are likely to be more talkative and less inhibited or easily talked into saying or doing things they normally would not do.
- *difficulty performing controlled processes*. Think of a scene in which a person is under the influence of alcohol. They are likely to be staggering along, being clumsy and reacting to things more slowly than usual. Alcohol impairs the functioning of the brain, including the cerebellum, a large structure at the base of the brain that is responsible for balance and coordination. This affects reaction times, thinking and

perception. As a result, carrying out complex tasks (controlled processes) becomes more difficult as the person consumes more alcohol. Even simple tasks (automatic processes) such as writing become more difficult as alcohol is consumed.

- *likely perceptual and cognitive distortions*. Alcohol depresses the brain and its functions, distorting thoughts, perceptions and behaviours (Stahl 1996). Reaction time and reflexes are slowed, which affects motor coordination. Speech is slurred and judgment is impaired. The perception of stimuli from our senses (including pain and temperature) is dulled. Vision may be hazy or blurred. A person's ability to focus attention and think clearly is impaired. This makes it harder for the brain to process information and form memories (Givens 1996). Alcohol can cause someone to lose the ability to pay attention to as much information as when they are sober and this negative effect has been termed 'shortsightedness thinking' or 'alcohol myopia' (Steele & Josephs 1990). As such, a person under the influence of alcohol is only able to focus on aspects that stand out in their immediate surroundings without thinking of the long-term consequences. They find it difficult to weigh up the pros and cons of a situation or course of action. In this case, brightly coloured warning signs are needed in drinking environments so intoxicated people can attend to the dangers.

FIGURE 2.13 Alcohol decreases self-control and may cause people to behave aggressively.

- *changes in emotional awareness*. Alcohol can give you a false sense of confidence, which can affect the way you behave and express emotions. People's emotional states can vary. It can cause someone to become aggressive and violent or sad and uncommunicative. We may misread or not consider other people's emotions, or we may have flattened emotional responses.
- *decrease in self-control*. Alcohol can cause people to behave aggressively, become over-friendly, share private thoughts and do silly things. They may take risks they would not normally take and carry out behaviours that they would not normally do. People are more likely to engage in sexual activities despite alcohol impairing sexual performance (Cooper 2002). A New South Wales survey of prisoners found that almost half had been drinking in the 24 hours leading up to the offence, and 25 per cent blamed alcohol for the offence (Stathis 1991). In addition, 42 per cent of homicides involved alcohol.
- *time orientation diminishes*. The ability to track the time is lost when in an alcohol-induced state. Time can appear to pass more quickly or more slowly than it actually does.

REVIEW 2.4

1 What effect does alcohol have on our nervous system?
2 Give an example of another altered state of consciousness (besides daydreaming and alcohol-induced state). In terms of the characteristics of an altered state of consciousness, why is this example considered to be an altered state?
3 Complete the following table in your workbook:

ALTERED STATE OF CONSCIOUSNESS (ASOC)		
CHARACTERISTIC	DAYDREAMING	ALCOHOL-INDUCED STATE
Levels of awareness		
Content limitations		
Controlled and automatic processes		
Perceptual and cognitive distortions		
Emotional awareness		
Self-control		
Time orientation		

SUPPORTING UNDERSTANDING

Meditation – another example of an ASC

While meditation is not explicitly mentioned in the study design, it is an example of an altered state of consciousness that is a different experience from daydreaming and alcohol-induced state. Although being good at meditation takes practice, it is an altered state of consciousness that you can begin to experience in class (try Investigate 2.8).

Meditation induces an altered state of consciousness in which a person uses mental exercises to become highly focused on a single thought to the exclusion of others. This single thought may be a stimulus that is usually ignored, such as breathing, or a simple stimulus such as a pattern or a word. As a result, meditation encourages a heightened awareness and brings cognitive processes under greater control. The normal flow of consciousness is disrupted and, with practice, meditation prevents the ever-changing stream of thoughts from entering consciousness.

Meditation has a long history, especially in Eastern cultures, dating back at least 26 centuries as an integral part of many religious practices. For example, Buddhists view meditation as a vehicle to produce inner peace, insight and enlightenment, as well as opening the pathway to different dimensions of consciousness.

In Western society, meditation is becoming more popular regardless of people's religious beliefs. It is seen as a way to achieve a state of serenity and promote psychological and physical health, especially in terms of managing stress. These are positive benefits that most, if not all, people would like to experience. Meditation is a vehicle to developing a deeper understanding of reality and the purpose of life as it encourages extended reflection and contemplation.

Why is meditation considered to be an altered state of consciousness?

The characteristics of meditation include:

- *lowered level of awareness*. While meditation leads to a heightened awareness of a *single* thought, your overall level of awareness decreases. Meditators are not aware of other stimuli, from either internal events or external surroundings. Experienced meditators become totally unaware of their body and surroundings. Some have been known to meditate in the freezing cold for hours at a time and others on a bed of nails with no obvious perception of cold or pain.
- *more or less content limitations*. What you think about during meditation is usually strictly limited. Your attention is narrowly focused on a single stimulus, train of thought or movement or, as in the case of mindfulness meditation, your thoughts pass through your mind without judgment. Meditation is a skill you must practise in order to be able to control your thoughts, or limit their content. This restriction of content leads to beneficial psychological and physiological effects.
- *difficulty performing controlled processes*. During meditation, the person is usually very still or performing slow-moving exercises, such as those in t'ai chi. The mental (and sometimes physical) exercises are initially controlled processes. They require hours of training to be performed correctly. Performing other controlled or automatic processes while meditating is not encouraged and is, most likely, impossible.
- *likely perceptual and cognitive distortions*. Meditation has been used for pain control because the stimuli that you attend to during meditation are restricted. You effectively remove pain from your conscious awareness by not paying attention to it. Cognitive processes are under control during meditation. You can feel more focused, creative and aware following meditation. Experienced meditators have claimed that meditation leads to insight into the meaning of life and enlightenment.
- *changes in emotional awareness*. Meditation can give a sense of control over emotions and reduce the feelings associated with stress. It can increase self-awareness and empathy for others. It can help you pay attention to the emotions that you are experiencing and reduce any negative impact they may be causing. There are many traditional religions, such as Buddhism, that include meditation as a pathway to happiness.
- *changes in self-control*. Meditation increases your self-control. It takes much practice to become adept at controlling your thoughts and behaviours while meditating.*iminishing time orientation*. Like other altered states of consciousness, we lose our sense of time when meditating. Time often appears to fly by or, for some, remain stationary.

FIGURE 2.14 Meditation is an altered state of consciousness

INVESTIGATE 2.8

GUIDED MEDITATION

Meditation is an example of an altered state of consciousness, one you can try to deliberately induce yourself. Guided meditation exercises, such as the one below, encourage a relaxed state and are particularly good for someone who is new to meditation and prefers listening to a soothing, relaxed voice. Meditation is a trained skill and it takes practice to become good at it. Meditation can help you become calmer and your thoughts become clearer. It is often used as for stress management.

Before you start, take the following measurements:

- your level of anxiety, on a scale of 1 = very calm, 2 = calm, 3 = slightly tense, 4 = tense, 5 = very tense
- your heart rate (beats per minute).

Follow the instructions for the meditation exercise and then answer the questions about your experience.

The meditation exercise

Make yourself comfortable, either at your desk or on the floor. Either record the following instructions first and play them back or get someone (perhaps your teacher) to read them slowly to you, including pausing at the appropriate times.

- Sit quietly for about a minute, concentrating on your breathing. Breathe in slowly through your nose. Let your lungs fill up with air and then breathe out slowly through your mouth. Breathe in and out another 10 times, allowing yourself to relax and unwind.
- Visualise your muscles relaxing. Notice how quickly your body relaxes from the top of your head to the tips of your toes. Breathe in and out another three times.
- Imagine you are in a quiet place. Take your time to look around this place. What does it look like? Where is it? What does it smell like? What colours dominate the landscape?
- Imagine there is a track. Walk along this track. What type of track is it? Is it bumpy, smooth, wide or narrow?
- Imagine that you can hear water. Walk along your track to the water. What sort of body of water is it? What noise is it making? Describe the landscape – what does it look, feel and smell like?
- You notice something on the ground at your feet. Slowly bend down to look at this object. You start to become smaller and smaller and are now the same size as the object on the ground. What does it look like? Note the texture on the object.
- You start getting bigger and bigger. Pick up the object on the ground and carry it back along the path to your quiet place.
- Breathe in and out another five times. You are slowly becoming aware of where you are again. When you are ready, slowly open your eyes.

  Now take the following measurements:

  - your anxiety levels
  - your heart rate
  - an estimate of how long the exercise took.

Discussion

1 Compare your experiences with other members of the class. For example:
   a Describe your quiet place. Did other people have a similar quiet place?
   b What type of path did you walk down? What was the body of water? What was the object that you picked up?
   c Were your visual images very vivid?
   d Were you distracted by any outside noise or other events in your surrounding environment?

2 Consider your measurements.
   a Were you able to relax during this activity? Did your anxiety level reduce?
   b Did the meditation exercise reduce your heart rate?
   c Did you accurately guess the amount of time that passed during the meditation exercise?

3 Collect class results. Work out the means for each type of measurement.

	DIFFERENCE IN ANXIETY LEVELS	DIFFERENCE IN HEART RATE	PERCEIVED LENGTH OF TIME
Individual results			
Class results (means)			

4 Discuss the results. Consider the characteristics of an altered state of consciousness. To what extent did participants experience an altered state of consciousness? Discuss.

5 Were there any potentially confounding variables in this experiment? Discuss.

→ CHAPTER SUMMARY

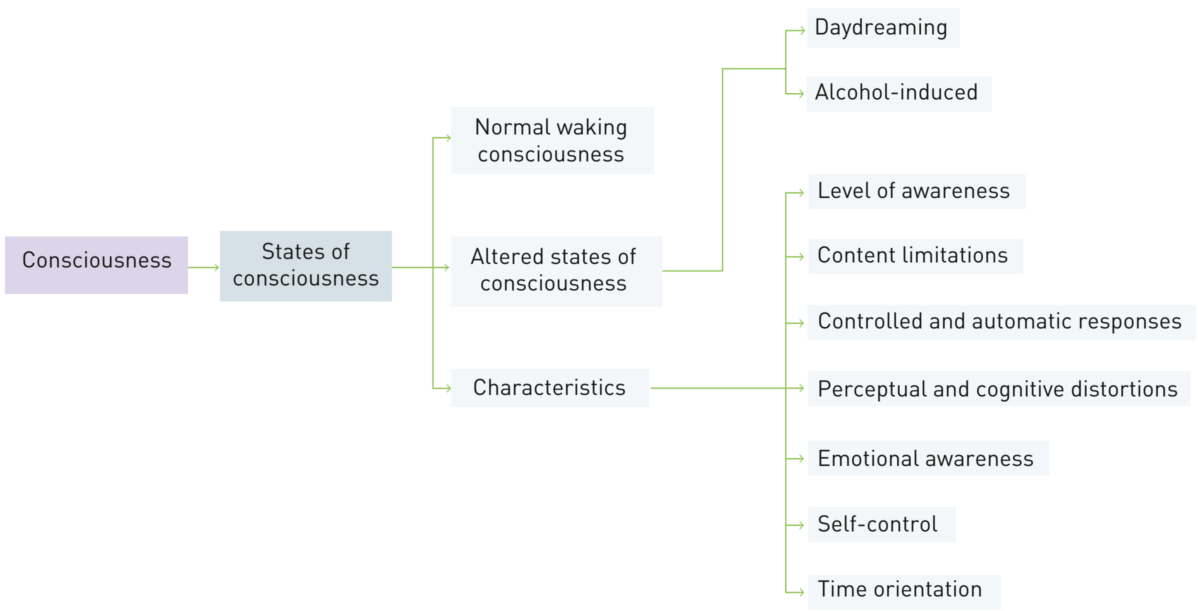
02:

- Consciousness is a hypothetical construct because it is believed to exist but cannot be directly observed or measured. Descriptions are 'constructed' to explain it.
- Normal waking consciousness can loosely be defined as the state of consciousness we experience when we are awake and aware of our thoughts, feelings and perceptions from internal events and the surrounding environment. During normal waking consciousness, we experience a real sense of time and place. Our experience during normal waking consciousness creates our reality and gives us a baseline from which to judge all other states of consciousness.
- Consciousness can be thought of as operating on a continuum, from a high level of consciousness (awareness) through to a low level and even on to the point of being unconscious (totally unaware). The more aware we are of our thoughts, feelings, perceptions and surroundings, the greater the level of consciousness.

- If we deviate from this normal baseline of waking consciousness, we experience an altered state of consciousness. Altered states of consciousness tend to differ from normal waking consciousness in terms of:
  - level of awareness: more or less aware of internal and external events
  - content limitations: usually less (though sometimes more) control to limit what you want to attend to
  - controlled and automatic processes: ability to effectively perform two or more tasks at once, depending on their level of complexity, is more likely to decline and it is more difficult to perform automatic processes
  - perceptual and cognitive distortions: the degree of awareness and efficiency of your perceptions and cognitions (thoughts and memories) is often more distorted
  - emotional awareness: the experience of emotions (feelings) is more or less in an altered state
  - self-control: the ability to maintain self-control, usually in terms of monitoring behaviours, is affected
  - time orientation: the ability to correctly perceive the speed at which time passes declines.
- We daydreams when we shift attention to our private thoughts, feelings and imagined scenarios and ignore the external world. Since the level of awareness of external stimuli is reduced, daydreams are considered an altered state of consciousness.
- Alcohol is a psychoactive drug of dependence. It is a depressant, slowing or depressing the nervous system and, as a result, alters our state of consciousness.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

alcohol-induced state of consciousness
altered states of consciousness
attention
automatic processes
cognition
consciousness
continuum of awareness
controlled processes
daydreams
divided attention
normal waking consciousness
perception
psychoactive drugs
selective attention
states of consciousness

KEY IDEAS

For the exam, you must know:

- the reason why consciousness is a psychological construct
- the difference between normal waking consciousness and altered states of consciousness, including the possible differences in each of the following characteristics:
  - level of awareness
  - controlled and automatic processes

  - content limitations
  - perceptual and cognitive distortions
  - emotional awareness
  - self-control
  - time orientation
- the reasons, in terms of the characteristics of consciousness, that each of the following is known as an altered state of consciousness:
  - daydreaming
  - alcohol-induced states
- the ability to classify examples of a state of consciousness as normal waking consciousness or altered state of consciousness.

RESEARCH METHODS

For the exam, you must be able to:

- understand the challenges that surround studying consciousness
- use your knowledge of research methods to evaluate a research study
- apply your knowledge and understanding from this chapter to a related research study
- understand ethical considerations relating to studying consciousness.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Which of the following is *likely to be true* for a person in an altered state of consciousness?

  a The person may find it easy to judge the passage of time.
  b The person may have more control over emotions.
  c The person may be more open to suggestion.
  d The person may find that their powers of thought and reasoning are enhanced.

2 Which of the following is *unlikely to be true* for a person in a (heightened awareness) altered state of consciousness?

  a The person may find it difficult to judge the passage of time with accuracy.
  b The person may be more sensitive to noise than in normal waking consciousness.
  c The person may be more (or less) emotional than they are when in normal waking consciousness.
  d The person may find that they are paying selective attention to several automatic processes.

3 Which of the following is *not* a true statement?
  a Controlled processes require divided attention.
  b Automatic processes enable divided attention.
  c Controlled processes require selective attention.
  d Both controlled and automatic processes enable divided attention.

4 When Erwin was first learning to play the guitar, he found it impossible to change chords and sing at the same time. Now that he has been in a rock band for two years, he finds it easy to play, sing and even execute complex sequences of steps on stage. The explanation for this is:
  a an automatic process has become a controlled process, enabling divided attention.
  b a controlled process has become an automatic process, enabling selective attention.
  c an automatic process has become a controlled process, enabling selective attention.
  d a controlled process has become an automatic process, enabling divided attention.

5 Controlled processes require ______________ attention.
  a selective
  b divided
  c automatic
  d unconscious

6 Victor has been driving a manual car for several years; Hugo has just passed his test for his P-plates. When Miranda is a passenger in their cars, she finds that she can have a sensible conversation with Victor but Hugo does not seem to pay any attention to her. Which of the following is the most likely explanation for this?
  a For Victor, driving is a controlled process enabling divided attention.
  b For Victor, driving is a controlled process requiring selective attention.
  c For Hugo, driving is a controlled process enabling divided attention.
  d For Hugo, driving is a controlled process requiring selective attention.

7 Sacha is sitting in class one afternoon. She hears what the teacher is saying, feels that she would like to open a window to relieve the stuffiness and wonders how tough basketball training will be later today. Sacha can be described as being in:
  a an altered state of consciousness of heightened awareness.
  b an altered state of consciousness of reduced awareness.
  c a state of normal waking consciousness.
  d a state of daydreaming.

8 Johannes is sitting in class, trying to listen to what the teacher is saying but he is also aware that he is feeling warm in the sunshine, he is looking forward to a game of tennis after school, the new girl in the row in front of him has sparkling highlights in her hair and the chair he's been sitting in for the double lesson has a hard seat! Johannes is most likely experiencing:
  a normal waking consciousness.
  b an altered state of consciousness showing reduced awareness.
  c an altered state of consciousness showing heightened awareness.
  d distortions of cognition and perception.

9 Tia is taking her first driving lesson in a manual car. Which of the following is **not** likely to be true?
  a Tia finds it difficult to judge the passage of time.
  b Tia finds it difficult to hold a sensible conversation with the instructor.
  c At the end of the lesson, Tia finds it difficult to remember features of the buildings they have passed.
  d At the end of the lesson, Tia can recall all the features of the route they have taken.

10 Ravi is experiencing an altered state of consciousness. He does not notice that the temperature has dipped to below 4°C. Which of the following explains his experience according to the characteristics of an altered state?

a Ravi's self-control is reduced.

b Ravi's controlled processes require increased attention.

c Ravi's perception of the passage of time is distorted.

d Ravi's perceptions are distorted.

SHORT ANSWER

11 Matilda has taken juggling classes for the last six months. She had never juggled before the classes started and found it quite difficult. Now she is quite good and can easily carry out a conversation while juggling. She often performs in front of an audience. Do you think Matilda was capable of carrying out a conversation when she first started juggling? Explain your answer with reference to the psychological terms that relate to attention and type of processes.

4 marks

12 Playing 'Advance Australia Fair' on the piano can change with experience from being a controlled process to being an automatic process. Explain what this means.

2 marks

13 Giacomo is taking pain-killers for a torn hamstring muscle. He believes that these are so strong that they put him into an altered state of consciousness (ASC). He asks his girlfriend, Maria, to observe him carefully and report his behaviour so that he can decide whether he enters an ASC. Given Maria has no electronic equipment, suggest two behaviours she may observe that will show Giacomo to be in an ASC.

2 marks

14 a What is the continuum of awareness?

1 mark

b Where does normal waking consciousness tend to be situated on the continuum of awareness?

1 mark

15 Can we experience more than one state of consciousness during normal waking consciousness? Explain your answer.

2 marks

16 With reference to two characteristics of consciousness, explain why each of the following is considered to be an altered state of consciousness:

> daydreaming

> alcohol-induced state.

4 marks

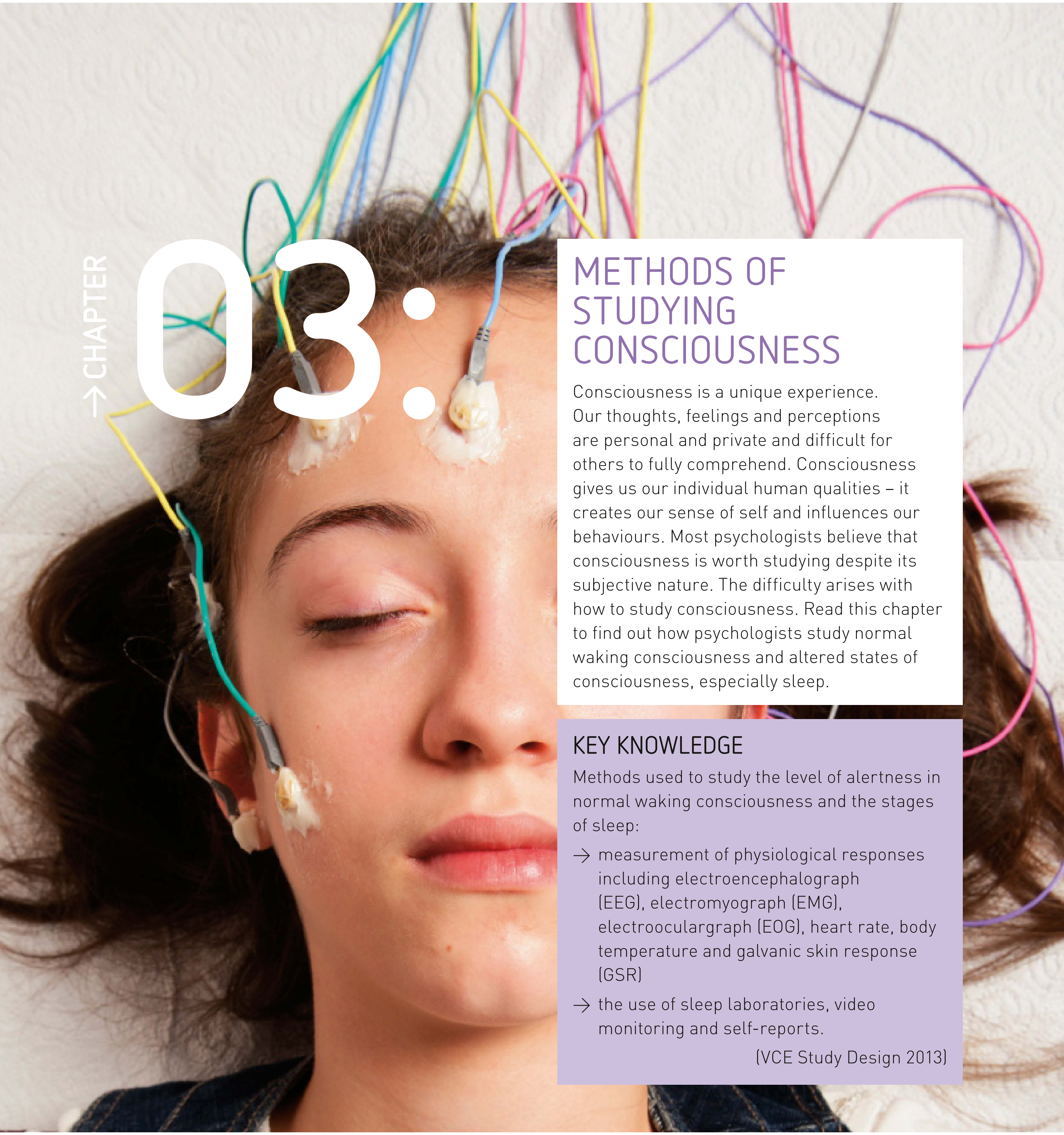
17 Marcel is working outside on an extremely hot day. As a result, he is experiencing an altered state of consciousness. What is he likely to experience, in terms of:

> content limitations?

> perceptual and cognitive distortions?

> perception of time?

3 marks



→ CHAPTER 03:

METHODS OF STUDYING CONSCIOUSNESS

Consciousness is a unique experience. Our thoughts, feelings and perceptions are personal and private and difficult for others to fully comprehend. Consciousness gives us our individual human qualities – it creates our sense of self and influences our behaviours. Most psychologists believe that consciousness is worth studying despite its subjective nature. The difficulty arises with how to study consciousness. Read this chapter to find out how psychologists study normal waking consciousness and altered states of consciousness, especially sleep.

KEY KNOWLEDGE

Methods used to study the level of alertness in normal waking consciousness and the stages of sleep:

- measurement of physiological responses including electroencephalograph (EEG), electromyograph (EMG), electrooculargraph (EOG), heart rate, body temperature and galvanic skin response (GSR)
- the use of sleep laboratories, video monitoring and self-reports.

(VCE Study Design 2013)

Studying states of consciousness

CHAPTER OVERVIEW

Studying states of consciousness	Studying alertness in normal waking consciousness and the stages of sleep
Measurement of physiological responses	Three main devices used to study states of consciousness > Electroencephalograph (EEG) > Electrooculargraph (EOG) > Electromyograph (EMG) Other measurements > Heart rate > Body temperature > Galvanic skin response (GSR)
Other methods to study states of consciousness	The use of sleep laboratories Video monitoring Self-reports

You probably have a good idea of what happens to you when you are awake. But what happens when you sleep? When you fall asleep, does your body relax and your brain stop working? Is sleep really a time to switch off? How does it differ from normal waking consciousness?

As we know from the previous chapter, we experience a number of different states of consciousness during normal waking consciousness. Our level of alertness can change during our waking time and it is natural to feel drowsy at some stages and alert at others, as well as sometimes being between the two. This level of awareness influences our thoughts, feelings, perceptions and behaviours.

Sleep is a *dynamic* process. Like normal waking consciousness, we experience a number of different states (known as stages) during our sleeping time. There are several characteristic physiological changes that occur throughout sleep that make sleep an active – as opposed to passive – event. These physiological changes are predictable and, along with other measures including self-reports and video monitoring, can assist in studying sleep and normal waking consciousness. Sleep laboratories often combine a number of approaches to studying sleep and have provided us with a deeper understanding of what happens when we sleep. This chapter will explore some of the most common methods used to study normal waking consciousness and sleep.

Studying alertness in normal waking consciousness and the stages of sleep

Consciousness is a psychological (hypothetical) construct – it is believed to exist but cannot be directly observed or measured. Most of what is known by psychologists about different states of consciousness is inferred from physiological changes that can be measured, from observable behaviour, or by research participants themselves (self-reporting). Indeed, researching sleep by only one method, such as asking participants to report their experience, is not ideal. During sleep our level of awareness is extremely low and participants are unlikely to remember much about the experience other than the odd dream. Sleep laboratories commonly use a wide range of methods at the same time to collect rich sleep data and open the window into the mysteries of sleep.

Measurement of physiological responses

Measurable changes in physiological responses are probably the most reliable and least subjective means of indicating different states of consciousness during sleep. Typically, the data is consistent and stable and it can be recorded and usually interpreted consistently between researchers and from time to time.

There are weaknesses with using only this method. First, while not as subjective as asking a participant to describe the experience, it is limited in its ability to identify the participant's private and personal conscious experience. Researchers may be able to observe physiological changes but they won't really know about the experience unless they ask the participants! Second, changes in physiological events may be due to other reasons, not a change in state of consciousness. If a person is sick with a fever while asleep, this will alter physiological responses and may be interpreted as a different stage of sleep rather than a fever.

Many physiological measures provide psychologists with information about how bodily functions change during normal waking consciousness and about changes that occur during altered states of consciousness. Such bodily functions include brainwave patterns (caused by changes in the electrical activity of the brain), eye muscle movement, muscle movement, heart rate, body temperature and electrical conductivity of the skin.

The three main devices used to study states of consciousness, especially sleep, are:

- EEG (electroencephalograph)
- EOG (electrooculargraph)
- EMG (electromyograph).

Other measurements include:

- heart rate
- galvanic skin response
- blood pressure.
- body temperature
- respiration rate

In more recent times, brain scanning techniques (CT, PET, Spect, MRI and *f*MRI scans) are popular in studying brain structure and function and offer further insights into the conscious and unconscious processing. It is important to acknowledge their value as this new technology opens new ways of researching and understanding the brain. These techniques are not a focus of this section or the current study design but are briefly introduced on page 216–19.

Three main devices used to study states of consciousness

ELECTROENCEPHALOGRAPH (EEG)

The **electroencephalograph** (EEG) is a device that detects, amplifies and records electrical activity in the brain in the form of brainwaves. It does this by monitoring the electrical activity of the brain that is detectable on the outside of the skull. Many tiny electrodes are placed on the skull in a symmetrical pattern (see Figure 3.1). These electrodes measure the very small voltages created by the synchronised activity of large numbers of neurons (nerve cells) in the outer layer of the brain. You do not have to worry about the electrodes hurting a participant – wearing electrodes on your head may look scary but they are certainly not able to deliver electric shocks! The recordings produced by the EEG, called **electroencephalograms**, were originally made by a pen that moved up and down on a roll of graph paper; today they are often recorded by a computer and shown on a monitor.

FIGURE 3.1 Many tiny electrodes are placed on the skull in a symmetrical pattern to record brainwave activity.

EEG recordings indicate changes in brainwave activity associated with changes to states of consciousness, such as when a person falls asleep, and the various stages of sleep, including the stage in which we are most likely to experience dreaming. Sleep is made up of two phases: **rapid eye movement (REM) sleep** and **non-rapid eye movement (NREM) sleep**. NREM sleep is further broken down into four stages and will be discussed in more detail in the next chapter.

Brainwave patterns may vary in **frequency** (i.e. the *number* of brainwaves per second). High frequency brainwave patterns indicate faster brainwaves as demonstrated by more waves per unit of time (usually seconds). Frequency is measured in hertz (Hz: vibrations per seconds).

Brainwaves may also vary in **amplitude** (i.e. the *height* of the peaks and troughs of the curved graph that represents brainwave activity). Amplitude is measured in microvolts (μV).

When we are awake and alert, we exhibit fast (high frequency) and small (low amplitude) brainwaves. In deep NREM sleep, we exhibit slow (low frequency) and big (high amplitude) brainwaves.

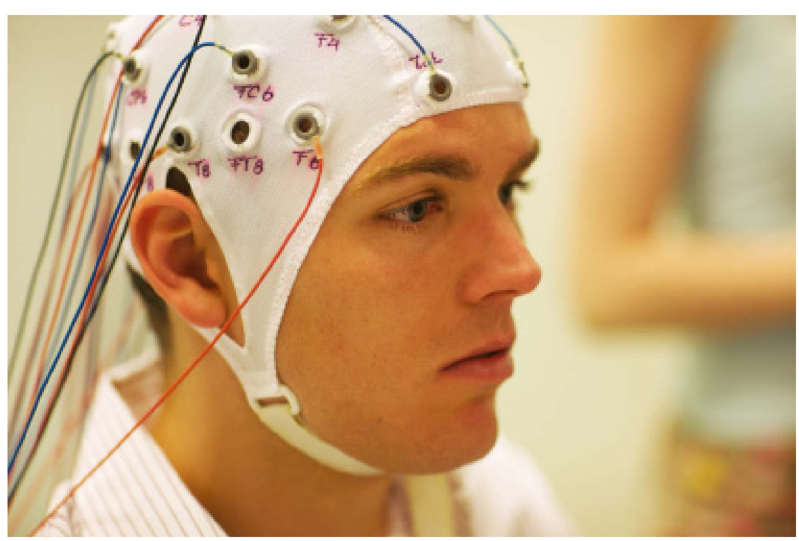


FIGURE 3.2 Tiny electrodes can also be placed on the skull, using a cap that fits snugly on the head, to measure brainwave activity.

There are basic types of brainwave activity that are associated with certain states of consciousness, especially during normal waking consciousness and sleep. Table 3.1 outlines four of the major types of brainwave activity.

TABLE 3.1 Four major types of brainwave activity and their association with consciousness

BRAINWAVE PATTERN	DESCRIPTION	ASSOCIATION
Beta waves	High frequency (fast – up to 40 per second) and low amplitude (small)	The typical brainwave pattern during normal waking consciousness, associated with being alert, active, anxious and paying (selective) attention. Eyes are open, person is awake and alert.
Alpha waves	Reasonably high frequency (but not as high as beta waves) and low amplitude (but slightly higher than beta waves)	The typical brainwave pattern when awake but very relaxed, such as while daydreaming, very drowsy or when we are about to fall asleep. Eyes are often closed. May be seen in people in a coma.
Theta waves	Medium frequency and mixed amplitude (some high, some low)	The typical brainwave pattern during the early stages of sleep. Also seen in young children and psychopaths, may be caused by frustration.
Delta waves	A steady pattern of low frequency (slow 1 to 4 per second) and high amplitude (large)	The typical brainwave pattern associated with NREM deep sleep. Also mainly seen in babies and adults with brain tumours.

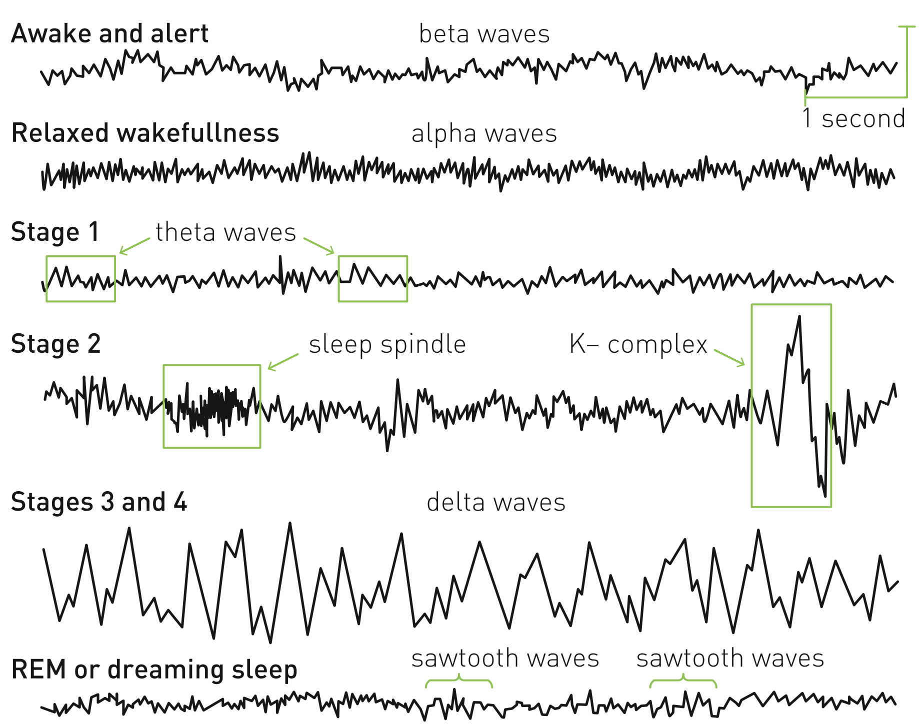


FIGURE 3.4 K-complexes and sleep spindles are indicative of stage 2 NREM sleep. Sawtooth waves are associated with REM sleep.

Other brainwave patterns or features, usually not very long-lasting, can occur during these patterns (see Figure 3.4). For instance, **K-complexes** (sharp rise and fall in amplitude, lasting for about two seconds) and **sleep spindles** (periodic bursts of rapid frequency) are indicative of stage 2 NREM sleep, something we will discuss in the next chapter.

Sawtooth waves are random, fast waves that are slightly bigger than alpha waves. They resemble waves for being awake but occur among the beta-like waves during REM sleep. Sawtooth waves are associated with dreaming.

3.1 REVIEW

Fill in the gaps.

1 The __________ (EEG) is a device that __________, __________ and records electrical activity in the brain in the form of brainwaves.
2 Beta waves are the distinctive brainwave pattern characteristic of when we are awake and __________.
3 __________ waves have a medium frequency and mixed amplitude.
4 __________ waves are distinctive of deep NREM sleep.
5 When we are lying in bed, feeling drowsy but still awake, we are likely to exhibit __________ brainwaves.
6 K-complexes consist of a sharp rise and fall in __________ and sleep spindles are periodical __________ of __________ electrical activity.
7 Sawtooth waves are associated with __________ sleep.
8 The four major patterns of brainwave activity are called __________, __________, __________ and __________ waves.

ELECTROOCULARGRAPH (EOG)

The **electrooculargraph** (EOG) is a device that detects, amplifies and records electrical activity in the muscles that move the eye. The resulting signal is called the **electrooculargram**. It measures changes in voltage as the eyes move and rotate in their sockets. Electrodes are attached to areas on the face around the eyes (see Figure 3.6) and the recording procedure is similar to that used for the EEG. One set of electrodes will measure the electrical activity of the muscles of the right eye and the other will measure left. Measurements are displayed individually for each eye.

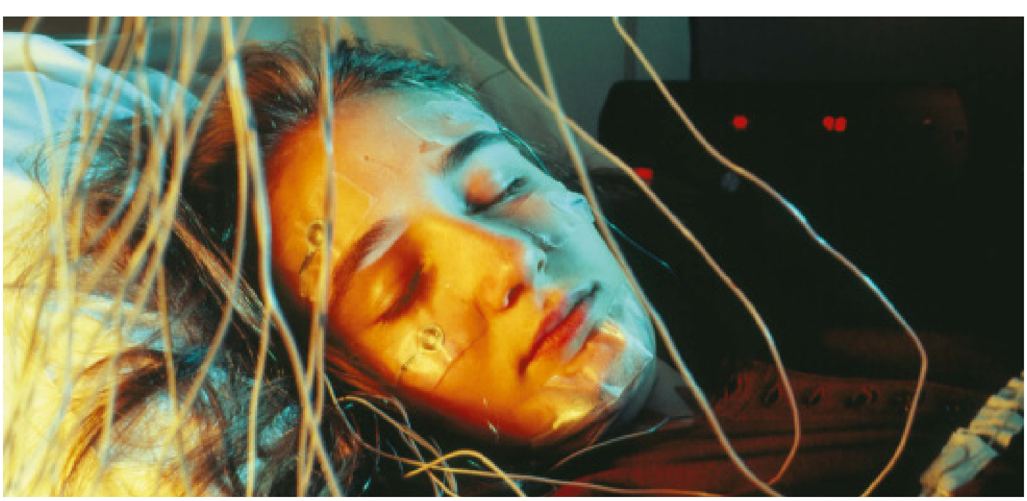


FIGURE 3.5 This sleeping participant is wired up to collect EEG, EOG and EMG information.

The EOG is particularly useful to determine whether a person is in one of the two phases of sleep (REM and NREM sleep). During sleep, there are periods of no or very little rapid eye movement (NREM sleep) and others that consist of bursts of rapid eye movement (REM sleep). When we are awake, our eyes may move rapidly depending on what we are doing visually at the time. For instance, if you are staring out a window or thinking deeply about an issue, there will be little eye movement. If you are looking for a friend in a crowd, you would expect more eye movement.

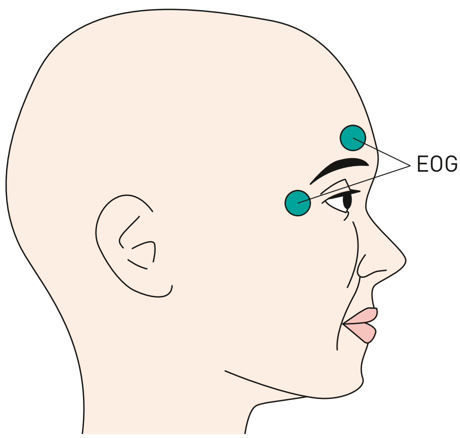


FIGURE 3.6 EOG: Electrodes are placed on the muscles near the eye.

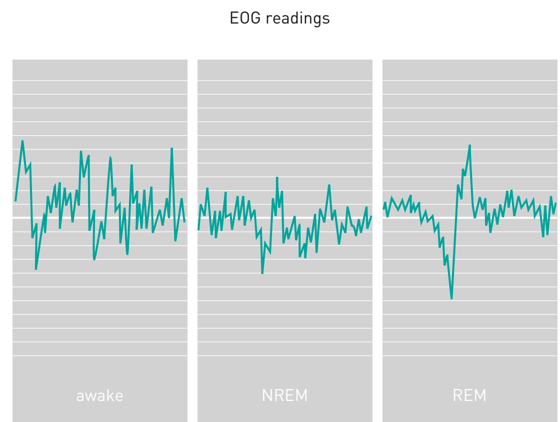


FIGURE 3.7 EOG recordings for someone who is awake and asleep (REM and NREM sleep)

FIGURE 3.8 The muscles of the eyes are in constant motion during rapid eye movement sleep.

ELECTROMYOGRAPH (EMG)

Another device commonly used to measure the stages of sleep is the **electromyograph**. The electromyograph is a device that detects, amplifies and records the electrical activity of muscles. The recording is called an *electromyogram*. Electrodes are attached to the skin directly above the muscles (usually the ones located under the chin – see Figure 3.9) and the recording procedure is similar to that of an EEG and EOG. An EMG indicates changes in electrical activity in muscles that accompany changes in states of consciousness.

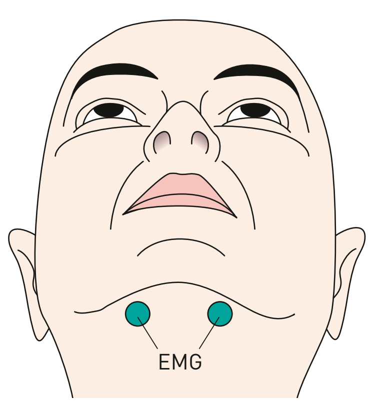


FIGURE 3.9 EMG: Electrodes are placed on the muscles to record electrical activity of the muscles.

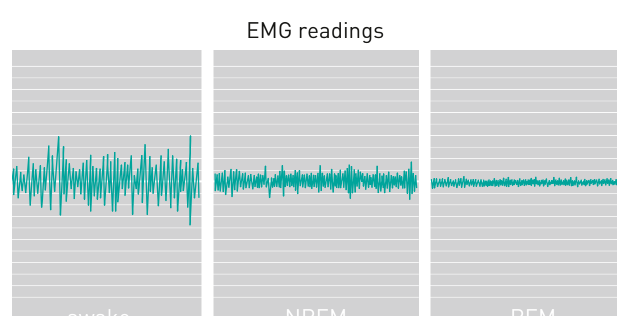


FIGURE 3.10 EMG recordings for someone who is awake and asleep (REM and NREM sleep)

This EMG can be useful to determine whether a person is awake or asleep and, if asleep, which one of the two main types of sleep (REM or NREM sleep). When someone is awake, activity on the EMG recordings vary between moderate and high, depending on the activity at the time. During sleep, the activity is moderate to low during NREM sleep (with some mild spasms associated with light sleep) and is virtually non-existent during REM sleep.

Data can be collected simultaneously from the EEG, EOG, EMG and any other devices and displayed on a continuously moving chart, known as a **polysomnogram**. This allows a researcher to compare corresponding data at once and make more informed decisions about the state of consciousness and any underlying problems. It takes training to be able to read the polysomnogram accurately, as large quantities of data are produced in one night's sleep and some features or patterns can be difficult to understand. Look carefully at Figure 3.11. This participant is asleep but enters REM sleep, in this case determined by the high amplitude waves in the EOG data.

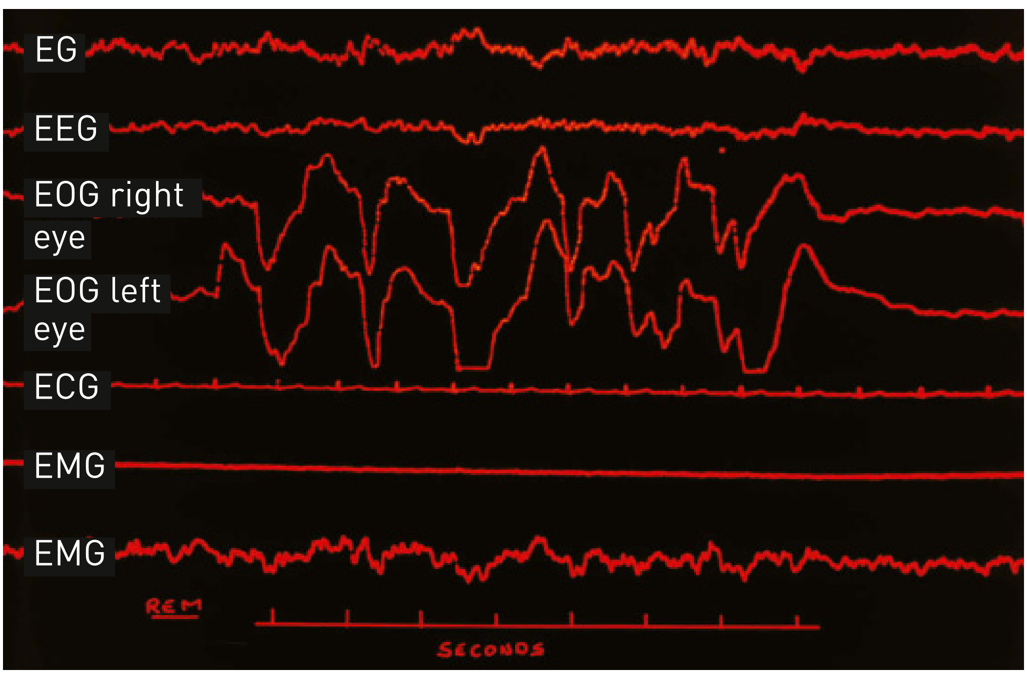
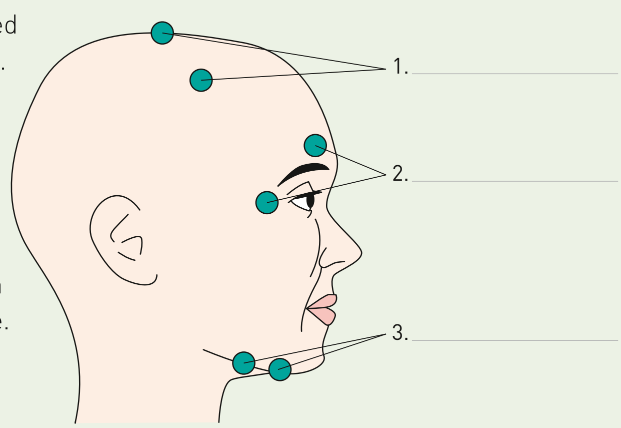


FIGURE 3.11 Look closely at the data on this polysomnogram. Can you determine when the participant entered REM sleep?

3.2 REVIEW

1 Look carefully at the following illustration of a participant wired up with the EEG, EOG and EMG.
   a Decide which electrodes are collecting EEG, EOG or EMG data. Write the name in the appropriate place.
   b Write the definition for each device underneath its name.



2 What is a polysomnogram? Why are they useful when studying sleep?

Did you know?

Two other physiological measurements commonly used are blood pressure and respiration. Exercise, stress and strong emotions can increase these. During NREM sleep, blood pressure decreases and respiration slows. During REM sleep, blood pressure varies and may increase up to 30 per cent above resting levels when awake and respiration is irregular.

Other measurements

HEART RATE

Heart rate may be measured using a standard heart rate monitor or by using an **electrocardiograph** (ECG or EKG) that detects, amplifies and records the electrical activity of the heart muscles. Heart rate is measured in beats per minute (bpm).

When awake, heart rate can vary depending on what you are doing. Exercise and most strong emotions will raise heart rate. Heart rate is lower when we feel drowsy. In some altered states of consciousness, heart rate increases (for example, with stimulant drugs such as caffeine) while in other states of consciousness it decreases (for example, when meditating). During NREM sleep, heart rate is usually slow and regular, often slower than resting heart rate. During REM sleep, heart rate can vary remarkably and even rise to levels seen when carrying out strenuous exercise.

BODY TEMPERATURE

Body temperature varies in a regular way over a 24-hour period. It is usually measured during sleep by recording the temperature on the skin of the fingers. Our body temperature tends to peak in the mid-afternoon and reach its lowest point in the early hours of the morning (Figure 3.12). Body temperature is linked to alertness, and fluctuation in temperature can lead to drowsiness. This helps explain why some cultures encourage a siesta in the afternoon and why there are more accidents in the early hours of the morning – both times when we are likely to feel less alert.

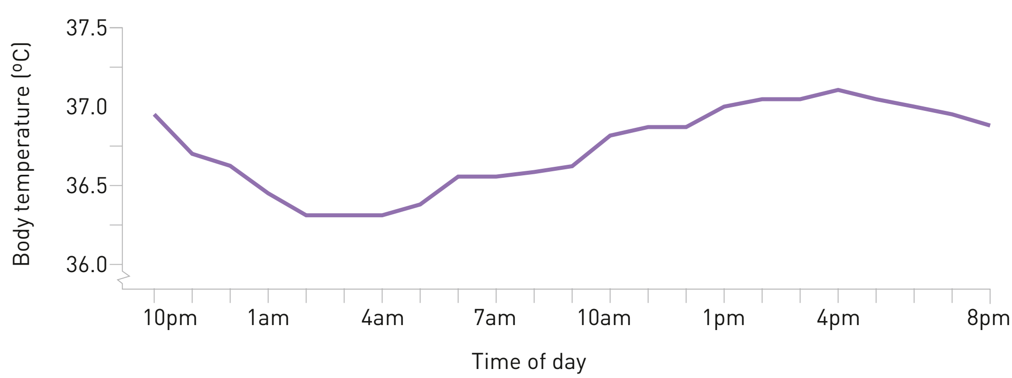


FIGURE 3.12 Body temperature varies in a regular way over a 24-hour period.

Body temperature is predictable and there is little variation in daily rhythm when we are awake, despite changes in alertness. In other altered states of consciousness, such as an alcohol-induced state, body temperature can drop and expose the person to the risk of hypothermia. Other states, such as those induced by drugs like Ecstasy, can raise body temperature, risking overheating and dehydrating. Body temperature reaches its lowest levels in NREM sleep. It is not regulated during REM sleep, causing it to drift towards the temperature in the surrounding environment.

GALVANIC SKIN RESPONSE (GSR)

The physiological response that indicates the electrical conductivity of the skin is known as the **galvanic skin response** (GSR). As the skin becomes more moist (through perspiration), its electrical conductivity increases.

During normal waking consciousness, events that cause us to perspire, such as strong emotional reactions or physical exercise, will increase our GSR. Conversely, GSR decreases when we are relaxed and in a cool environment. In some altered states of consciousness, GSR will increase while in others (such as meditation), GSR will decrease.

It is important to note that physiological measurements are only indicators of states of consciousness. They don't record our thoughts, feelings and perceptions.

TABLE 3.2 Summary of physiological measurements used to research states of consciousness

PHYSIOLOGICAL MEASUREMENT	WHAT IS MEASURED	NORMAL WAKING CONSCIOUSNESS		SLEEP	
		Alert	Drowsy (relaxed)	Non-rapid eye movement (NREM)	Rapid eye movement (REM)
Electroencephalograph (EEG)	Detects, amplifies and records electrical activity in the brain in the form of brainwaves	Beta waves	Alpha waves	Alpha, theta and delta waves, sleep spindles and K-complexes depending on the stage of NREM sleep	Similar to being awake, including random and fast sawtooth waves
Electrooculargraph (EOG)	Detects, amplifies and records electrical activity in the muscles that allow the eye to move	Depends on the activity, rapid if involves eye movement	Little	None or very little	Bursts of rapid movement
Electromyograph (EMG)	Detects, amplifies and records the electrical activity of muscles	Moderate and high depending on the activity at the time	Moderate	Moderate to low	Virtually non-existent
Heart rate monitor or Electrocardiograph (ECG or EKG)	The number of times the heart beats per minute (can be used to determine the electrical activity of the heart muscles)	Medium to fast, depending on the activity at the time	Medium to slow (resting levels)	Slow and regular	Increases and varies markedly
Thermometer	Temperature of the body		Moderate to low (resting levels)	Low	Not regulated so varies depending on surrounding environmental temperature
Galvanic skin response (GSR)	Electrical conductivity of the skin	Moderate to high depending on the activity at the time	Moderate to low (resting levels)	Low	Varies from low to moderate
Blood pressure monitor	Pressure of blood pumping through arteries	Moderate to high depending on the activity at the time	Moderate to low (resting levels)	Low	Increases and varies markedly
Respiration monitor	Number of breaths per minute	Moderate to high depending on the activity at the time	Moderate to slow (resting levels)	Slow and regular	Increases and varies markedly

REVIEW 3.3

1 Why are physiological measurements used to study consciousness?
2 What is the galvanic skin response (GSR)?
3 What happens to the galvanic skin response when we sweat?
4 What happens to heart rate and body temperature during REM sleep?
5 When is our body temperature at its lowest in a 24-hour period?
6 What information cannot be obtained about consciousness from physiological measurements?

Other methods to study states of consciousness

The use of sleep laboratories

The nature of sleep fascinates many people. Sleep laboratories have provided researchers with a deeper insight into the differences between normal waking consciousness and sleep. They have helped us to know more about what happens during sleep – both physiologically and psychologically.

In sleep laboratories, video monitoring and self-reports are often used in conjunction with physiological measurements. For instance, videos can observe the sleeping participant's body movements and they may be woken and asked to recall dreams or experiences. Such data can be matched up with how the participant was feeling before and after going to sleep and with physiological measurements. This can reveal a great deal about sleep, including stages of sleep, sleep disorders and the purpose of sleep and dreaming.

A **sleep laboratory** is a place used for scientific research on sleep. It usually resembles a bedroom. The participant stays one or more nights. In a sleep laboratory, the participant is usually 'wired up' to record the physiological measurements. The researcher monitors the participant from another room, usually through a window that looks into the bedroom or by video. The researcher can control environmental aspects such as room temperature and make this constant for all participants. Data is recorded both when the participant is awake and asleep throughout their time in the laboratory. Waking participants at particular points and asking them about the experience can also give an indication of the mental processes taking place at the time. For example, dreams are more likely to be remembered when dreamers are awakened from REM sleep.

Research in sleep laboratories allows brainwave activity and other physiological measures to be monitored in a controlled environment. In addition, the equipment is difficult, if not impossible, to transport outside the laboratory. Sleep researchers can comfortably work in their workplace with all their resources without having to intrude into participants' homes.

Sleep laboratories present some challenges for researchers. First, the participant must be able to sleep in the **artificial environment**, one that is unfamiliar and contrived. Think about how you cope when sleeping in a different place. For participants in sleep laboratory research, a different bed and different routines, along with being 'wired up', can make it hard for them to fall asleep or sleep in their usual manner and this can confound the results. For example, consider if the researcher is investigating people who have frequent nightmares. Participants in sleep laboratories tend not to have really emotional dreams – in fact, participants rarely experience nightmares, making it difficult to collect the relevant data. One way to reduce this problem is to have the participant stay more than one night. Staying longer can enable more data to be collected and allows the participant to adapt to the new environment, making them more likely to resume their normal sleeping habits on the later nights. For this reason, some studies will not begin until after the first or second night.

FIGURE 3.13 A sleep researcher monitors a participant in a sleep laboratory.

A second challenge for researchers is that sleep may be deliberately interrupted. Being woken up at regular intervals to report on your dreams interferes with your normal cycle.

A third challenge is for a participant to agree to being 'wired up' and observed. It is not a comfortable thought for many people – it requires trust and respect between the researcher and the participant. For some, just knowing that the wires will not hurt them is reassuring, for others it feels like an invasion of privacy. Take a minute to think about whether or not you would volunteer for a sleep study.

Sleep laboratory research is becoming more complex with brain-scan imaging. The latest technology will advance our knowledge and understanding of what happens within our brain when we sleep. However, interpreting dreams and other experiences via brain scans will still be difficult, because this technology does not allow researchers to see the actual thoughts, feelings and perceptions that a person is experiencing.

LOOKING FOR VOLUNTEERS!

INVESTIGATE 3.1

Working in small groups, answer the following questions:

1. Would you volunteer for sleep laboratory research? Why or why not? Discuss your reasons with other members of the group. Is there a range of reasons among group members?
2. Brainstorm a list of the advantages and disadvantages of research in a sleep laboratory.

Video monitoring

Methods for observing behaviour, such as video monitoring, can provide an insight into how we behave in different states of consciousness, including normal waking consciousness and sleep. Researchers can observe participants when they are awake, including differences between their levels of alertness. Are you more likely to move around when you are feeling alert or drowsy? They can also study sleep, aiming to answer research questions such as 'How often do people roll over in the night?' or 'In which stage are sleepwalkers more likely to sleepwalk?'

CASE STUDY

DO YOU ROLL OVER IN YOUR SLEEP?

Yes, you do! In a pioneering study, Hobson, Spagna and Malenka (1978) used time-lapse photography with EEG recordings and self-reports to investigate sleep. Cameras were installed in a sleep laboratory to take photographs of sleeping participants at regular intervals and the photographs were displayed simultaneously with the EEG recordings.

This study demonstrated the association between major body movements (postural shifts), such as rolling over, and particular sleep phases. It showed that we regularly change our body position during the night and go through periods of immobility when we don't change our body position. In addition, they found that participants who report a better night's sleep tend to change their body position fewer times than those who don't. So there is now evidence that tossing and turning all night is linked with the feeling of poor quality sleep.

This work demonstrated the usefulness of video monitoring and the possibility of recording participants sleeping in their own bed without being 'wired up'.

Video monitoring is now a common method that can be used both in sleep laboratories and in the participant's own home. It uses infrared cameras (or cameras in a room lit with infrared light) that operate silently to allow footage to be seen and recorded in the dark without disturbing the sleeping participant. The recordings can be observed at any time after the period of sleep and given to other researchers to interpret. This is like your teacher asking another teacher to mark your work in order to test that each is interpreting the data the same way or to seek a second opinion. Recordings can also be shown to the participant to help them become aware of and understand their behaviour, for example, showing what they do when sleepwalking or even observing the effects of a snoring partner on their sleep.

FIGURE 3.14 Which sleeping position do you prefer?

When video monitoring, the researcher can continuously study the

behaviour, either at the time of collection or at a later stage or both. Often the data is recorded alongside the physiological measurements at the time, often in the form of a photograph that is taken every few seconds. If done at home, video monitoring allows the participant to sleep in their **natural environment**, a setting that is familiar and where the experience normally occurs. This way, the participant is more likely to sleep as they normally do and the researcher is more likely to collect realistic data. In addition, the researcher is not required to stay overnight – which, given they know more than most the value of a good night's sleep, is a decided advantage!

There are limitations with video monitoring. Like other behavioural observations, video monitoring cannot tell us what is going on inside the body or what the participant is experiencing – it relies on the researcher to interpret the behaviour. Therefore, the observations may be **subjective** (open to bias). In an attempt to overcome this, researchers often devise standard methods of measuring and interpreting behaviour. For instance, what constitutes a major shift in body position? Is it when you change trunk position (e.g. roll from side to back) or major limb position (move legs from straight position to bent position) or head position (move head from lying on right to left side) or a combination of moves? In addition, researchers often get two or more other researchers to independently interpret the data.

When video monitoring, we can only observe what is displayed on the screen or in the photographs that are taken every few seconds. This is similar to watching a football replay but not seeing the right angle to fully comprehend if the free kick was justified. The problem is not as bad for sleep researchers – at least they can usually predict where their participant will be!

INVESTIGATE 3.2

EVALUATION OF A STUDY DESIGN: SLEEPING POSITIONS AND AGE

Which sleeping position do people prefer and does this change over the lifespan?

In one study, participants from various age groups (five males and five females in each group) slept for four nights in a sleep laboratory, except for the youngest group who slept in a sleep laboratory for only two nights (De Koninck, Lorrain & Gagnon 1992). Participants were all right-handed, normal weight, not on medication and did not have a sleep disorder. They signed an informed consent form and received $10 compensation per night of stay.

The participants each slept in a single bed (with a single sheet) and the room temperature was kept constant at 22°C.

Video monitoring took place on the third and fourth nights (first and second nights for the youngest group), with the camera taking photos every eight seconds.

Two psychologists viewed the photographs independently and scored the sleep positions. The body position had to remain the same for at least one minute in order to be scored. The mean percentage of total time spent in various body positions was calculated and the results are displayed in Table 3.3.

1 Describe the main characteristics of the participants (how many, age, and other important characteristics) in this study.
2 Why was it important to have participants with similar characteristics (for example, not on medication and not suffering from a sleep disorder)?
3 What is the advantage of not collecting the data until the third and fourth nights?
4 Why do you think two psychologists independently scored the sleep positions?
5 What do the results suggest about the time spent sleeping on our stomachs as we get older?
6 What do the results suggest about the time spent sleeping on our right side as we get older?
7 Outline one advantage of using a sleep laboratory for this study.
8 Outline one potential confounding variable in this study. Explain how it could have affected the results.
9 a What is informed consent?
   b What information should have been included on the informed consent form?
   c Outline one other ethical consideration that would have been followed.

TABLE 3.3 Mean percentage of total time spent in various body positions for each of the five age groups

	AGE GROUPS				
	3–5 YEARS	8–12 YEARS	18–24 YEARS	35–45 YEARS	65–80 YEARS
Stomach	16.9	20.2	13.4	16.9	1.3
Back	27.6	27.2	26.7	13.4	26.0
Right side	27.8	23.2	30.0	37.5	55.0
Left side	27.7	29.5	29.2	32.1	17.6

(Source: De Koninck, Lorrain & Gagnon 1992)

Self-reports

How well did you sleep last night? Rate the quality of your sleep last night on the following scale: 1 (very poor); 2 (poor); 3 (fair); 4 (good); or 5 (very good). Discuss and comment.

You have just completed a self-report. Self-reports are statements and answers to questions made by the participants concerning their psychological experience (thoughts, feelings and behaviours) in relation to a psychological phenomena, in this case, sleep. They can be carried out in a number of different ways. For example, they can be in the form of questionnaires (with open and/or closed questions), diary entries and interviews. Self-reports can indicate whether or not a person is experiencing normal waking consciousness. For example, asking a person in an altered state of consciousness to tell a story about something that happened yesterday is likely to generate a response that is missing pieces or does not make complete sense.

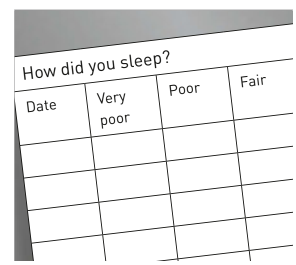


FIGURE 3.15 Self-reports are often used to study a person's sleep experience.

FIGURE 3.16 Self-reports are a valuable research method as they attempt to capture the person's psychological experience (thoughts, feelings and behaviours).

Self-reports can provide extremely valuable information about what the participant is experiencing. However, like all research methods, there are drawbacks. It is a subjective measure, based on personal judgments that may be difficult to communicate and compare with others. Self-reports have other limitations:

- Will the participant remember to complete the report? If the participant is carrying out a self-report sleep study over a week, it is likely that they will have to find ways to remind themselves to complete it, especially if it is to be done as soon as they wake in the morning.
- Are participants able to describe the experience accurately? For many of us, accurately describing our dreams or what we are thinking and feeling can be difficult.
- Are participants telling the truth? Sharing your personal and private thoughts or dreams can be difficult.
- Can participants remember? This is unlikely if they were in an altered state of consciousness, such as sleep. Dreams are usually quickly forgotten, if remembered at all.
- Have participants unintentionally left out key information? Sometimes we just forget.
- Can the researcher interpret the descriptions accurately and reliably? It can be very difficult to interpret self-reports objectively.

INVESTIGATE 3.3

RESEARCH INVESTIGATION: PANDA-CAM!

Giant pandas are solitary animals that can be active at night and during the day. In a 24-hour period, they spend about 10 hours awake and 14 hours asleep. They are slow-moving animals, probably because of their size and the limited nutrition in their diet. Giant panda cubs, like the young of all mammals, require more sleep.

Live webcams stream footage in a number of places around the globe. Look at the 'Panda–Cam' on the San Diego Zoo website. For this activity, use this webcam or a similar one (but not one with footage of humans).

1 Watch 5 minutes of live footage.
   > Make a list of the behaviours that you observe (for example, sitting still, walking, sleeping, eating, raising arm, rolling over, climbing, legs twitching).
   > Brainstorm this list with other members of the class. Add any other behaviours that you are likely to observe.
   > Assign each behaviour a letter of the alphabet. This is now your checklist.

CHECKLIST OF BEHAVIOURS
A: sitting still
B:
C:

2 Watch another 10 minutes of live footage.
   > Using your checklist, monitor the panda's behaviour every 15 seconds (you could get a member of the class to call out this time). What do we call this process?

> List the behaviours in a table like the one below.

TIME (IN SECONDS)	BEHAVIOUR (USE CODE FROM CHECKLIST)	ALERTNESS RATING
15		
30		
45		
60		
75		

> At the same time, on a scale from 1 to 5, give the panda a rating of alertness.

1	2	3	4	5
asleep	very drowsy	drowsy	alert	very alert

Questions to consider:

1 What behaviours were observed during the 10 minutes? Which behaviours were the most common?

2 Did you have any problems noting the behaviours? For example, were some hard to describe and/or not already included on your checklist?

3 Did you miss the opportunity to record a behaviour because it did not occur at the point of sampling (at the 15-second mark)?

4 What characteristics did you observe before making a decision about the pandas' level of alertness?

5 Compare your results to another class member's. Are your noted behaviours similar? Are your alertness ratings similar? Did you use similar cues to rate alertness?

6 In terms of ethics, why is it unethical to monitor people on a live webcam (e.g. the camera in Federation Square) without their knowledge?

7 In order to rate the level of alertness of a person, what additional information would you like to know?

FIGURE 3.19 Panda sleeping at the Beijing Zoo

8 What are some of the advantages and some of the difficulties with observing behaviours in this way?

9 Why is it ideal to use a range of research methods when investigating states of consciousness?

TABLE 3.4 Advantages and disadvantages of methods of researching sleep

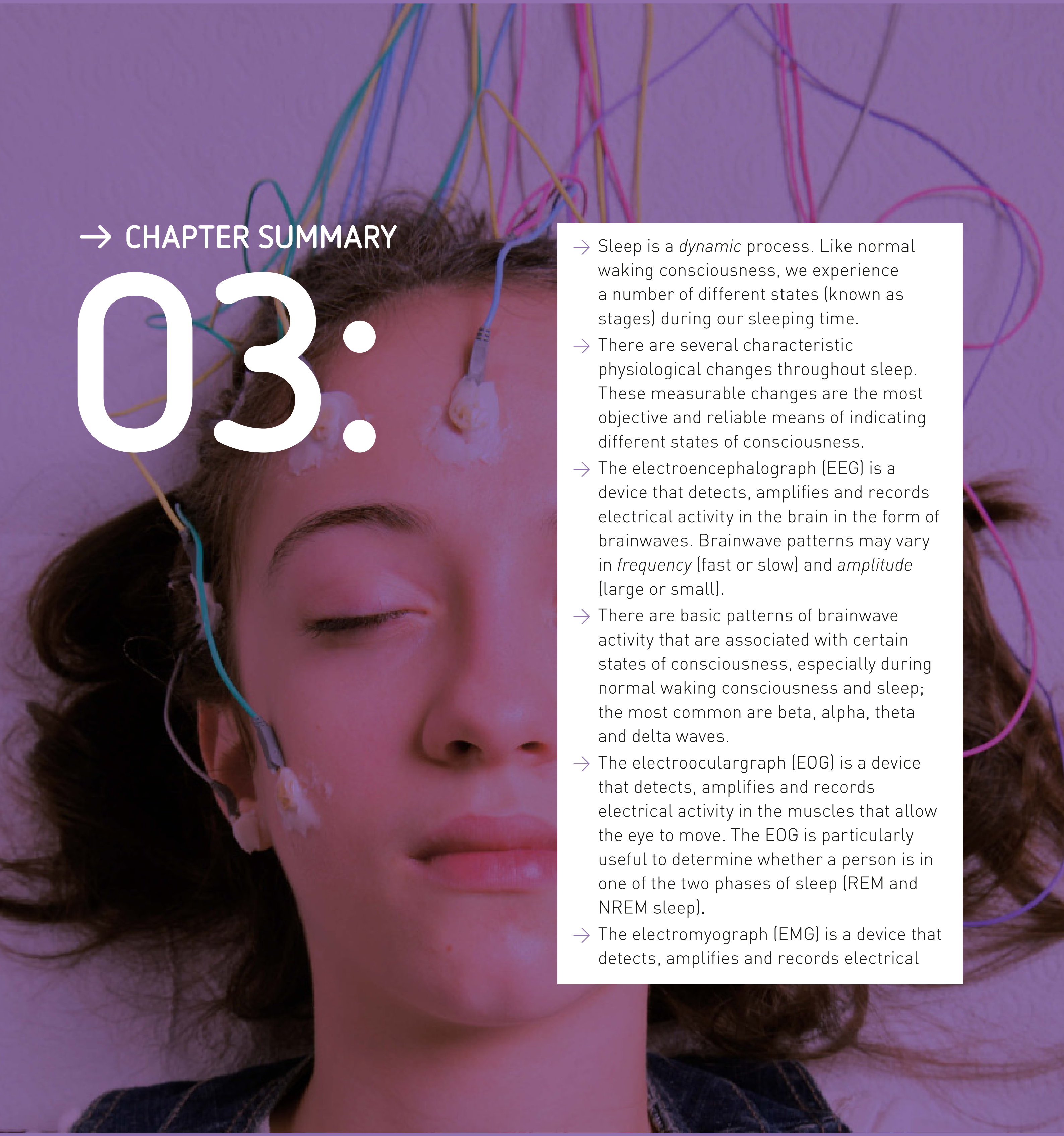
RESEARCH METHOD	DESCRIPTION	ADVANTAGES	LIMITATIONS
Physiological measurements	Recording of physiological (physical body) events	> Most objective and reliable means of indicating different states of consciousness	> Cannot describe the person's private and personal conscious experience (thoughts and feelings) > Changes in physiological events may be due to other reasons, not a change in state of consciousness
Sleep laboratory	A place used for scientific research on sleep that usually resembles a bedroom	> Research is conducted in a controlled environment > A number of research methods can be employed at once > The equipment is difficult, if not impossible, to transport outside the laboratory	> An artificial environment that may disrupt normal sleep patterns > Sleeping participants may be continually woken up and this may affect normal sleep patterns > Being monitored and wired up can be a frightening or invasive experience for some people
		> Sleep researchers can comfortably work in their workplace with all their resources without having to intrude into participants' homes	
Video monitoring	Using infrared cameras (or cameras in a room lit with infrared light) that operate silently to allow footage to be seen and taped in the dark without disturbing the sleeping participant	> Insight into observable behaviour during sleep > Can be undertaken in sleep laboratory or in normal bed (natural setting) > Researchers can continuously monitor the behaviour, either at the time of collection or at a later stage or both > Data can be recorded alongside the physiological measurements at the time	> Data can be open to interpretation so requires clear definitions for a specific behaviour > May miss important events if only considering still photographs every few seconds/minutes. Otherwise, lots of information to sift through > Participant's behaviour may be blocked from view of the camera
Self-reports	Statements and answers to questions made by the participants concerning their thoughts, feelings and behaviours	> Gives a rich and important insight into actual thoughts, feelings and behaviours experienced by the participants	> Subjective measures that are open to interpretation and difficult to communicate and compare with others.

In summary, researchers use a number of different methods to study consciousness. Measuring physiological responses, observing behaviours and asking for self-reports from participants are common methods that help unpack the mysteries of the different states of consciousness. For sleep, this data is often collected in sleep laboratories and combining this data can reveal what really happens when we are asleep and awake. Data can be used to investigate areas such as the purpose of sleep and dreaming, and a range of sleep disorders, such as insomnia (having trouble getting to sleep or staying asleep) and sleep apnoea (ceasing breathing during sleep). Everyone must sleep and this fact makes sleep research applicable to our own lives.

3.4 REVIEW

1. What does a sleep laboratory usually resemble?
2. What methods are usually used to study sleep in a sleep laboratory?
3. Why are sleep laboratories often described as artificial settings?
4. Why are video monitors used in sleep laboratories?
5. What information is likely to be displayed alongside the photographs taken in a sleep laboratory?
6. Why are self-reports used in sleep research?
7. Outline two limitations with using self-reports.

FIGURE 3.20 Sleep laboratories are helpful for measuring physiological responses and observing behaviours of those afflicted with sleep disorders.



→ CHAPTER SUMMARY 03:

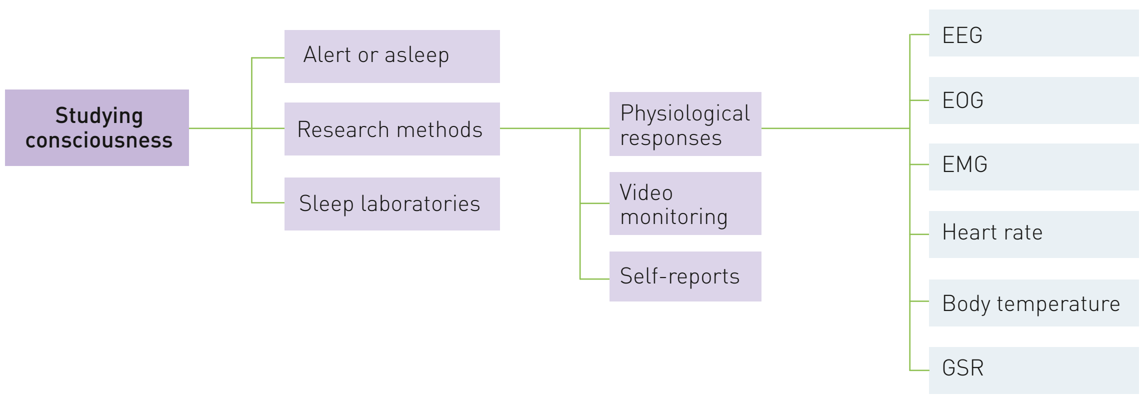
- Sleep is a *dynamic* process. Like normal waking consciousness, we experience a number of different states (known as stages) during our sleeping time.
- There are several characteristic physiological changes throughout sleep. These measurable changes are the most objective and reliable means of indicating different states of consciousness.
- The electroencephalograph (EEG) is a device that detects, amplifies and records electrical activity in the brain in the form of brainwaves. Brainwave patterns may vary in *frequency* (fast or slow) and *amplitude* (large or small).
- There are basic patterns of brainwave activity that are associated with certain states of consciousness, especially during normal waking consciousness and sleep; the most common are beta, alpha, theta and delta waves.
- The electrooculargraph (EOG) is a device that detects, amplifies and records electrical activity in the muscles that allow the eye to move. The EOG is particularly useful to determine whether a person is in one of the two phases of sleep (REM and NREM sleep).
- The electromyograph (EMG) is a device that detects, amplifies and records electrical

activity of muscles. Tiny electrodes are usually placed under the chin when used to study stages of sleep, with less activity recorded in REM sleep rather than NREM sleep.

- Data is collected simultaneously from EEG, EOG, EMG and any other devices and displayed on a continuously moving chart, known as a polysomnogram. This allows a researcher to compare corresponding data at once and make more informed decisions about the state of consciousness and any underlying problems.
- When awake, heart rate can vary considerably depending on the type of activity you are engaged in. It can be slow and regular or vary considerably during sleep.
- Body temperature follows a circadian rhythm; it varies in a regular way over a 24-hour period. Our body temperature tends to peak in the mid-afternoon and reach its lowest temperature in the early hours of the morning.
- The physiological response that indicates the electrical conductivity of the skin is known as the galvanic skin response (GSR). As the skin becomes more moist (usually through perspiration), its conductivity increases.
- In sleep laboratories, video monitoring and self-reports are often used in conjunction with physiological measurements. A sleep laboratory usually resembles a bedroom and the participant often stays one or more nights. In a sleep laboratory, the participant is usually 'wired up' to record the physiological measurements. The researcher monitors the participant from another room, usually through a window that looks into the bedroom. The researcher can control aspects like room temperature and make this constant for all participants. There are some limitations with recording data in an artificial environment.
- Video monitoring is now a common method used in sleep laboratories and in the person's own home. This method uses infrared lights and operates silently to allow footage to be seen and recorded in the dark without disturbing the sleeping participant. Often the data is recorded alongside the physiological measurements at the time, often in the form of a photograph that is taken every few seconds.
- Self-reports are statements and answers made by the participants concerning their psychological experience (thoughts, feelings and behaviours). They can be carried out in a number of different ways. For example, they can be in the form of questionnaires (with open and/or closed questions), diary entries and interviews.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

alpha waves
amplitude
artificial environment
beta waves
delta waves
EEG (electroencephalograph)
EMG (electromyograph)
EOG (electrooculargraph)
frequency
galvanic skin response
K-complexes
natural environment
objective measurements
physiological measurements
polysomnogram
sawtooth waves
self-reports
sleep laboratory
sleep spindles
subjective measurements
theta waves
video monitoring

KEY IDEAS

For the exam, you must know:

- the reasons why a number of research methods are used to study consciousness
- that sleep is an altered state of consciousness and consists of a number of different stages
- the advantages and limitations of using physiological measurements to study consciousness
- the use of the following physiological measurements in research and how each measurement differs between being alert, drowsy, REM and NREM sleep:
  - electroencephalograph
  - electrooculargraph
  - electromyograph
  - heart rate

- body temperature
- galvanic skin response
- how to describe brainwave patterns including:
    - the four major types (beta waves, alpha waves, theta waves and delta waves)
    - other common patterns (K-complexes, sleep spindles and sawtooth waves)
- the use of sleep laboratories, including:
    - description of how a sleep laboratory is most commonly set up
    - reasons for using sleep laboratories
    - limitations with the use of sleep laboratories
    - methods of research used in sleep laboratories (physiological measurements, video monitoring and self-reports)
- the use of video monitoring, including:
    - a description of how they are usually set up
    - how the data is usually displayed
    - reasons for video monitoring
    - limitations with the use of video monitoring
- the use of self-reports, including:
    - some ways self-reports can be carried out
    - reasons for using self-reports
    - limitations with the use of self-reports.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- understand why consciousness is difficult to study
- be aware of ethical considerations relating to studying consciousness.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 The __________ is a device that detects, amplifies and records electrical activity in the brain.
   a electroencephalograph
   b electroocculargraph
   c electromyograph
   d galvanic skin response

2 A physiological measure that is commonly used is the GSR. GSR stands for:
   a electrogalvanicograph.
   b galvanic skin response.
   c general skin response.
   d electrical skin recorder.

3 The ____________ is a device that detects, amplifies and records electrical activity of muscles, with electrodes located ____________ when used to study stages of sleep.
- a electrooculargraph; on the top of head
- b electromyograph; on the top of the head
- c electrooculargraph; on the chin
- d electromyograph; on the chin

4 Jane begins to perspire. This increase would cause:
- a an increase in GSR.
- b a decrease in GSR.
- c a decrease in EEG.
- d an increase in EEG.

5 Which of the following is true about the electrodes used for an electroencephalograph?
- a The electrodes are inserted into the skull to measure brainwave patterns.
- b The electrodes deliver a very small electric shock to the brain.
- c The electrodes are arranged in a symmetrical pattern.
- d The electrodes are placed under the chin.

6 Which one of the following is *not* one of the four basic types of brainwave patterns?
- a beta waves
- b alpha waves
- c theta waves
- d sawtooth waves

7 Which of the following brainwave patterns are indicative of being alert and awake?
- a beta waves
- b alpha waves
- c theta waves
- d sawtooth waves

8 K-complexes are:
- a a steady pattern of slow and large brainwaves.
- b a sharp rise and fall in brainwave amplitude.
- c rapid bursts of brainwave activity.
- d small, fast brainwaves.

Questions 9 and 10 relate to the following information:

Professor Lupin believes that VCE students are more likely to have dreams about animals on the night of a full moon than on other nights. He tells his participants to keep a 'dream diary' for one month. At the end, he collects the diaries and asks two researchers to 'score' each night's dreams for the percentage of animal content.

9 The dream diary is an example of:
- a a physiological measure.
- b video monitoring.
- c an objective test.
- d a self-report.

10 Professor Lupin asked different researchers to 'score' the diaries to minimise:
- a experimenter effects.
- b subject expectations.
- c the placebo effect.
- d objectivity.

11 The best physiological measure to use to examine whether a person meditating had entered an altered state of consciousness would be:
- a an EEG.
- b an EOG.
- c body temperature.
- d galvanic skin response.

SHORT ANSWER

12 Describe how an EEG can indicate whether a person is awake or has just fallen asleep.

2 marks

13 Name one device used by researchers in a sleep laboratory to investigate eye movements. How would this device indicate NREM sleep?

2 marks

14 A sleep psychologist will often use readings from EEG, EOG and EMG devices to study sleep.

a What are the essential similarities between these three measures?

1 mark

b What are the essential differences between these three measures?

1 mark

c How do they help build a better understanding of sleep?

1 mark

d Should a sleep psychologist use only these three measures to study sleep? Give reasons for your answer.

2 marks

15 The polysomnogram is commonly used in sleep laboratories.

a What is a polysomnogram?

1 mark

b Why is it useful when carrying out research in a sleep laboratory?

1 mark

c What causes heart rate and galvanic skin temperature to vary in normal waking consciousness?

1 mark

16 Heart rate and body temperature can become unregulated during sleep.

a What does 'unregulated' mean?

1 mark

b When is this likely to occur?

1 mark

17 Outline two limitations of carrying out research in sleep laboratories.

2 marks

18 What is the value of using a video monitor when carrying out sleep research?

2 marks

19 Self-reports are subjective in nature.

a What does this statement mean?

1 mark

b Why are self-reports an important research method despite being a subjective measure?

1 marks

20 Piya is a psychologist investigating sleep. She plans to carry out research in a sleep laboratory.

a Explain one advantage of using a sleep laboratory to carry out her research.

1 marks

b Explain why Piya is likely to use a number of different methods to study sleep.

1 mark

c Piya wants her participants to stay two nights in the sleep laboratory and plans to collect the data on the second night. Why is it often better for participants to stay more than one night?

1 marks

d Piya follows ethical guidelines. At the end of the study, she debriefs her participants. What does debriefing involve?

2 marks

SLEEP

Sleep is simply irresistible. We all need it and, even when we try to stay awake, sleep eventually takes over. Sleep is an example of an altered state of consciousness. During sleep, we are almost – but not totally – unaware of our surrounding environment. Much happens to our mind and body when we drift off to sleep. This chapter considers why we sleep and looks at the various different states we are in when asleep: states known as the stages of sleep.

KEY KNOWLEDGE

Sleep as an altered state of consciousness: purpose of sleep, characteristics and patterns of the stages of sleep including rapid eye movement (REM) and the non-rapid eye movement (NREM) stages of sleep.

(VCE Study Design 2013)

Stages of sleep

CHAPTER OVERVIEW

Stages of sleep	Altered state of consciousness
Sleep as an altered state of consciousness	Characteristics of sleep as an altered state of consciousness
Characteristics and patterns of sleep including REM and NREM stages of sleep	A typical night's sleep > Awake > Non-rapid eye movement sleep > Rapid eye movement sleep
Purpose of sleep	Survival (adaptive and evolutionary) theories of sleep > Criticisms of the survival (adaptive and evolutionary) theories Restorative (restore and recover) theories of sleep > Criticisms of the restorative (restore and recover) theories of sleep

On average, we spend about one-third of our lives asleep. If you are 17 years old, you have probably spent more than 5 ½ years asleep. A person who is 45 years old has spent about 15 years asleep and someone who is 75 years old has slept for 25 years. As discussed in Chapter 2, we spend up to a third of our waking time daydreaming, or more than 5 hours per day (1 year every 4 ½ years). Add this up – how many years have you spent sleeping and daydreaming?

Have you ever wondered what happens to your body and mind during sleep? Many psychologists are researching this fascinating area, with some leading research being conducted in Melbourne. In this chapter we will explore some of the wonders of sleep. Sleep is something that we all experience. Sleep is a crucial part of our lives; without it we cannot survive. In this chapter, we will consider sleep as an altered state of consciousness and look at what happens to our bodies during sleep, including the various stages of sleep. A message of caution though – reading about sleep can make you drowsy!

INVESTIGATE 4.1

HOW MUCH SLEEP DID YOU HAVE LAST NIGHT?

Think about your sleep last night.

1 What time did you go to bed?
2 How long did you sleep last night?
3 Did you wake up during the night? If so, at what time(s)?
4 What time did you wake up in the morning (to start the day)?
5 Did you wake at the sound of your alarm clock?
6 Did you wake up feeling refreshed and ready to start the day?
7 Did you dream? If so, how many dreams can you recall?
8 If you did dream, did you dream in colour?
9 If you did dream, who was the main character in your dream(s)?
10 Did you sleepwalk or sleep talk during the night?

Collect the class results by putting answers on the board.
Look for patterns in the data. Can you see any trends?
Discuss the findings in class. Did these questions inspire further questions about the nature of sleep?
Refer to your answers and the class results throughout the next two chapters.

Sleep as an altered state of consciousness

Have you ever found yourself desperately trying to fight off sleep during class? Perhaps you were struggling to stay awake while reading a textbook or watching a documentary. Perhaps you found yourself nodding off in class, with your head bobbing downwards, and then you suddenly jolted awake as you realised that sleep is likely to take over! How long can you fight against sleep? You don't stand a chance – sleep will eventually win, even if later that night.

FIGURE 4.1 Have you ever found yourself feeling sleepy in class?

Sleep is a natural occurrence and each day/night we have a period of sleep and of being awake. The sleep/wake cycle is an example of a circadian rhythm. **Circadian rhythms** are biological rhythms that occur approximately once every 24 hours.

Sleep can be viewed as an altered state of consciousness because it differs remarkably from normal waking consciousness. To nod off to sleep is to temporarily lose normal waking consciousness, including some awareness of yourself and your environment.

Characteristics of sleep as an altered state of consciousness

Following the discussion of the characteristics of states of consciousness, below is an outline of the characteristics of sleep that define it as an altered state of consciousness.

Level of awareness

- Sleep is a unique state of awareness. Each night we fall into this altered state of consciousness. It is certainly not a period of being awake, nor are we in a coma (totally unconscious). We have some, albeit very little, awareness of our external environment when we are asleep.
- We are not fully conscious of what is going on around us, but we can be aware of noise such as a barking dog. Neither are we totally unconscious. A person in a coma cannot be readily awoken with a loud stimulus and displays different brainwave patterns. At times, we may incorporate what is happening around us into a dream or we may suddenly be woken from a deep sleep by something highly personally relevant (such as a parent responding to their baby's crying). Other times, equally intense but less meaningful stimuli do not awaken us. We even know the location of the edge of the bed so we can avoid falling off! Compared with normal waking consciousness, however, when asleep our awareness of stimuli is much reduced.

Fewer content limitations

- When we sleep, we relinquish conscious control of our thoughts. Everyone dreams and the dreams we remember tend to be weird or bizarre. The contents of our dreams tend to be much broader and deeper than our thoughts in normal waking consciousness.

Controlled and automatic processes

- Performing other tasks is probably impossible. It is interesting to note that most sleepwalkers, known as **somnambulists**, usually carry out routine, automatic processes when they sleepwalk. This includes everyday events such as walking along the hallway, making a sandwich or going to the toilet.

Perceptual and cognitive distortions

- Our attention to sensory stimuli is lowered during sleep, including our perception of pain. Our thoughts are more likely to be disorganised and unrealistic during our dreams. Although most of us dream about four or five times a night (about 2 hours in total), we remember little upon awaking.

More or less emotional awareness

- Our emotions can be more or less intense or flattened during sleep. A nightmare can make us feel very scared and a good dream can make us feel terrific. There is some evidence that sleep can help us deal with our emotions (Cartwright 1998). Have you

FIGURE 4.2 Do you often wake up just as the alarm is about to sound?

Did you know?

Many of our body's physiological measurements fluctuate and follow a cyclic pattern over varying time periods. These rhythms, controlled by internal biological clocks, include:

- **infradian rhythms:** biological rhythms with cycles longer than 24 hours. Examples include migration patterns of some animals, seasonal variations in mood/appetite and menstrual cycle
- **circadian rhythms:** biological rhythms with cycles that occur on a 24-hour cycle. Examples include sleep/wake pattern, alertness, body temperature and growth hormone secretion
- **ultradian rhythms:** biological rhythms with cycles shorter than 24 hours, for example: sleep (REM/NREM) cycles.

ever felt very anxious about something late at night but woken up the next morning feeling better after a good night's sleep?

Less self-control

- Our ability to maintain self-control, including monitoring our own behaviour, is lowered during sleep. For instance, we may snore, dribble on our pillow, grind our teeth or sleep-talk during our sleep.

Distorted time orientation

- Our ability to perceive the speed at which time passes may be affected. How often has the alarm clock gone off and you have woken to the rude surprise that it is morning already? Or the alarm buzzes almost immediately after you have hit the 'snooze' button! Time can fly and, on other nights, it can feel as if it takes forever to reach the morning.

Despite this, there is growing evidence that suggests we have the ability to estimate the amount of time that has elapsed during sleep (Aritake-Okada, Uchiyama, Suzuli, Tagaya, Kuriyama, Matsuura, Takahashi, Higuchi & Mishima 2009). Often, we are able to wake up at a predetermined time without the use of an alarm clock. It appears that the ability to estimate time is associated with our deep (stages 3 and 4 NREM sleep) sleep and is more likely when we follow a regular sleep routine, including going to bed at the same time each night.

REVIEW 4.1

Fill in the following table that compares normal waking consciousness with sleep (an altered state of consciousness).

CHARACTERISTIC	NORMAL WAKING CONSCIOUSNESS	SLEEP
Level of awareness awareness of internal and external events		
Content limitations the amount of control you have to limit what you attend to		
Controlled and automatic processes your ability to effectively perform two or more tasks at once depending on their level of complexity		
Perceptual and cognitive distortions the degree of awareness and efficiency of your perceptions and cognitions (memory and thought processes)		
Emotional awareness the experience of emotions (feelings)		
Self-control the ability to maintain self-control, usually in terms of monitoring behaviours		
Time orientation your ability to correctly perceive the speed at which time passes		

Characteristics and patterns of sleep including REM and NREM stages of sleep

Sleep is not just one state of consciousness; it comprises a number of predictable states and follows a highly organised sequence of events. Throughout sleep, our bodies shift through a number of stages, each with its own unique characteristics. The different stages of sleep are usually identified by measurable changes in physiological responses (many of which are discussed in the previous chapter). Physiological changes include changes in brainwave patterns, muscle tension, eye movement, body temperature, heart rate, blood pressure, respiration and hormone release.

Throughout sleep, we shift between **non-rapid eye movement** (NREM) and **rapid eye movement** (REM) **sleep**, beginning with NREM sleep. The primary distinguishing feature between NREM and REM sleep is that rapid eye movement occurs in REM sleep. When investigated further, however, there are other physiological and psychological differences between the two. In addition, NREM sleep is often divided into four stages that are determined by predominant brainwave patterns. Whether a person is asleep or not, and which stage of sleep they are in, is usually defined by a distinctive pattern of brainwave activity.

On average, we go through one cycle of NREM and REM every 90 minutes. The NREM/REM cycle is an example of an **ultradian rhythm**, a biological rhythm that is shorter than 24 hours. Most adults typically experience 4–6 NREM/REM cycles per night. The amount of time spent in REM sleep increases and NREM sleep decreases as the night progresses. This means that we typically spend more time in REM sleep in the cycle *just before* we wake in the morning compared with cycles earlier in the night.

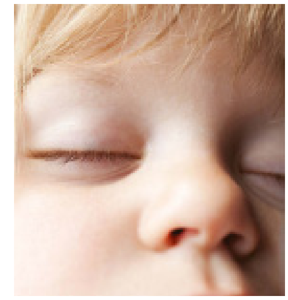


FIGURE 4.3 Rapid eye movement occurs during REM sleep.

Did you know?

Two sleep researchers noticed something unusual about their participants (Aserinsky & Kleitman 1953). At certain times, the eyeballs under a sleeper's eyelids would move rapidly to and fro. At the same time they noted a change in brainwave patterns, decided it was a distinct stage of sleep, and aptly named it rapid eye movement sleep. This simple observation changed the whole course of sleep research.

Ask the person next to you to close their eyes and move them around. Can you understand what Aserinsky and Kleitman observed?

A typical night's sleep

Imagine you are just about to go to bed for a good night's sleep. The following information outlines the sleep journey that we follow through a typical night.

AWAKE

Our state of consciousness, as marked by our brainwaves, starts to change as we prepare to sleep.

Awake and alert

During the evening we are likely to be awake and alert, maybe completing homework, playing sport, rehearsing music or watching television. When we are awake and alert, our brainwave activity consists of **beta waves** which are short (low amplitude) and fast (high frequency).

Awake and drowsy

Just before we fall asleep, we usually close our eyes and relax. Our brainwave patterns are predominately **alpha waves** during this time. Alpha waves are slower (lower frequency) and slightly bigger (higher amplitude) than beta waves, as seen in Figure 4.4.

FIGURE 4.4 Brainwaves become slower and slightly bigger as we move from being alert (left) to drowsy (right).

NON-RAPID EYE MOVEMENT SLEEP

Once asleep, we enter NREM sleep. NREM sleep consists of four stages and accounts for about 80 per cent of our total sleep time. Brainwaves become progressively slower, larger and more regular as we progress through the NREM stages of sleep.

Stage 1 NREM sleep

During the transition from being awake to being asleep, or falling asleep, we enter a relaxed state known as a **hypnogogic state**. During this state, we may experience hallucinatory images, such as flashes of light and vivid images. Hypnogogic (hypnic) jerks – involuntary muscle twitches that cause us to jolt – are common. When falling asleep, usually at the beginning of the night as your muscles relax, have you ever felt like you were falling and woken with a jump? The hypnogogic state is often considered to be part of Stage 1 NREM sleep.

Stage 1 NREM sleep is brief, lasting around 5 minutes for most people (it can range from 30 seconds to 10 minutes). It is a very light sleep from which we can be easily awakened. If this happens, we often think we haven't been asleep at all. It is sometimes called the *presleep* stage.

Alpha waves begin to be replaced by slower (lower frequency) and larger (higher amplitude) **theta waves**. Our eyes roll slowly, our muscles relax, and heart and breathing rate decreases.

Stage 2 NREM sleep

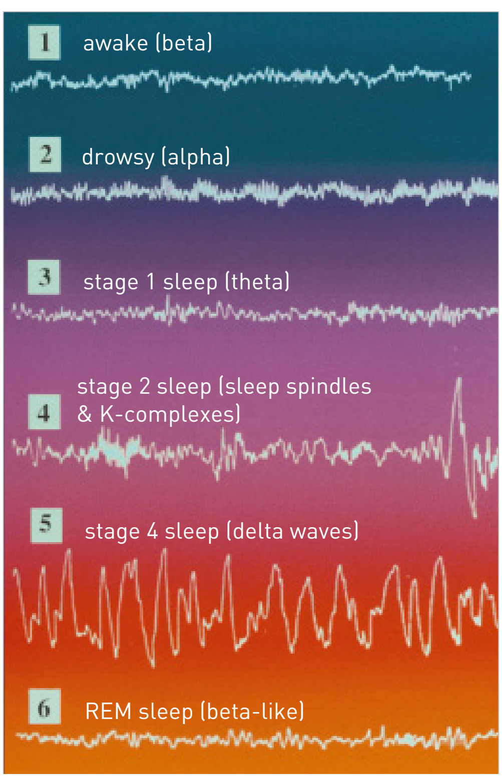


FIGURE 4.5 Brainwave patterns during the stages of sleep

Many consider the start of stage 2 as the point at which true sleep begins. We spend about 20 minutes in stage 2 sleep in our first NREM/REM sleep cycle and it is still fairly easy to be woken up at this stage, despite it being a deeper stage of sleep. If we are woken, it is likely that we still won't believe we were asleep.

Stage 2 sleep is easier to recognise on the EEG than stage 1. It is characterised by the appearance of **sleep spindles** (short bursts of rapid brainwave activity) and **K-complexes** (a single sudden high amplitude wave) among the theta waves. K-complexes occur about once a minute in stage 2. Sometimes they occur following a sleep spindles episode but can also be triggered by environmental stimuli, such as a door closing or someone calling your name.

Interestingly, older people tend to wake more often in the night and their sleep contains fewer sleep spindles. Some psychologists argue that sleep spindles represent a mechanism that helps the brain to 'switch off' its responses to sensory stimuli, thereby keeping us asleep (De Gennaro & Ferrara 2003).

As we slip further into stage 2 sleep, our eyes stop rolling, our muscles become further relaxed, and breathing and heart rate continues to decrease.

Stage 2 sleep accounts for about 50 per cent of our total sleep.

Stage 3 NREM sleep

Stage 3 NREM sleep is a brief transitional stage that marks the start of deep sleep (slow wave sleep). During stage 3, we become less responsive to external stimuli and more difficult to awaken. If we are woken from stage 3 sleep, we feel very groggy and disorientated.

Slower (lower frequency) and larger (higher amplitude) delta waves become more common. These replace theta waves and sleep spindles, and occur between 20 and 50 per cent of the time.

In stage 3 sleep, our eyes do not move, our muscles are relaxed, and heart and breathing rates continue to become slower and more regular.

Stage 4 NREM sleep

Stage 4 NREM sleep is the deepest sleep and, as in stage 3, it is extremely difficult to wake someone who is in this sleep stage. This is when we are 'fast asleep' or 'sleeping like a log'. Although our level of conscious awareness is very low, we can still be sensitive to certain stimuli, such as a baby crying or a smoke alarm.

In the first NREM/REM sleep cycle, we spend about 30 minutes in stage 4 sleep and it has probably been about an hour since we first fell asleep.

In stage 4, brainwave patterns consist of regular, slow and large delta waves for more than 50 per cent of the time. There is no eye movement, little, if any, muscle activity (muscles are very relaxed) and heart and breathing rates are at their slowest and most regular during sleep. While body temperature follows a circadian cycle, during NREM, it drops slightly, being lowest in stage 4 sleep.

Sleep stages 3 and 4 of NREM are collectively called **slow wave sleep**. They are usually grouped together because their main distinguishing feature is the percentage of delta waves.

SUPPORTING UNDERSTANDING

There are more likely to be episodes of sleepwalking, night terrors and bedwetting during stages 3 and 4 NREM sleep (Dement 1971). Sleepwalking, or **somnambulism**, is more common in children, with about 7 per cent of children (Neveus *et al.* 2001) and 2 per cent of adults experiencing this (Ohayon *et al.* 1999). Most sleepwalkers follow routine activities that are automatic and require very little conscious awareness. Contrary to popular belief, sleepwalkers are not acting out their dreams as there is very little, if any, dreaming during these stages of sleep. It is a common misconception that it is dangerous to wake sleepwalkers. Because they are in stages 3 and 4 NREM sleep, however, this means that they are likely to be startled and disoriented if awoken. Most sleepwalkers merely go back to bed and have no memory of the event the next day.

Night terrors occur in stages 3 and 4 NREM sleep, a time when voluntary muscles are very relaxed but still able to move. Night terrors are extremely frightening episodes where a person wakes, often screaming, in sheer terror. Although the person is often sweating, with rapid heart and breathing rates, he or she has little or no recall of dreaming and often falls asleep again very quickly. Night terrors are not nightmares and are usually not remembered in the morning.

Unlike night terrors, **nightmares** occur in REM sleep and are more likely to be remembered. Night terrors are more likely to occur in the first two sleep cycles (early in the night) in stages 3 and 4 NREM sleep. Nightmares occur in REM sleep and are more frequent in childhood but can be experienced by adults (more commonly by women than men).

FIGURE 4.6 Nightmares are more likely to be remembered than night terrors.

TABLE 4.1 Differences between nightmares and night terrors

NIGHTMARES	NIGHT TERRORS
Unpleasant and upsetting dreams associated with feeling of helpless terror	Extremely frightening episodes associated with sheer terror and often screaming
REM sleep	Stages 3 & 4 NREM sleep
Little physiological changes, similar to REM pattern	Breathing is usually rapid and heart rate may be as much as 2–3 times normal.
Very little movement	Involve violent body movements (including sitting up, crying out and even running!)
Often awaken during or immediately after a nightmare	Wake but usually fall asleep again quickly
Usually remembered	Generally cannot be remembered
Experienced more often by children than adults Experienced by twice as many females as males	Experienced more often in young children (3 to 5 year olds)

SLEEPWALKER, AGE 15, FOUND CURLED UP ON CRANE

by Olinka Koster and Tahira Yaqoob

She was more of a steepwalker than a sleepwalker.

A passerby could barely believe his eyes when he saw a body curled up on the counterweight of a 130-foot crane at 2 a.m.

The rescue operation his 999 call set in play revealed that the body belonged to a 15-year-old girl … who was fast asleep and blissfully unaware of her perilous predicament.

A fireman scaled the structure, on a building site in South-East London, and sat with the snoozing teenager while he anxiously discussed with colleagues below what to do next.

Fearful of waking her in case she should panic and fall, he attempted to secure her in position and conducted a cursory body search, finding a mobile phone. It is understood he found a number for her parents in the phone's memory. They were told the astonishing story, and then rang her on the mobile themselves to wake her.

A specialist fire rescue team, based at Battersea, arrived at the site and used a hydraulic ladder to carry the girl down. She was delivered safely to the ground and her parents came to collect her.

Unusual case

No one knows how she managed to climb up the crane. But Dr Irshaad Ebrahim, of the London Sleep Centre, said he was not surprised. Anything you can do while awake, you can do while sleepwalking, he said. And, of course, without the fear factor. "I treat people who have driven cars, ridden horses and even attempted to fly a helicopter while asleep," he said.

"However, this is one of the more unusual cases I've come across.

"Up to 10 per cent of adolescents sleepwalk, so her age is a common factor. Sleepwalking is nothing to do with dreaming because it occurs in a non-dreaming sleep state."

FIGURE 4.7 Imagine sleepwalking to the top of a 130-foot crane!

Dr Ebrahim was recently an expert witness in a court case in Manchester where Jules Lowe was acquitted of murdering his father Eddie after he convinced the jury he had been sleepwalking.

The girl apparently walked unnoticed out of her home in Dulwich to the building site nearby. The crane was switched off and in a stationary position.

A security guard was on duty but did not see the girl.

After reaching the top she somehow crawled around 40 ft horizontally to the end of the counterweight section of the crane.

Responding to the emergency call, police initially thought she might be attempting suicide. But when the fireman reached her the innocent, but terrifying, truth became clear.

A source, who was involved in the rescue operation, said: "The fireman had to be very careful because he realised the girl was asleep and he knew it might cause a serious problem if he woke her suddenly.

"He gently tried to wake the girl while talking to her and reassuring her that she was safe and well.

continued over page

"Police then took the decision to scroll through her mobile phone electronic contacts book to find a number for her mum or dad and they contacted them to explain what was going on. Whoever the police called, they explained to the officers that the girl was a frequent sleepwalker.

"They came down to the building site straight away to take her home."

'It was tense'

A London Fire Brigade spokesman, who attended the incident, said: "It was tense for a while.

"One of our guys had to wait up there with her, making sure she was all right and couldn't fall.

"She was fast asleep until we got one of her relatives to phone her. That woke her."

The girl did not need medical treatment and her name has not been released by emergency services.

The incident happened in the early hours of Saturday, June 25.

The medical term for sleepwalking is somnambulism. Experts say it is common for sleepwalkers to go outside or up stairs.

But it is a myth that waking a sleepwalker will seriously harm them, they say, though they might become confused or hysterical.

Dr Neil Stanley, of Surrey University's psychopharmacology research unit, said: "It is certainly feasible for the girl to climb up a crane.

"People do all manner of odd things when they are sleepwalking, including driving 20 kilometres and killing their parents.

"Anything short of that I'm prepared to believe."

Daily Mail, Wed July 6, 2005

Sleep talking (verbalising during sleep) can occur during any stage (NREM or REM sleep) of the night although it is more common in NREM. Sleep talking can range from a mumble to a recognisable word, to a phrase that does not make sense to a short conversation (although this is rare). If the sleep talking makes no sense at all, it is probably occurring in deep stages of NREM sleep. If the talking is recognisable and makes sense, then it may be occurring during REM sleep and can be linked with a dream. Sleep talking is very common, probably happening at one time or another to everyone. Often we are unaware that we have talked in our sleep.

Rather than remaining in stage 4 sleep, we quickly cycle back through the sleep stages in reverse, stage 4 to stage 3 to stage 2, then skipping stage 1 going straight into REM sleep.

RAPID EYE MOVEMENT SLEEP

As the name suggests, rapid eye movement (REM) sleep is a period of sleep when your eyes move rapidly, for short bursts of time. The first cycle of REM sleep lasts for about 10 minutes. REM sleep is a lighter sleep than stages 3 and 4 sleep and therefore easier to wake from. Unlike NREM sleep, if we are woken during REM sleep, we are likely to report that we were dreaming. This is true for everyone, even those who say they don't dream.

Our brain is very active during REM sleep, and the EEG patterns resemble those of a person who is awake and alert. Compared to stages 3 and 4 sleep, brainwaves are irregular (desynchronised), faster (high frequency) and smaller (low amplitude). **Sawtooth waves** (a special type of theta-like wave that resembles the blade of a saw) may be found among these random and fast beta-like waves, especially when there is a burst of rapid eye movement.

During REM sleep there are marked physiological changes. There are repetitive bursts of rapid eye movement, and heart rate, blood pressure and respiration increase and fluctuate. Body temperature tends to match the surrounding environment and genitals are aroused. There is, however, no muscle tension – the muscles that move voluntarily, especially those below the neck, are very relaxed to the point of being almost paralysed (except for the occasional twitching). This paralysis is known as **muscle atonia** or **cataplexy**.

REM sleep is often referred to as *paradoxical* sleep. This is because the body can appear calm on the exterior (virtually no muscle activity) but other bodily systems and the brain are highly active, having many features that are similar to being awake.

It appears that most dreaming occurs during REM sleep. Dreams during REM sleep tend to follow a storyline (though a bizarre one at times) and the dreamer often feels as if they are experiencing a different world. The final dream of the night tends to be the longest, strangest and most exciting – elements that make it more likely to be remembered. Therefore, the dreams you remember and repeat to other people are most likely to be your last REM dreams in the night. In reality, though, we remember very few of our dreams. Can you remember the four or five dreams you had last night? You probably spent about two hours dreaming. That adds up to about six years of dreaming in a lifetime.

Dreaming also can occur in NREM sleep. NREM dreams are less frequent (around 10 per cent) and are more difficult to remember than REM dreams. NREM dreams tend to be similar to waking thought patterns. Compared to REM dreams, they are usually briefer, less intense and without a real storyline. People who are lighter sleepers and people who are anxious are more likely to dream in NREM sleep. Have you ever felt as if you have been awake all night thinking about a problem? The chances are that you did sleep and some of this thinking occurred during a NREM dream.

TABLE 4.2 Physiological characteristics of the stages of sleep

CHARACTERISTIC	NREM SLEEP				REM SLEEP
	STAGE 1	STAGE 2	STAGE 3	STAGE 4	
Sleep state	Drifting in and out of sleep	Light sleep (real sleep starts)	Moderately deep sleep	Deep sleep	Light sleep
Brainwaves	Alpha and theta	Theta and sleep spindles	Theta and delta	Delta	Beta-like and sawtooth waves
Heart rate	Irregular	Slower and more regular	Slower and more regular	Slow and regular	Increases and fluctuates
Breathing rate	Irregular	Slower and more regular	Slower and more regular	Slow and regular	Increases and fluctuates
Muscle tension	Relatively tense	Lower muscle tension	Lower muscle tension	Relaxed (low tension)	Virtually non-existent
Body temperature	Normal	Lower	Lower	Lowest	Unregulated

INVESTIGATE 4.2

WATCH YOUR PET SLEEP

Have you ever watched a sleeping dog that appears to be dreaming about a terrific chase? They might make snorting noises and twitch their paws. At the same time they might twitch their legs as though they are trying to run.

Like humans, dogs experience REM sleep, as do all mammals except dolphins and echidnas.

Get some students in your class to video their dogs asleep and dreaming.

FIGURE 4.8 Dogs dream of the big chase.

1 Briefly describe the video.
2 In the footage, what do you think indicates that the dog is dreaming?
3 When is dreaming more likely to occur?
4 During REM sleep, what happens to the muscles that move voluntarily?
5 Why do you think it is important that this happens to these muscles when the dog is dreaming during REM sleep?

After the first NREM/REM cycle, we often skip stage 1 sleep and enter stage 2 sleep again. We then descend through stages 3 and 4 before returning via 3 to 2 to REM sleep. This cycle can be plotted onto a graph known as a **hypnogram** (refer to Figure 4.9). Return to stage 2 marks the start of the third cycle and this time we stay in this stage for about an hour, often not descending into stages 3 and 4. We spend longer time in REM sleep and, again, the end of REM sleep marks the end of the cycle. The fourth, fifth and (sometimes) sixth cycles are similar; we are unlikely to enter stages 3 and 4 sleep and increasingly more time is spent in REM sleep. We have a tendency to wake briefly (usually without conscious awareness) before or after a period of REM sleep (Zepelin 1986). We might wake up in the fifth sleep cycle, either directly from stage 2 or REM sleep, but often roll over and go back to sleep and start another cycle.

While the exact pattern of sleep varies from person to person and from night to night, the following two features are the same:

1 stages 3 and 4 sleep typically occur in the first two cycles of NREM/REM sleep cycle
2 we spend more time in REM sleep as the night progresses.

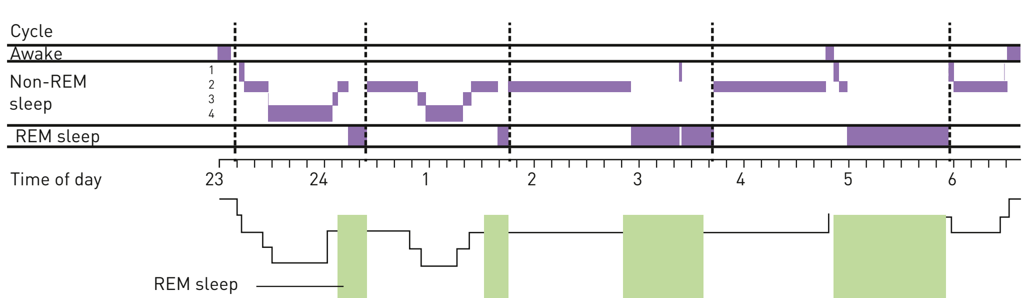


FIGURE 4.9 A typical hypnogram of a night's sleep

The period between being asleep and waking up, a time when brainwaves are predominately alpha waves, is called the **hypnopompic state**. Like a hypnogogic state, we may experience vivid visual images during this time, known as hypnopompic images.

Sleep patterns also change with age (refer to Figure 4.10). Newborns spend about 16 hours per day sleeping, with about half of this time in REM sleep. Adults sleep for about 8 hours, with about a quarter of this in REM sleep. By the age of 60 years, very little time, if any, is spent in stage 4 sleep with sleep lasting for about 6 hours – still with 20–25 per cent in REM sleep.

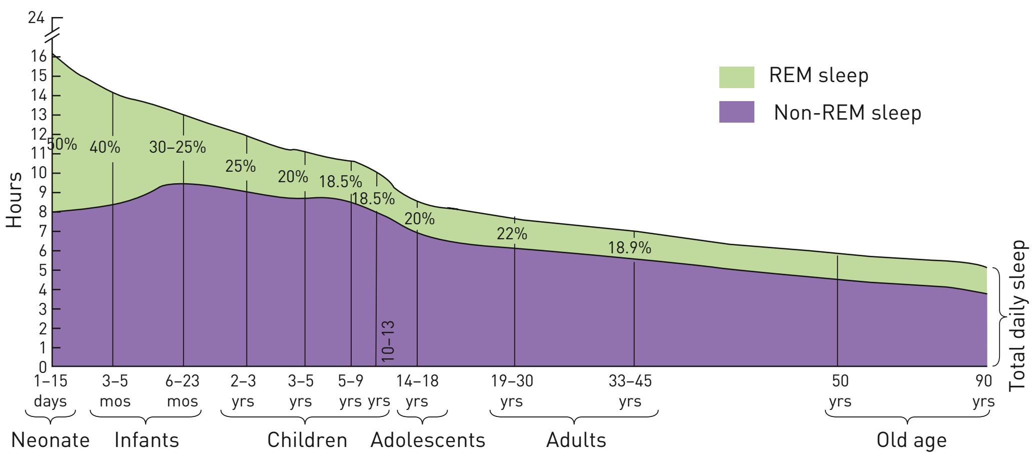


FIGURE 4.10 Changes in sleep patterns with age

SLEEP PATTERNS AND AGE

4.3 INVESTIGATE

Using Figure 4.10, write responses to the following questions.

1. What proportion of time do neonates (newborn babies) spend in REM sleep?
2. By the time people reach late childhood, they spend about 20–25 per cent of time in REM sleep. Write a sentence to summarise the proportions of NREM and REM sleep from late childhood to old age (hint: don't try to provide exact figures from the graph for every age, instead recognise the general patterns in the graph and give an overview).
3. How much sleep-time is needed by each of the following groups?
   a. 1-year-old babies
   b. 5-year-old children
   c. adolescents
   d. people in middle adulthood (40–50 years)
   e. the elderly (70+ years)

WHEN DO YOU WAKE UP?

4.4 INVESTIGATE

Have you ever noticed that it is harder to wake up at some times of the morning than others? For example, you wake before the alarm goes off, feeling quite alert. However, you drift off to sleep again. Thirty minutes later you are woken by the alarm clock; now you feel sluggish and tired, despite the extra 30 minutes of sleep.

Throughout the night, we often awaken briefly before or after a REM cycle, which occurs about every 90-minutes. We are unlikely to remember waking, especially when we are young. However, it is easier to get out of bed if our wake-up time coincides with the end of a 90-minute NREM/REM cycle.

1 Tonight, write down the time you go to bed. Then note the time if you wake during the night, and when you wake in the morning.

   Did you wake in the morning at the end of a 90-minute cycle or was it interrupted mid-way?

   Was it difficult to wake up in the morning? If it was difficult, was your NREM/REM sleep interrupted?

   If you woke during the night, was it around the end of a 90-minute cycle?

2 The following night, set a time to go to bed. Make sure that a series of 90-minute cycles will bring you to your chosen waking time, for example, go to bed at 10.00 p.m. and wake at 7.00 a.m.

   Was it easier to wake in the morning at the end of a NREM/REM sleep cycle?

3 Some people with routine sleep habits have the ability to wake naturally at close to a desired time and never use an alarm clock (Moorcoft & Breistenstein 2000). Do you think you have this ability? Do you think you can wake yourself at a time in line with the 90-minute cycle? Imagine you are a sleep psychologist and design a test to find out.

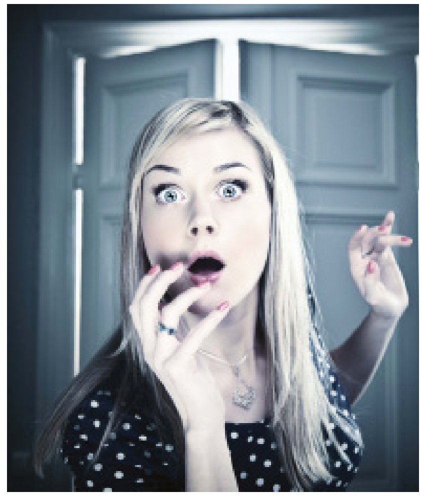
In your dreams!

It is likely that you can recall having some of the dreams shown in Figure 4.11 – some dreams are more memorable than others!

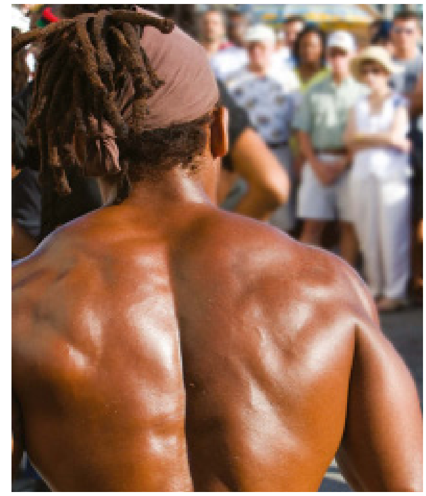
There are several interesting facts about our REM dreams.

- Many of the storylines in our dreams are similar to the concerns we have in everyday life (Domhoff 2005) and they incorporate personal experiences from the previous day or week. For example, pregnant women are more likely to dream of pregnancy-related themes.
- Negative emotions are more prevalent than positive emotions.
- About 88 per cent of people dream in colour, although not all dreams are in colour. For some people, dreams only occur in one or two colours.
- The dreamer is usually at the centre of the dream. In about 95 per cent of cases, other characters are family and friends of the dreamer – not monsters or people out to get us!
- Females tend to dream of males and females equally while 65 per cent of people in males' dreams tend to be male.
- Males' dreams tend to be more aggressive in content than those of females.
- The most common actions in dreams include running, jumping, sitting and talking. Slightly less common dream actions are flying, floating and falling.

BEING CHASED

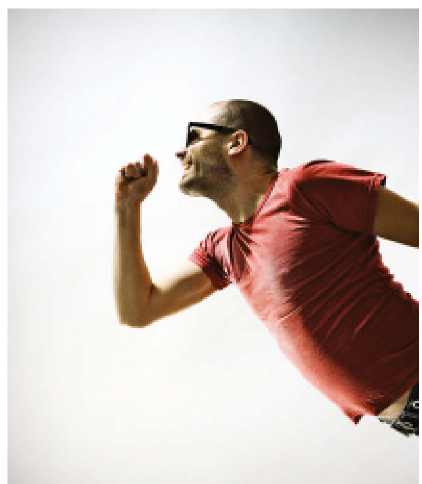


BEING FROZEN WITH FRIGHT



BEING NAKED IN PUBLIC

FALLING



FLYING AND SOARING THROUGH THE AIR

YOUR TEETH FALLING OUT

FIGURE 4.11 Have you ever dreamed of any of the following?

Increase your dream recall

Can you recall the dreams you had last night? It is unlikely that you can recall all of them: over 95 per cent of dreams are forgotten. Some people are 'low dream recallers' – that is, they tend to recall few dreams – while others ('high dream recallers') recall dreams more easily (Wolcott & Strapp 2002). Interestingly, low dream recallers tend to wake up more slowly and experience, on waking, more electrical activity between the brain hemispheres than do high recallers.

You are more likely to remember a dream if you wake during REM sleep or immediately after your REM dream.

Try the following activity to increase your dream recall.

Keep a pen and paper beside your bed. When you wake in the morning, try to note the thoughts and images that are in your head. Do your dreams relate to your daily concerns? Does the dream content remain the same or does it change over time?

If you still can't remember your dreams, try this (but not when you have to go to school the next day!). Set the alarm for 4 ½ hours after you have gone to bed, a time when you are likely to be near the end of dreaming in REM sleep. When the alarm sounds, try to note the thoughts and images that are in your head.

If you have a positive attitude towards dreaming, then you are more likely to recall dreams. This suggests that if you are carefully reading this section on dreaming, you have an interest in dreams and this is likely to increase your ability to recall them. Most students find that they do take more notice of their sleeping habits and dreams when studying this section of the course. Is this your experience too? Have you been sharing your dreams with others in the last week or so?

INVESTIGATE 4.5

EVALUATION OF A RESEARCH DESIGN

House fires are regularly reported in the media and there have been tragic reports of deaths despite working smoke alarms. Most of these deaths have occurred early in the night, a time when we are likely to be in deep sleep. To what extent can we rely on smoke alarms waking us in the middle of the night? Can they rouse us even from our deepest sleep? Is there a better signal to help us wake from the deepest sleep?

A team of Melbourne sleep psychologists investigated this critical issue (Bruck, Ball, Thomas & Rouillard 2008). They tested a number of different signals, varying in pitch and complexity, for their ability to wake people from the deepest sleep (stage 4 NREM sleep). They believed that a higher pitch and more complex tones were more likely to wake a person during stage 4 NREM sleep than a lower pitch with less complex (more pure) tones.

Thirty-nine volunteers (18 males and 21 females) participated in the study. All were healthy young adults (18–27 years old) not on medication, not suffering from a sleep disorder and having normal hearing. They were paid $80 per night with a bonus of $180 on completing the study. The research was approved by the ethics committee of their university.

Most of the participants were tested in their own home, with a few deciding to be tested in the sleep laboratory. For the study, recording devices were attached to the participants and the researcher sat in the hallway monitoring their brainwaves. They were tested one night per week for three weeks, allowing participants to recover from any sleep loss between tests. Conditions were kept similar on each testing night (same diet, exercise, bedtime, door closed, etc.) and all the participants were administered the same test.

During the testing, four different signals were tested per night at different times and the order of these signals was counterbalanced between participants. When each participant entered stage 4 sleep, one of the signals was switched on. It became louder until the participant pressed a button by their bedside to turn it off. The length of time it took for beta brainwave patterns to appear was recorded.

Analysis of the results found that a low pitch and a complex tone were significantly more likely to wake people. Standard smoke alarms are currently high pitched with pure tones and are at least seven times less likely to wake an adult in deep sleep. Professor Bruck and her team are calling for changes to Australian smoke detector signals.

Search the internet for videos to learn more about Professor Bruck's studies.

1 What was the aim of the experiment?
2 Write an experimental hypothesis for this study.
3 What was the independent variable?
4 What was the dependent variable?
5 What was the name of the experimental research design used in this study?
6 What is counterbalancing? How is counterbalancing used in this study? What are the advantages of counterbalancing?
7 In terms of characteristics of altered states of consciousness, how does level of awareness during sleep differ from normal waking consciousness?
8 When are we more likely to experience deep sleep (stage 3 and 4 NREM sleep) in a typical night of sleep?
9 Is it difficult or easy to wake someone in stage 4 NREM sleep?
10 What are the typical brainwave patterns for stage 4 NREM sleep?
11 Which state of consciousness is associated with beta brainwave patterns?
12 What is the advantage of testing participants in their own home?
13 What were the findings of this study?
14 What was the conclusion for this study?
15 What relevance does this finding have to Australians' everyday lives?

FIGURE 4.12 Smoke alarms save lives

REVIEW 4.2

1 What is the distinguishing feature between NREM and REM sleep?
2 State one example of a circadian rhythm.
3 State one example of an ultradian rhythm.
4 Name the predominant brainwave patterns that occur in the following states:
   a awake and alert
   b awake and sleepy
   c stage 1 sleep
   d stage 2 sleep
   e stage 3 sleep
   f stage 4 sleep
   g REM sleep
5 During which stage(s) of sleep is each of the following likely to occur?
   a hypnogogic jerks
   b irregular heart rate
   c K-complexes
   d muscle atonia/cataplexy
   e sleepwalking
   f sleep talking
   g nightmares
   h night terrors

Purpose of sleep

Picture this scenario between a parent and child: preschool-aged Emily 'snaps' at her mother when told to pick up her toys. Her mother says to her visitor, 'Oh, she is just tired. She stayed up late last night.'

Have you ever been told your behaviour indicates that you need more sleep? Or have you ever justified your poor behaviour by blaming a lack of sleep? If so, it shows that you, like most of us, have some understanding of the need for sleep and know what happens if you don't get enough. While the quality or quantity of sleep should not justify bad behaviour (for example, 'I didn't mean to hurt your feelings. I'm just tired'), it can highlight the importance of sleep. Feeling grumpy, tired, irritable, anti-social and unmotivated are just some of the consequences – you can probably think of more. On the other hand, you have probably noticed that too much sleep can also make you feel sluggish and irritable.

Sleep is a necessity, not a luxury. While sleep is essential to being healthy, alert and happy, the overriding purpose of sleep is much debated. We know we need sleep but we are still unclear about exactly *why* we need sleep. The amount of sleep we need varies markedly from one person to another. One approach often used to understand sleep and its purpose is to study the effects of sleep deprivation on people and other animals (see Chapter 5).

There are several theories of sleep function and most of these belong to two broad categories:

1 survival (adaptive and evolutionary) theories of sleep
2 restorative (restore and recovery) theories of sleep.

FIGURE 4.13 Are you more irritable when you are tired?

Survival (adaptive and evolutionary) theories of sleep

According to **survival (adaptive and evolutionary) theories of sleep**, survival is the main purpose of sleep. Sleep is a means of increasing an animal's chances of survival in its environment. 'Adaptive' means to adjust in a useful or appropriate manner. Sleep can be adaptive; it allows us to change to meet the demands of our environment and it depends on how much food we need, how available it is (we may need to conserve energy) and our safety when we sleep. These sleep requirements have evolved over time in order for the species to hunt food, hide and conserve energy.

Consider the different sleep needs for different animals (refer to Figure 4.14). The **adaptive theory** posits that:

- *Sleep depends on the need to find food.* Animals that need to graze for hours, such as cows, sleep less. They sleep less because they need to find more food to survive.
- *Sleep depends on an animal's vulnerability to predators.* Small animals that are very vulnerable to predators, such as mice, sleep more so that they can hide safely from carnivores that will eat them. Larger prey animals, such as deer, sleep less because they are more exposed in their environment and need to be ready to escape from predators. From an evolutionary stance, our prehistoric ancestors were more vulnerable to predators at night. They relied heavily on vision, a sense that is not very good in the dark. To avoid predators, they carried out duties (hunting and gathering food) during the safe daylight hours and slept quietly and safely at night, a time when their vision was poor.
- *Sleep conserves energy.* When an animal sleeps, its metabolism slows, thus reducing the need for food – a human's metabolic rate during sleep is about 10 per cent less than when awake (Wouters-Adriaens & Westerterp 2006). Sleeping is a means of conserving energy in hibernating animals, such as squirrels or grizzly bears, which sleep during winter months when food is scarce and the weather conditions are harsh.

BAT: 19.9 HOURS

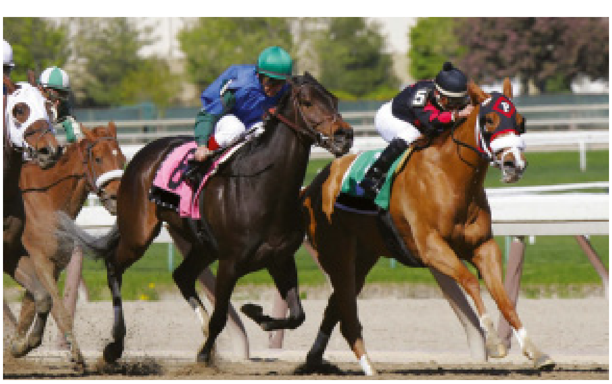
KOALA: 19.0 HOURS

CAT: 13.2 HOURS

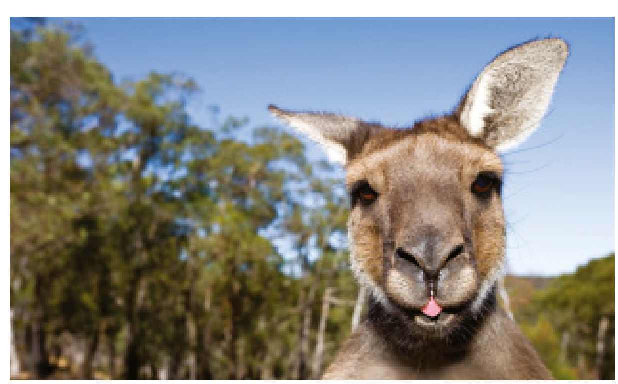
RED FOX: 9.8 HOURS

HUMAN: 8.0 HOURS

COW: 3.9 HOURS



HORSE: 2.5 HOURS



KANGAROO: 1.5 HOURS

FIGURE 4.14 Different animals need different amounts of sleep. Which animals need to work harder to get enough food? Which are vulnerable to predators? Which have a higher metabolic rate?

CRITICISMS OF THE SURVIVAL (ADAPTIVE AND EVOLUTIONARY) THEORIES

The survival (adaptive and evolutionary) theories have attracted criticism including:

- the assumption that sleep is very useful but not essential. This theory does not explain why we *must* have sleep. All species sleep, despite the amount of food (abundant or scarce) or danger they are in. Not getting enough sleep – sleep deprivation – can have fatal consequences (discussed in Chapter 5)
- the assumption is that sleeping is a way to hide safely from predators. For animals that are highly preyed upon, sleeping can be dangerous. The loss of awareness during sleep makes the animal very vulnerable to predators and unlikely to be able to respond to danger.

Restorative (restore and recover) theories of sleep

According to **restorative (restore and recover) theories of sleep**, sleep allows us to recharge our bodies, recover from the physical and psychological work during the day and allows our bodies' growth processes to function. Think about how you feel when you wake up after a good night's sleep. Refreshed, re-energised and ready to start the day. It is like undergoing a routine check-up and maintenance every time we sleep!

According to the restoration theory:

- *Sleep repairs and replenishes the body and prepares it for action the next day.* Sleep looks after the health of the physical body. Activities that are more physically demanding should increase sleep. A study of marathon runners supports this view (Shapiro *et al.* 1981). The marathon runners slept 90 minutes longer and doubled their deep sleep (stages 3 and 4 NREM) for the two nights after running a 107.8 km marathon.
  - Neurotransmitters are chemicals that relay information from one neuron to the next; they are essential for communication within the body. The neurotransmitter adenosine may provide further evidence for the restorative theory. Adenosine is produced when our cells use energy – it is suspected to be a cellular waste-product that accumulates when we are awake. The more energy we spend, the more adenosine is produced. Adenosine is linked to making us feel sleepy and the longer we are awake, the sleepier we get. When asleep, adenosine levels decrease and we wake feeling refreshed and alert (Rainnie, Grunz, McCarley & Greene 1994; Alanko *et al.* 2004). It is a bit like taking out the rubbish – sleep gets rid of the waste products! Lack of sleep will affect our energy levels and make us feel drowsy and fatigued. Caffeine increases alertness and also blocks adenosine, further adding support to the theory of adenosine's role in making us feel sleepy.
  - Other neurotransmitters, including norepinephrine, play a major role in keeping us alert during the day. It has been found that our bodies are more sensitive to norepinephrine when our sleep is adequate (Steriade & McCarley 1990). Therefore, less norepinephrine is required to make us feel alert after a good night's sleep compared with a poor night's sleep. Other neurotransmitters such as adenosine (mentioned previously) are also involved.
- *Sleep enhances mood.* Are you grumpy, short-tempered or miserable? Perhaps you need more sleep! Many hormones and neurotransmitters influence your mood and emotions. A number of these are activated during sleep. As a consequence, not getting

Did you know?

Another possbile reason why we sleep includes the 'sleep to dream' theories. Sleep is viewed as fulfilling a psychological need to dream, rather than for biological reasons.

What happens when we sleep is remarkably similar for all of us. We follow predictable physiological patterns and tend to dream or find it difficult to wake at certain times. Deep sleep (stages 3 and 4 NREM sleep) takes place early in the night during the first two NREM/ REM sleep cycles, while REM sleep increases in length throughout sleep. Why we follow such a strict sleep pattern is unclear.

enough sleep can lead to negative thoughts, feelings and behaviours, making us cranky, irritable and unhappy (Boivin *et al.* 1997; Durmer & Dinges 2005).

  - It has also been found that mammals with higher metabolic rates like dogs and cats are likely to spend more time sleeping, especially in deep sleep (stages 3 and 4 NREM sleep), than mammals with lower metabolic rates such as cows and kangaroos (Allison & Cicchetti 1976). This finding may suggest that animals with a higher metabolic rate need more sleep to recover. Take another look at Figure 4.14. Which animals have a high metabolic rate and spend more time asleep?

- *Sleep activates growth hormone.* Growth hormone is responsible for physical growth. It has been linked with sleep, especially during the early years and adolescence, and the more you sleep (especially stages 3 and 4 NREM sleep), the more likely you are going to grow and meet your potential growth (Gais, Hullemann, Hallschmind & Born 2006).
  - Growth hormone is also involved in controlling our metabolism. This means that sleep increases growth hormone levels and therefore helps control metabolism, including our energy levels (Pekkanen 1982).
- *Sleep increases immunity to disease.* For good reasons, we are often told to rest and sleep when we are ill. Sleep is a natural medicine as it appears to help our immune system become stronger. Immune cells that fight disease and infections are produced during sleep (Motivala & Irwin 2007). If we go without sleep, our immune system will often reduce its natural response, causing us to be more susceptible to disease and infection (Irwin *et al.* 2003). We are more prone to heart disease if we sleep either too much or too little.
- *Sleep increases alertness.* Sleep keeps our minds alert and assists our psychological state. When we are not getting enough sleep, we tend to be inattentive and more easily distracted (Jennings, Monk & van der Molen 2003; Kendall, Kautz, Russo & Killgore 2006).
- *Sleep consolidates memories.* According to the consolidation theory of memory, sleep plays an important role in forming new memories. Information that you have reviewed or rehearsed during the day is more likely to be remembered after a good night's sleep (Gais, Lucas & Born 2006). Sleep assists with consolidation of memories, a process whereby new memories are transferred into long-term memory (Smith *et al.* 2004).

CRITICISMS OF THE RECOVERY AND RESTORATION THEORIES

Not all research has supported the restore and recover theories, and there are criticisms of some of the underlying assumptions, including:

- *the assumption that more sleep is needed to recover when we are physically active.* Unless we partake in extreme physical activities (such as a 100 km marathon), there is little evidence that we need more sleep when we exercise. A review of research in this area concluded that we tend to sleep longer by about 10 minutes on days we have exercised (Youngtedt 1997) – a small difference from days we don't exercise.

  If this assumption is true, we might expect that those who do little exercise, including people who are disabled or confined to bed, would sleep less, but there is no evidence to support this statement: bed-ridden people show sleep patterns that are similar to those of normally active individuals. The need for sleep is not reduced with lack of exercise.

- *the assumption that the body rests during sleep.* The brain is active during sleep. Increased blood flow and energy expenditure occurs during REM sleep and this slows down the synthesis of proteins, assisting the body in getting ready for the next day.

The survival (adaptive and evolutionary) and restorative (restore and recovery) theories address different issues about the purpose of sleep. The restorative theories help to explain *why* sleep is important, whereas survival theories focus on *when* and *why* different species sleep. While the two theories give different views of the purpose of sleep, they are complementary and work together to contribute to our understanding of why we sleep. There is certainly a need for further research to better understand the purpose of sleep.

4.3 REVIEW

1 In the following table, briefly explain each theory and the main limitations of this theory.

THEORY OF SLEEP FUNCTION	EXPLANATION	LIMITATIONS
Adaptive and evolutionary theories		
Restore and recover theories		

2 For each of the following statements, state whether it supports the adaptive and evolutionary OR restore and recover theories of sleep.
   a Sleep increases alertness.
   b Sleep enhances mood.
   c Sleep conserves energy.
   d Sleep depends on the need for food.
   e Sleep increases immunity to disease.
   f Sleep activates growth hormones.
   g Sleep depends on an animal's vulnerability to predators.
   h Sleep consolidates memories.
   i Sleep repairs and replenishes the body and prepares it for the next day.

3 The purpose of sleep is to survive. What do you think? Justify your answer using psychological evidence (research findings and theories).

→ CHAPTER SUMMARY 04:

- Sleep is an altered state of consciousness because it differs markedly from normal waking consciousness. Sleep is a natural occurrence and each day/night we have periods of being awake and asleep. The sleep/wake cycle is an example of a circadian rhythm.
- Sleep is not just one state of consciousness; it comprises a number of predictable states and follows a highly organised sequence of events. Throughout sleep, we shift between non-rapid eye movement (NREM) and rapid eye movement (REM) sleep, beginning with NREM sleep. NREM sleep consists of four stages and accounts for about 80 per cent of our total sleep time.
- On average, we go through one cycle of NREM and REM every 90 minutes. The NREM/REM cycle is an example of an ultradian rhythm. Most adults typically experience 4–6 NREM/REM cycles per night.
- The percentage of time spent in REM sleep increases and NREM sleep decreases as the night progresses.
- When we are awake and alert, our brainwave activity consists of beta waves.
- Just before we fall asleep, we usually close our eyes and relax. Our brainwave patterns are predominantly alpha waves during this time.
- During the transition from being awake to being asleep, or falling asleep, we enter a relaxed state known as a hypnogogic state, in which we may experience hallucinatory images and hypnogogic (hypnic) jerks.
- Stage 1 NREM sleep is brief, lasting around 5 minutes for most people. It is a very light sleep, one from which we can be easily awakened. If awakened at this stage, we will usually think that we haven't been asleep at all. Alpha waves are replaced by slower theta waves. Our eyes roll slowly, our muscles relax, and our heart and breathing rates decrease.
- We then spend about 20 minutes in stage 2 sleep. Although this is a deeper stage of sleep it is still fairly easy to be woken from it. If awakened at this stage, it is likely that we still will not believe that

we were asleep. Stage 2 sleep is characterised by the appearance of sleep spindles and K-complexes. Our eyes stop rolling, muscles become further relaxed and breathing and heart rates continue to decrease. Stage 2 sleep accounts for about 50 per cent of our total sleep.

- Stage 3 NREM sleep is a brief transitional stage that marks the start of deep sleep (slow wave sleep). During stage 3, we become less responsive to external stimuli and are more difficult to wake. Delta waves begin to replace theta waves and sleep spindles and occur between 20 and 50 per cent of the time. The eyes are not moving, our muscles are relaxed and heart and breathing rates continue to become slower and more regular.
- Stage 4 NREM sleep is the deepest of sleeps. It is extremely difficult to wake from this stage. In the first NREM/REM sleep cycle, we spend about 30 minutes in stage 4 sleep, usually about an hour since we first fell asleep. In the last two or three cycles of NREM/REM sleep, we often do not descend into stages 3 or 4 sleep. Brainwave patterns consist of regular, slow and large delta waves for more than 50 per cent of the time. There is no eye movement, little, if any, muscle activity (muscles are very relaxed) and heart and breathing rate are at their slowest and most regular during sleep. While body temperature follows a circadian cycle, it drops slightly during NREM sleep with the greatest drop during stage 4 sleep. Episodes of sleepwalking and night terrors are most likely to occur during stages 3 and 4 NREM sleep.
- The first cycle of REM sleep lasts for about 10 minutes. REM sleep is a lighter sleep than stages 3 and 4 sleep and easier to wake from. Unlike NREM sleep, if we wake during REM sleep we are likely to report that we were dreaming. This is true for everyone, even those who say they don't dream!
- Our brain is very active during REM sleep, resembling that of a person who is awake and alert. Compared to stages 3 and 4 sleep, brainwaves are irregular (desynchronised), faster (high frequency) and smaller (low amplitude) and exhibit sawtooth patterns. There are repetitive bursts of rapid eye movement, and heart rate, blood pressure and respiration increase and fluctuate. Body temperature is less regulated so tends to match the surrounding environment. Genitals become aroused. There is virtually no muscle tension – the voluntary muscles, especially those below the neck, are very relaxed to the point of being essentially paralysed (except for occasional muscle twitching).
- NREM dreams are less frequent (around 10 per cent of all dreams) and are more difficult to remember than REM dreams. NREM dreams tend to be more similar to waking thought patterns. Compared to REM dreams, they tend to be brief, less intense and have little storyline.
- There are several theories of sleep function and most of these belong to two broad categories: the survival (adaptive and evolutionary) theories of sleep and the restorative (restore and recovery) theories of sleep. The restorative theories provide a thorough and well-developed account of *why* sleep is important, whereas survival theories focus on *when* and *why* different species sleep. While the two theories take a different view of the purpose of sleep, they are complementary and work together to contribute to our understanding of the purpose of sleep.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP

- Sleep
  - Stages of sleep
    - REM sleep
      - Sawtooth waves
      - Muscle atonia (cataplexy)
    - NREM sleep
      - Stage 1: theta waves; hypnogogic jerks
      - Stage 2: K-complexes and sleep spindles
      - Stage 3: delta waves
      - Stage 4: delta waves
  - An altered state of consciousness
  - Purposes of sleep
    - Survival theories
      - Need to find food
      - Vulnerability to predators
      - Conserve energy
    - Restorative theories
      - Repair and replenish the body
      - Increase immunity to disease
      - Increase alertness
      - Enhance mood
      - Consolidate memories

KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

alpha waves
amplitude
beta waves
cataplexy
circadian rhythm
deep sleep
delta waves
frequency
hypnogogic (hypnic) jerks
hypnogogic state
hypnogram
hypnopompic state
hypnopompic images
K-complexes
muscle atonia
non-rapid eye movement sleep (NREM sleep)
rapid eye movement sleep (REM sleep)
restorative (restore and recover) theories of sleep
sawtooth waves
sleep spindles
slow wave sleep
somnambulism (sleep walking)
survival (adaptive and evolutionary) theories of sleep
theta waves
ultradian rhythm

KEY IDEAS

For the exam, you must know:

- the characteristics that define sleep as an altered state of consciousness
- the differences between sleep and normal waking consciousness
- the difference between REM and NREM sleep (including stages 1 to 4) in terms of:
  - physiological responses (brainwave patterns; eye movements; muscle tension; heart rate; respiration rate)
  - likelihood of waking
  - likelihood of dreaming and remembering dreaming
  - likelihood of sleepwalking, sleep talking, bedwetting, and experiencing nightmares and night terrors.
- sleep patterns in terms of:
  - NREM/REM cycles throughout the night (as displayed on a polysomnogram)
  - changes throughout the lifespan (age) including the total amount of time spent sleeping and the proportions of REM and NREM sleep.
- the two broad theories that attempt to explain the purpose of sleep:
  - survival (adaptive and evolutionary) theories such as: sleep depends on the need to find food; sleep depends on the animal's vulnerability to predators; sleep conserves energy
  - restorative (restore and recovery) theories such as: sleep repairs and replenishes the body; sleep activates growth hormone; sleep increases immunity to disease; sleep increases alertness; sleep enhances mood; sleep consolidates memories
- the limitations of each of these theories.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- understand why consciousness is difficult to study
- identify ethical considerations relating to studying consciousness.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Mary sits down at the end of a busy day. As she begins to relax, her ________ brainwaves are replaced by ________ brainwaves.

a beta; alpha
b alpha; beta
c theta; alpha
d beta; theta

2 The amount of time we spend in NREM sleep ________ throughout a night's sleep.

a remains stable
b increases
c decreases
d fluctuates

3 Sleep is;
- a a deliberately induced altered state of consciousness.
- b a natural altered state of consciousness.
- c part of normal waking consciousness.
- d an unconscious state.

4 Sleepwalking is a sleep phenomenon that is experienced by some people. Sleepwalking usually occurs in
- a any stage of NREM, or in REM sleep.
- b REM sleep.
- c stage 2 of NREM sleep.
- d stages 3 and 4 of NREM sleep (slow wave sleep).

5 In a normal night's sleep, an adult will go through one cycle, from stage 1 to stage 4 and through the first REM period in approximately how many minutes?
- a 20
- b 50
- c 90
- d 200

6 Cataplexy occurs in:
- a stage 1 sleep.
- b stage 2 sleep.
- c stages 3 and 4 sleep (slow-wave sleep).
- d REM sleep.

7 Dreaming occurs:
- a only in REM sleep.
- b only in stages 3 and 4 sleep.
- c mainly in NREM sleep.
- d in both REM and NREM sleep.

8 When we enter stage 3 sleep from stage 2 sleep, ___________ and ___________ start to be replaced by ___________.
- a alpha waves; sleep spindles; delta waves
- b theta waves; sawtooth waves; delta waves
- c delta waves; sawtooth waves; alpha waves
- d theta waves; sleep spindles; delta waves

9 The sleep/wake cycle is an example of a(n) ___________ rhythm, and the NREM/REM cycle is a(n) ___________ rhythm.
- a infradian; ultradian
- b circadian; infradian
- c ultradian; circadian
- d circadian; ultradian

10 Which of the following is true of stages 3 and 4 sleep?
- a They occur in only the first two cycles of NREM/REM sleep.
- b They are collectively known as light-wave sleep.
- c It is relatively easy to wake a person during these stages of sleep.
- d They increase in time throughout a night's sleep.

11 During stage 4 sleep,
- a respiration increases and fluctuates.
- b voluntary muscles are virtually paralysed.
- c brainwave patterns are slow but irregular.
- d heart rate is slow and regular.

12 Sleep spindles are:
- a short bursts of high amplitude, low frequency waves.
- b short bursts of rapid brainwave activity.
- c a sudden high amplitude wave.
- d a sudden low amplitude wave.

13 K-complexes are:
- a short bursts of high amplitude, low frequency waves.
- b short bursts of rapid brainwave activity.
- c a sudden high amplitude wave.
- d a sudden low amplitude wave.

14 K-complexes are most likely to occur:
- a in REM sleep.
- b in stage 1 sleep.
- c once a minute in stage 2 sleep unless triggered by external stimuli.
- d once a minute in stage 2 sleep unless suppressed by external stimuli.

15 Which of the following statements supports the survival theory of sleep?

a Animals that are less susceptible to predators and require less time to forage for food tend to sleep for longer periods than those that are more susceptible and need more time to find food.

b Animals with higher metabolic rates need more sleep than those with a lower metabolism.

c Growth hormone is released during stages 3 and 4 sleep and this aids growth.

d Sleeping enhances mood and can aid memory.

16 As we fall asleep, we enter a relaxed state known as hypnogogic state, which many consider to be part of

a the awake and alert state of normal waking consciousness.

b REM sleep.

c stage 1 sleep.

d stages 3 and 4 sleep.

17 Involuntary muscle twitches that cause us to jolt while falling asleep are called ___________ and occur in ___________ sleep.

a muscle atonia; REM

b hypnogogic (hypnic) jerks; REM

c muscle atonia; stage 1

d hypnogogic (hypnic) jerks; stage 1

SHORT ANSWER

18 Is our perception of time distorted during sleep? Discuss.

2 marks

19 In terms of levels of awareness, why is sleep not the same as being unconscious?

1 mark

20 Explain content limitations during sleep compared to normal waking consciousness.

1 mark

21 Is sleep the time for the brain to shut down for rest? Discuss, with reference to REM and NREM sleep.

2 marks

22 What happens to the amount of time spent in REM sleep during each NREM/REM sleep cycle throughout the night?

1 mark

23 Why is a sleepwalker more likely to sleepwalk in the first three hours of sleep?

2 marks

24 Why is REM sleep often referred to as paradoxical sleep?

2 marks

25 How many sleep cycles does the average sleeper experience in a night's sleep?

1 mark

26 Describe the difference in the typical sleep patterns of an infant, an adult and an elderly person.

3 marks

27 In terms of brainwave activity, which is the most active stage of sleep?

1 mark

28 Despite much sleep research, the exact purpose of sleep is still unclear.

i Name two theories that attempt to explain the purpose of sleep.

2 marks

ii For each theory, give one piece of evidence that supports the theory.

2 marks

iii Outline one criticism of each theory.

2 marks

iv Do you think it is possible that both theories can be used to help explain the purpose of sleep? Give reasons for your answer.

1 mark

→CHAPTER 05:

SLEEP DEPRIVATION

Our society doesn't switch off at night – we can work, shop, email, text, blog, post, go to a venue and be entertained by the media 24/7. Our society promotes this flexible lifestyle as being convenient, efficient and exciting. But it is one that seems to overlook the need for sleep. Is a lifestyle, one that seems to devalue sleep, good for us? Is there room in our busy lives for good quality sleep? In this chapter we will investigate the effects of sleep deprivation, with a focus on adolescent sleep/wake cycles.

KEY KNOWLEDGE

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.

(VCE Study Design 2013)

FIGURE 5.1 Poor sleep can affect our ability to concentrate in class.

Deprived of sleep?

CHAPTER OVERVIEW

How much sleep do we need?	Age Lifestyle Genetics
Sleep deprivation: What happens if we don't get enough sleep?	Total sleep deprivation > Non-human studies > Is one night without sleep OK? Partial sleep deprivation > Effects of sleep deprivation Loss of REM and NREM sleep
Sleep recovery patterns	Amount of sleep required REM rebound Microsleeps
Adolescent sleep/wake cycles	Can we change our sleep habits? Conclusion

William Dement, a pioneer in sleep research, decided to test himself and see if he could stay awake for a long period of time (Goleman 1982). As much as he tried, he could not fight off sleep. He found that just as we cannot hold our breath until we die, neither can we stay awake. In the end, sleep sets in and saves us.

Dement's experience of sleeplessness probably does not surprise you. Take a moment to think about how you think, feel and behave when you are tired. We all know the groggy feeling that lack of sleep can cause and how it affects our ability to concentrate. We dislike being forced to stay awake when we are very tired. So strong is the desire to fall asleep that we require repeated and intense stimulation to stay awake. In the end, it is wonderful to escape into sleep.

While the exact purpose of sleep is unclear (as discussed in Chapter 4), everyone sleeps and everyone needs sleep to function properly although the amount of sleep needed varies from person to person. When we are not getting the amount we need, we are **sleep deprived**.

Too little or too much sleep can seriously impact on the way we function – both physiologically and psychologically. Poor sleep can dramatically lower our mood, health and ability to perform physically and mentally. In addition, there are now more than 70 known sleep disorders affecting the quality of our sleep. So it should not surprise you that sleep can help us live longer. Research suggests that adults who sleep around 7–8 hours per night typically outlive those who sleep less (Dement 1999). Sleep tends to be undervalued in our lives although the effects of sleep deprivation on our society can be costly and devastating.

In this chapter we will explore the effects of sleep deprivation, with the focus on teenage sleep/wake patterns. *Good sleep hygiene* can be a key to coping well in our lives – look for tips that help improve the quality of your sleep. Sleep should be viewed as a wonder drug: a natural remedy that positively influences our thoughts, feelings and behaviours.

INVESTIGATE 5.1

RESEARCH INVESTIGATION: GETTING ENOUGH SLEEP?

1 Take a moment to reflect on a time when you have not had enough sleep. How did you think, feel and behave?
2 Ask five people to answer the following questions:
   a How many hours did you sleep last night?
   b How many hours of sleep do you think you need each night in order to function well the next day?
   c Do you think you usually get enough sleep? If not, what prevents you from getting enough sleep?
   d How does lack of sleep affect the way you feel?
   e How does lack of sleep affect the way you behave?
   f How does lack of sleep affect the way you think?
3 Summarise the results.
   a Were answers similar between participants?
   b What was the mean number of hours slept last night for participants?
   c How many participants are likely to be sleep deprived today?
   d Compare your list of sleep deprivation effects with the information presented in Table 5.1. Are they similar?

Keep these results in mind as you read the rest of this chapter.

How much sleep do we need?

The media sometimes portrays examples of well-known people who function well on very little sleep. Political figures such as Kevin Rudd, Barack Obama, Margaret Thatcher and Bill Clinton have often been noted for only needing (or claiming to need) four hours of sleep per night. But these are rare examples and most of us need much more sleep.

There are no hard and fast rules about the exact amount of sleep we need. Sleep needs vary between individuals and depend on a number of factors such as age, lifestyle and genetics.

Age

As discussed in the last chapter, the amount of sleep each person needs varies with age (refer to Figure 4.10, Chapter 4). As a guide, most teenagers need 9–10 hours per night. A young child needs more and an adult less to perform at their best. Mason (2005) found that 80 per cent of teenagers in the United States wish they slept more on school nights. This echoes the love/hate relationship some of us have with sleep. We love the feeling of being well-rested but dislike sleep interfering with things we enjoy or our time completing work. It is all too easy to surf the Internet or watch television late into the night.

FIGURE 5.2 Babies require more sleep than adults.

FIGURE 5.3 Siestas are popular in many cultures.

Lifestyle

Our lifestyle influences the amount of sleep we need. For instance, working day or night shifts, sleeping in quiet or noisy places, leading an active versus inactive lifestyle, and having a stressful versus low-key way of life all influence our individual need for sleep (Bronzaft *et al.* 1998). We tend to sleep slightly longer in winter than in summer, and some cultures enjoy an early afternoon nap – the siesta is popular in countries such as Spain, Italy and Mexico. For some, getting up early every day is a way of life. Others are able to sleep in on weekends and are likely to adopt a different sleep routine. People tend to alter their sleep routines as responsibilities, relationships and stressors change with age. However, good sleepers are more likely to have a regular bedtime and rise time than poor sleepers (Carney *et al.* 2006).

Genetics

Our genes may influence our sleep/wake cycle. Surveys of twins in Australia and Finland found that identical twins tend to have more similar sleep patterns (going to bed at the same time and sleeping the same length of time) than fraternal (non-identical twins) (Heath *et al.* 1990). Some studies suggest that females tend to need more sleep than males and therefore are more likely to be sleep deprived (Wever 1984).

SUPPORTING UNDERSTANDING

Our sleep/wake cycle

Our bodies are attuned to a sleep/wake cycle that revolves around night and day. This regular cycle, an example of a circadian rhythm, is determined by an internal body clock (the suprachiasmatic nucleus [SCN]) located in the hypothalamus in the brain. Levels of arousal, hormone secretions, metabolism, heart rate and body temperature are largely influenced by this clock. For most people, this peaks during the day (usually the afternoon), with the lowest point being early in the morning.

Our internal body clock does not appear to be synchronised with the clock on the wall. The clock on the wall runs a 24-hour cycle whereas our bodies, in the absence of environmental cues about the time, run close to a 24.2 hour cycle (Czeisler *et al.* 1999) or even longer (up to 25 hours), especially in brightly lit rooms. This means that our *natural* sleep/wake cycle is slightly longer than 24 hours and explains why it is often easier to fall asleep slightly later rather than earlier than usual at night. Sunlight appears to readjust this small mismatch in time, with sensors in your eyes (and even the back of your knees) informing the brain when it is sunlight and allowing the brain to adjust its internal body clock accordingly. Find out more about melatonin, a sleep hormone involved in this process, on page 151.

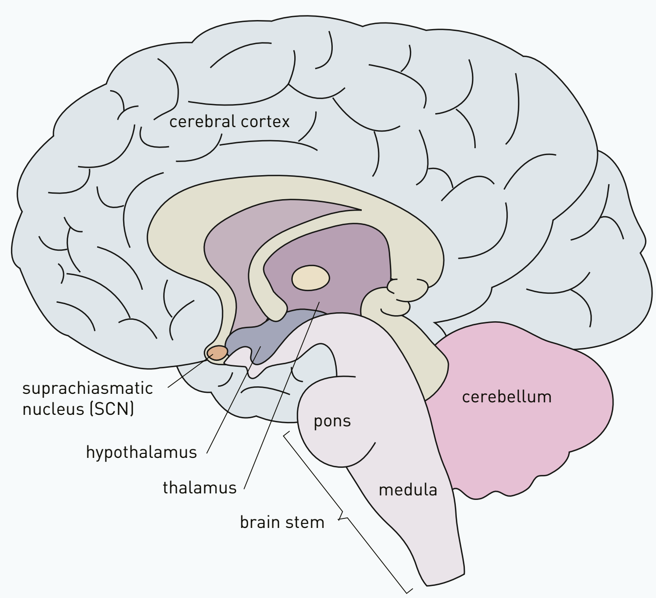


FIGURE 5.4 The internal body clock, the suprachiasmatic nucleus (SCN), is located in the hypothalamus. It governs the release of melatonin from the pineal gland.

> The amount of sleep we require is what we need not to be sleepy in the daytime.
>
> Jim Horne, sleep researcher

5.2 INVESTIGATE

ARE YOU SLEEP DEPRIVED?

Try the Epworth Sleepiness Scale to find out if you are sleep deprived. This popular scale was designed by Dr Murray Johns, a leading Melbourne sleep researcher. You can complete it online or answer the questions below.

Epworth Sleepiness Scale

Name: ________________________today's date: _______________

Your age (yrs): _______ Your sex (Male = M, Female = F): ________

How likely are you to doze off or fall asleep in the following situations, in contrast to feeling just tired? This refers to your usual way of life in recent times. Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the **most appropriate number** for each situation:

0 = would **never** doze
1 = **slight chance** of dozing
2 = **moderate chance** of dozing
3 = **high chance** of dozing

It is important that you answer each question as best you can.

SITUATION	CHANCE OF DOZING (0–3)
Sitting and reading	
Watching TV	
Sitting inactive in a public place (e.g. cinema or in a meeting)	
Being in a car for an hour as a passenger (without a break)	
Lying down to rest in the afternoon (when possible)	
Sitting and chatting to someone	
Sitting quietly after a lunch (not having had alcohol)	
In a car when you stop in traffic for a few minutes	

Add up your score. The higher it is, the higher the level of daytime sleepiness.

Less than 10 = you are most likey getting enough sleep;

10 to 16 = you may be suffering from excessive daytime sleepiness;

16+ = you are dangerously sleepy and should seek professional help.

This score provides an estimate of sleepiness in your daily life which can be influenced by many factors. This survey does not identify these factors.

Find out your sleep needs: try going to bed 15 minutes earlier each night this week. Add another 15 minutes the following week and continue each week until you can wake without an alarm clock and feel alert all day (Maas 1999). You will then know how much sleep you really need!

Sleep deprivation: What happens if we don't get enough sleep?

Do you like to sleep in on the weekends? Do you find it hard to wake up on Monday mornings? Do you often press the 'snooze' button on your alarm clock? Do you feel sleepy during the day?

If you answered 'yes' to any of these questions, then you are probably not getting enough sleep. While the exact reasons for sleep are unclear, what we do know is that it is crucial that we sleep. **Sleep deprivation**, not getting the amount of sleep you need, involves partial or total loss of sleep. **Partial sleep deprivation** is having some sleep in a 24-hour period but not getting enough to meet your needs. There may be **total sleep deprivation**, going without sleep for an entire 24-hour period, for just one night or for several nights. Both partial and total sleep deprivation can have serious consequences.

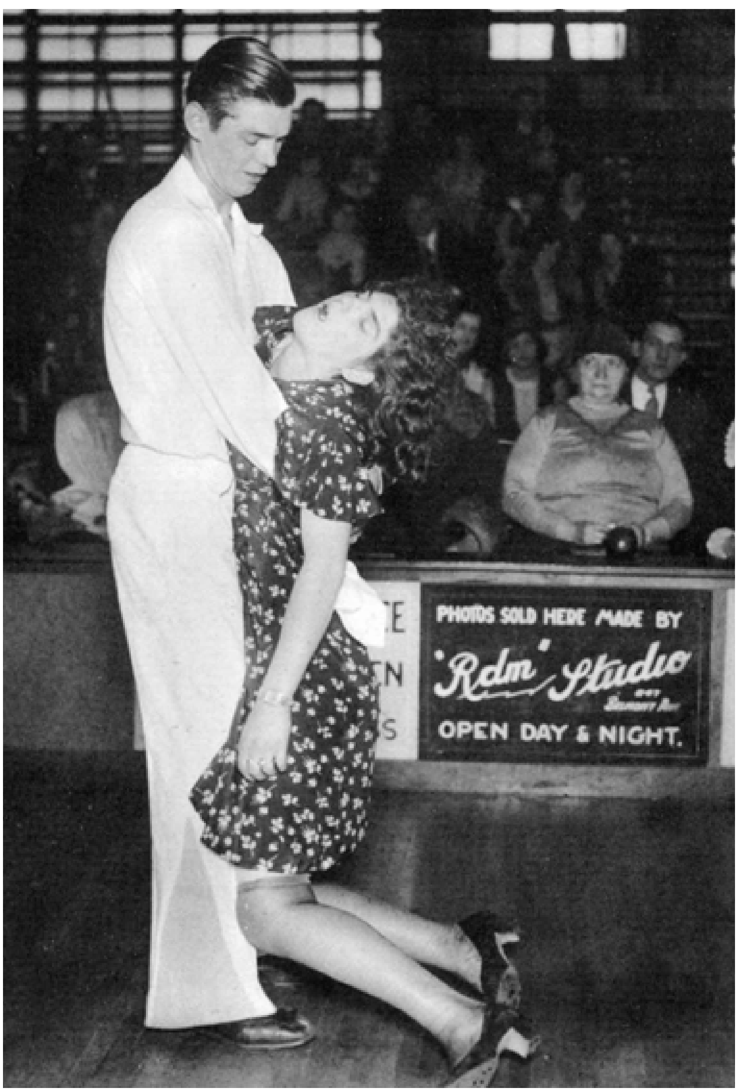


FIGURE 5.5 Couples danced for days in dance marathon competitions in the 1930s.

Total sleep deprivation

US dance marathon competitions, ones in which the last couple to remain dancing wins, were very popular during the 1930s. Couples danced for days without stopping in the hope of winning prize money, with many collapsing from exhaustion. This was during the Great Depression and some even used them to make a living. These dances were eventually restricted in their length of time, and even outlawed in some places, because of the associated risks.

In 1959, Peter Tripp, a disc jockey, managed to stay awake for eight days (200 hours) for a charity 'wake-a-thon'. Peter suffered from delusions and hallucinations at the time, including once thinking his desk drawer was on fire. It has been reported that he suffered psychological consequences for some months later but it is unclear if this was due to his individual characteristics or the loss of sleep, as the study lacked adequate scientific testing and control procedures.

A few years later, Randy Gardner, a 17-year-old student, entered the *Guinness Book of Records* for staying awake for 264 consecutive hours (11 days) without the use of any stimulants (even coffee). His physical health and thoughts, feelings and behaviours were scientifically monitored throughout the ordeal (Gulevich *et al.* 1966). He struggled at times – he underwent significant and uncharacteristic mood changes (grumpiness and short-temperedness), he had difficulties concentrating and short-term memory problems, and he suffered delusions (he thought he was a famous sportsperson at one stage) and hallucinations (he once thought a street sign was a person). He was often disorientated and he developed finger tremors and slurred speech. However, he was still able to play pinball on day 11 (winning 100 consecutive times against one of the researchers) but had difficulty with some other simple tasks. Throughout his ordeal, his heart rate, respiration rate, blood pressure and body temperature showed little change. After giving a press conference, Randy collapsed into a deep sleep and slept for almost 15 hours. Within a few days his sleep patterns returned to normal. While it took several nights to recover from this extreme total sleep deprivation, he did not need to make up all the sleep time that he missed (10 entire nights) and did not seem to suffer from any long-term psychological or physiological effects. Randy claims, however, that he hasn't 'pulled an all-nighter' since!

Total sleep deprivation for an extended period of time is likely to lead to death. Obviously, for serious ethical reasons, investigating total sleep deprivation and its link to death is impossible to do on human participants. However, there are reported cases that highlight the need of sleep. For instance, a 52-year-old man suddenly began to lose the ability to sleep (Lugaressi *et al.* 1986). Not surprisingly, he quickly became totally exhausted and could not function normally. He developed a lung infection that eventually led to his death. An autopsy revealed that his SCN, the area of the brain that governs the internal biological clock, had been destroyed. Whether the sleep loss itself was fatal or other aspects of the brain damage were to blame was not clear. Distinguishing between the effects of sleep loss from the effects of stress that the man experienced during his horrific ordeal is also impossible.

NON-HUMAN STUDIES

Non-human studies offer a window into the effects of total sleep deprivation. A study on rats showed that those who were not allowed to sleep died within 33 days while those allowed to sleep remained in good health (Rechtschaffen *et al.* 1983). The rats were placed on a disk above a water container and their brainwaves were monitored via an EEG. When sleep was detected, the disk started to rotate causing the rat to fall in the water and wake. The rats' physical health declined throughout this time and their deaths were probably due to overheating of the body. Again, it is very hard to distinguish between stress-related illnesses and those due to sleep loss as the rats were living under extreme stress conditions. Interestingly, non-human studies have shown that the animals usually die faster from lack of sleep than they do if totally deprived of food but allowed to sleep normally.

IS ONE NIGHT WITHOUT SLEEP OK?

What about when total sleep deprivation is only for a short time? It is likely that you have thought about staying up all night to study before a SAC, believing that this will help your performance. But will it? In one study, college students were either deprived of sleep or allowed to sleep the night before a critical thinking task (Pilcher & Walters 1997). Those forced to forego sleep ended up performing poorly on the task compared to the sleepers. More interestingly, those who were sleep deprived thought they had performed better than they actually did, a result not seen in the group that slept.

Did you know?

Total sleep deprivation has been used in warfare throughout history. The ancient Romans used *tormentum vigilae* (the waking torture) as a method to extract secretive information from their enemies. In the Korean War of 1950–53, North Koreans 'brainwashed' captured American pilots by depriving them of sleep. This technique is still used to interrogate suspects in several parts of the world. Many argue that it is a form of torture and should be banned throughout the world.

FIGURE 5.6 Driving while sleep deprived is extremely dangerous.

When going without sleep, we are at more risk of accidents. Driving while sleep deprived is extremely dangerous and has led to many tragic outcomes. Adelaide sleep researchers found that a driver who has been awake for 17 hours has the same risk of having a car accident as someone with a blood alcohol concentration (BAC) of 0.05 and is twice as likely to have a car accident as a driver with a BAC of 0.00 (Dawson & Reid 1997). Twenty-four hours without sleep is equivalent to a BAC of 0.1, making these sleep-deprived drivers seven times more likely to have a crash.

The good news is that, in the event that we have to stay up all night, we can do so with no serious side effects other that those associated with feeling extremely sleepy at the time (trusting we don't drive or have any other accident). We would probably struggle to stay awake for a second night, however, and find it almost impossible after four days. At this time, we are likely to be irritable and confused and suffer from the 'hat phenomenon', a feeling of tightening around the head as though a hat that is too small is being worn. Further days without sleep can cause 'sleep deprivation psychosis' – we become depersonalised with a loss of sense of personal identity and increased difficulty in coping with other people and the environment. A long night's sleep followed by a few good nights' sleep tends to overcome most, if not all, the effects of sleep deprivation. Hüber-Weidman (1976) reviewed a large number of studies and summarised the effects of total sleep deprivation (refer to Table 5.1).

TABLE 5.1 The effects of total sleep deprivation

NIGHTS WITHOUT SLEEP	SYMPTOMS
1	Discomfort felt but is tolerable.
2	Urge to sleep, especially between 2 and 4 a.m. (when body temperature is at its lowest).
3	Tasks requiring concentration (sustained attention) are seriously impaired, especially if they are simple, repetitive or boring.
4	Periods of microsleep (about 3 seconds of staring blankly into space and losing awareness) are unavoidable. Person becomes irritable and confused. The 'hat phenomenon' is experienced (a feeling of tightening around the head as though a hat that is too small is being worn).
5	Still irritable and confused. May become delusional.
6	They may be depersonalisation, with a loss of sense of personal identity and increased difficulty with coping with other people and the environment. This is referred to as 'sleep deprivation psychosis'.

(Hüber-Weidman, 1976)

In summary, going without sleep for one or two nights is unlikely to cause long-term psychological and physiological effects, providing that we are in a safe environment (so accidents can be avoided), a good night's sleep follows and there are no other individual problems (risk factors). On the other hand, going without sleep for an *extended* period of time may be detrimental to your health (and may, in fact, result in death) and is *not* something to try out yourself! The *Guinness Book of Records* no longer records total sleep deprivation (loss) because of these associated health risks.

Partial sleep deprivation: Are you getting enough sleep?

People who do not get enough sleep are likely to suffer the effects of partial sleep deprivation. Partial sleep deprivation is experienced when a person does not get the amount of sleep they need or are deprived of one particular stage of sleep. Increasing instances of people working night shifts, waking in the night to check emails and text messages, and other modern lifestyle changes are leading to more people being sleep deprived. Often we don't realise the effects of sleep deprivation at the time.

FIGURE 5.7 An empty kindergarten in Chernobyl after the nuclear accident

Sleep deprivation has been associated with personnel involved in a number of international disasters, including the oil spill of the *Exxon Valdez*, the destruction of the space shuttle *Challenger* and the nuclear accident at Chernobyl which cost over 50 000 lives (Coren 1996).

An investigation into Australian train drivers found that fatigue interfered with their ability to plan ahead, causing them to use the brakes more heavily, use less throttle and use up to 9 per cent more fuel (Dorrian, Hussey & Dawson 2007). They were also more likely to exceed speed limits.

We need good quality sleep to survive, to recover both mentally and physically from the day's activities, and to grow. When we don't get enough sleep, we tend to get bored more easily. Activities we usually enjoy can seem dull. We are likely to feel unmotivated in class. Even the simplest of tasks can become difficult. Paying attention and concentrating on routine, simple, boring, repetitive and self-motivated tasks is difficult. There may be memory problems, emotional issues and poor motor coordination. Our feelings of self-worth, our relationships with family and friends, and our school work can suffer. Interestingly, however, short performances on more physically or intellectually challenging tasks are usually not affected.

SUPPORTING UNDERSTANDING

Daylight savings and car accidents

You need to be careful on the road at the start of daylight savings time (October each year, in Australia).

A Canadian study investigated the effects of changing times due to daylight savings on the incidence of car accidents. The number of car accidents on the Monday following the change into and out of daylight savings was monitored over two years. It was found that there were about 7 per cent more accidents on the Monday following the start of daylight savings. It appears that more drivers are suffering from partial sleep deprivation after losing an extra hour of sleep.

On the other hand, car accidents decreased by about 7 per cent on the Monday following the end of daylight saving. The extra hour of sleep appears to help drivers to overcome partial sleep deprivation.

These findings support the Transport Accident Commission (TAC) message that we should not drive when we are tired (slogans such as 'Sleepy drivers die' and 'A powernap could save your life') and should be seriously considered by drivers.

FIGURE 5.8 Driving when sleep deprived can have disastrous consequences.

EFFECTS OF SLEEP DEPRIVATION

The effects of sleep deprivation can vary from one person to the next. A person with partial sleep deprivation may experience a number of psychological and physiological effects.

Psychological effects

Psychological effects include:

- cognitive difficulties
  - difficulties paying attention and concentrating
  - difficulty processing information
  - difficulty thinking and reasoning, poor decision making

  - memory problems
  - impaired creativity
  - distorted perceptions
- affective (feelings) disturbances
  - mood disturbances – high emotionality, confusion and irritability, feelings of sadness
  - previously enjoyed activities seem boring
  - lack of motivation
  - feelings of fatigue
- behavioural difficulties
  - slowed performance
  - clumsiness, injuries
  - risk-taking behaviour
  - problems performing tasks, especially *simple monotonous* tasks and ones requiring *sustained* attention or concentration.

Note: performance on short, complex, difficult tasks is not usually affected by sleep deprivation.

Physiological effects

Physiological effects include:

- slower physical reflexes
- hand tremors
- droopy eyelids
- difficulty in focusing eyes
- a heightened sensitivity to pain
- headaches
- lower energy levels.

Note: There is little change, if any, in heart rate, respiration, blood pressure and body temperature.

FACE MEMORY TEST

INVESTIGATE 5.3

Too tired to remember? Our memory is affected when we are tired. Go online to the BBC website and search for the Face Memory Test. Try the test to see if you can find evidence that links your score to tiredness.

Attempt the sleep quiz and work out your personal sleep profile.

At first, the effects of sleep deprivation appear to be more psychological than physiological. However, chronic sleep deprivation (not having enough sleep over an extended period of time) is associated with several serious psychological and physiological conditions.

There is increasing evidence that chronic sleep deprivation is linked to serious conditions including:

- depression
- hypertension
- heart disease
- diabetes
- heartburn
- obesity
- some forms of cancer
- anxiety disorders
- sleep disorders such as insomnia
- accelerated ageing process.

These conditions also suggest a link between sleep loss and stress-related conditions, including cardiovascular diseases, mood disorders and immune deficiencies (Meerlo *et al.* 2008). Lack of sleep increases the levels of cortisol, a stress-related hormone (related to alertness and discussed in more detail in Unit 4) that interferes with immune functioning. After several days of partial sleep deprivation there will be an effect on immunity (Irwin 2002). This may explain why we are more susceptible to colds in the lead-up to exams, a time when we are more likely to be sleep deprived. In addition, increased levels of cortisol have been linked to damage of brain cells responsible for learning and memory (Leproult *et al.* 1997).

FIGURE 5.9 Students can be susceptible to colds if they are sleep deprived in the lead-up to exams.

Other research raises concerns about the serious impact of sleep deprivation on health. Chung *et al.* (2009) reviewed a number of studies and found that female shift workers who reported poorer sleep quality were at higher risk of experiencing reproductive problems, breast cancer, and cardiovascular disorders than those who reported sound sleep patterns. It is important to note that this review provides correlational evidence; the data were not obtained from experiments but shows a strong relationship between chronic sleep deprivation and serious health issues. Experimental research is likely to be unethical. Independent variables were not manipulated, making it impossible to state that sleep 'caused' these potentially serious health problems. It may be that the health problems make it harder for women to sleep or there are other variables that have not been identified (for example, genetic risk or cigarette smoking). Refer to Chapter 1 for more explanation on the difference between correlational and experimental studies and the value and limitations of both.

In summary, sleep deprivation may be an important risk factor for a variety of serious health conditions.

5.1 REVIEW

1. Outline three factors that help determine the amount of sleep an individual needs.
2. What are some of the short-term psychological effects that Randy Gardner experienced during a sleep deprivation exercise?
3. What long-term psychological and physiological effects did Randy Gardner experience?
4. What is the 'hat phenomenon'? When is it more likely to occur?
5. What is sleep deprivation psychosis? When is it more likely to occur?
6. Can we survive without any sleep? Outline a non-human study that suggests we cannot.
7. How does sleep deprivation affect our performance on:
   a. repetitive, simple and boring tasks?
   b. short complex tasks?
8. Outline a number of sleep deprivation effects that could interfere with a student's performance at school.
9. Some people say that total sleep deprivation is a form of torture. What do you think? Use psychological evidence to justify your point of view.

Loss of REM and NREM sleep

Sleep is a vital and integral part of our lives and both REM and stages 3 and 4 NREM sleep play crucial roles in allowing us to function properly. Depriving someone of these sleep stages can have alarming consequences. Speak to new parents and they will probably tell you about the difficulties of coping with inadequate sleep. They are likely to be REM deprived, as their sleep is consistently interrupted throughout the night for months on end. When their baby settles into a sleep routine, many parents experience a marked improvement in their psychological and physical well-being with no long-lasting ill effects.

Why do we need REM and NREM sleep? What happens when we are deprived of REM or NREM sleep? We know that our brain behaves differently in each stage of sleep. As discussed in the previous chapter, there is no general agreement by researchers on the exact purpose of sleep and, consequently, this debate spills over to the purpose of REM and NREM sleep.

It has been suggested that REM sleep is more critical for psychological well-being and NREM sleep (especially stages 3 and 4 NREM) for physiological well-being. Other psychologists argue against this idea (Siegel 2003). Some of the questions that have been raised in the debate are discussed below.

COULD LACK OF REM SLEEP BE LINKED WITH MEMORY AND LEARNING PROBLEMS?

REM sleep has been linked with consolidation of memories (Smith *et al.* 2004). Many psychologists believe that the high level of brain activity during REM sleep helps our memories by allowing newly learnt information to be consolidated (i.e. transferred) into long-term memory. This leads to the idea that not getting enough REM sleep will cause memory problems.

However, such an idea is controversial. It has been demonstrated that performance on some tasks improves after a marked increase in both REM sleep and stages 3 and 4 NREM sleep (Walker & Stickgold 2006). Other research has failed to find a link between loss of REM sleep and memory problems (Siegel 2001). People who have brain damage that prevents REM sleep or are on medication that prevents REM sleep do not experience more memory problems than usual. Some animals, such as dolphins, do not appear to have REM sleep but are considered to be intelligent and able to learn.

COULD LACK OF REM SLEEP BE LINKED WITH MOOD DISTURBANCES, SUCH AS GRUMPINESS, IRRITABILITY AND SADNESS?

REM sleep interrupts the release of some neurotransmitters (e.g. norepinephrine) and this might allow the brain receptors to recover and become more sensitive to their release (i.e. more likely to react) after a break. Such neurotransmitters are likely to affect mood and learning. Being deprived of REM sleep may lead to mood disturbances such as grumpiness, irritability and sadness.

COULD LACK OF REM SLEEP BE LINKED WITH LESS PROTEIN SYNTHESIS IN THE BRAIN?

Studies have shown a greater rate of protein synthesis during REM sleep compared to NREM sleep (Rossi 1973). These proteins promote the growth of the nervous system, including the brain, and may replenish the brain. Newborn babies spend around 50 per cent of their sleep in REM sleep, a time when the brain rapidly grows. This decreases to around 20 per cent in adulthood and reflects a decrease in the rate of development. It is unclear what actually causes the increase in protein synthesis (REM sleep itself or increased brain activity) and some say that increased blood flow to the brain during REM sleep should actually prevent protein synthesis.

COULD LACK OF STAGES 3 AND 4 NREM SLEEP LEAD TO DISRUPTIONS IN GROWTH AND THE BODY NOT BEING ABLE TO RESTORE ITSELF PROPERLY?

Our brain is less active and our body's metabolism is lower during NREM sleep. This could provide an opportunity for brain cells to be repaired and its waste products to be replaced. The study of marathon runners found that stages 3 and 4 NREM sleep were important after such a physical event (Shapiro *et al.* 1981) and animals with higher metabolic rates also spend more time in stages 3 and 4 NREM sleep. Growth hormone is also released during these stages of NREM sleep.

However, increases in NREM sleep have been very minor, if any, in cases of inactive people, suggesting that both REM and NREM are involved in growth and restoration.

In summary, during REM sleep hormones are released that influence learning, memory, attention and mood. It has been argued that being deprived of REM sleep may lead to learning and memory problems and irritability, difficulties paying attention and feelings of fatigue. However, other research has not found this link. During NREM sleep, the body replenishes itself physically and restores body tissues. It does this in several ways, including via the release of growth hormones. Being deprived of NREM sleep, especially stages 3 and 4, may interfere with this process.

Be careful **not** to fall into the trap of thinking REM sleep is just for psychological well-being and NREM sleep is only for physiological well-being – this is a gross overgeneralisation. Physiological and psychological processes interact and overlap and the reasons for REM and NREM sleep are still hotly debated. *Both* stages of sleep are important for psychological and physiological well-being!

Sleep recovery patterns

Can we fully recover from sleep deprivation? Fortunately, the answer is 'yes' – most people recover quickly when allowed to get some good quality sleep.

After his sleepless ordeal, Randy Gardner slept longer than usual for the next few nights (Horne 1988). While he missed out on about 85 hours of sleep during the 11 days, he only recovered about 20 hours (25 per cent) of the loss during the subsequent nights. So it does not appear to be essential that a person catches up with the entire amount of sleep lost. What is interesting is that Randy Gardner's sleep consisted of more REM and stages 3 and 4 NREM sleep. In the end, he recovered about 70 per cent and 50 per cent of these respectively but there were only very small increases in the other stages of sleep. This suggests that REM and stages 3 and 4 NREM sleep are of significance.

FIGURE 5.10 Good quality sleep helps you fully recover from sleep deprivation.

Amount of sleep required

The accumulated amount of sleep loss from insufficient sleep is known as **sleep debt**. Not getting enough sleep night after night adds to this sleep debt. The good news is that sleep debt, like other debt, can be repaid. Unlike other debt, it does not accumulate in a direct fashion or attract interest. In other words, if you have been missing out on one hour of sleep for seven nights in a row, you definitely need extra sleep but not an extra seven hours – you do not need to make up for *all* the sleep missed.

However, sleeping longer than we need on one day will not counteract the late nights that follow. The best we can do is go to bed early the night before to make sure we are not sleep deprived to begin with.

Usually, a good night's sleep and being able to sleep in is enough to recover from sleep deprivation. Depending on the amount of sleep deprivation, a few more nights of slightly longer sleep than usual may be required. Most sleep deprivation effects are temporary and we are likely to fully recover without any long-term psychological and physiological problems.

The difficulty arises when a person may be suffering from a sleep disorder (such as insomnia) or another condition that is affecting their quality of sleep. Sleep is often linked with other conditions such as depression and anxiety disorders, and recovering from sleep loss may improve the condition or it may make it worse. In these cases, people often need professional intervention to help deal with these conditions and recover lost sleep. If a few good sleeps do not help you recover from the effects of sleep deprivation, please seek professional help.

REM rebound

When Randy Gardner finally fell asleep, he experienced an increase in REM sleep. REM sleep is essential, as demonstrated by **REM rebound**, an effect that follows a loss of REM sleep. When we sleep after being deprived of REM sleep, we experience a significantly larger amount of time in REM sleep.

Dream intensity during REM rebound tends to increase as well, with one study finding that participants experiencing REM rebound rated their dreams between 8 and 9 on a 9-point scale, with 1 being dull and 9 being extremely intense (Nielsen *et al.* 2005). Interestingly, REM rebound is also observed in other mammals.

Dement (1960) first noticed REM rebound. For five nights, he woke participants each time they entered REM sleep, therefore depriving them of REM sleep. He found many of the participants experienced significant difficulties, including trouble with their memory, motor coordination and perception of time, and a tendency to hallucinate. Many reported feeling irritable and anxious. These findings support the value of REM sleep as discussed earlier. When participants were allowed to have REM sleep on the sixth night, they engaged in much more REM sleep than usual, creating a catch up (rebound) effect.

REM rebound can have implications for people coming off drugs that prevent or limit REM sleep (such as alcohol, nicotine, some blood pressure medication and antidepressants). These people often report more vivid dreams, often nightmares, as they experience more time in REM sleep. These nightmares can be quite distressing and, for some, especially in cases of severe drug abuse, REM rebound can even lead to the resumption of the drug.

Microsleeps

As the amount of sleep deprivation (sleep loss) increases, we can suffer from **microsleeps**. A microsleep is a brief, involuntary period of sleep in the midst of a wakeful activity – we tend to drift off and stop concentrating on what we are doing. Microsleeps assist us in overcoming or preventing sleep deprivation and usually last 3–15 seconds. Randy Gardner almost certainly experienced many microsleeps during his 11-day wakefulness. We are usually unaware of a microsleep. If we are performing a dangerous activity, the consequences of a microsleep can be tragic, such as in the case of a driver falling asleep at the wheel. Avoiding sleep deprivation and having short sleeps, often called powernaps, can help prevent microsleeps.

FIGURE 5.11 Driving when tired can lead to serious accidents. Short sleeps (powernaps) can help overcome the effects of sleep deprivation and may prevent microsleeps.

5.2 REVIEW

1 What are some possible consequences from being deprived of REM sleep?
2 During which stage of sleep is growth hormone released?
3 During which stage of sleep is protein synthesis more likely to occur?
4 Why is it incorrect to say that REM sleep is *only* for psychological reasons and NREM sleep *only* for physiological reasons?
5 How much sleep do we need to recover from sleep deprivation?
6 Are there usually any long-term effects from sleep deprivation?
7 What is REM rebound?
8 What usually happens to the intensity of our dreams during REM rebound?
9 What are microsleeps?
10 How may microsleeps be avoided?

Adolescent sleep/wake cycles

Why do teenagers find it hard to wake up in the morning?

Do you like to stay up late? If you do, there may be a good reason. Research looking into teenagers' sleep cycles around the world has found an interesting pattern (Roenneberg 2004). No matter where they live, people tend to become night owls during their teenage years, with their sleep/wake pattern shifting towards the evening (phase delay). In addition, teens need slightly more sleep to function at their best. This suggests that the shift in sleep patterns is biological and a normal part of life.

In other words, during teenage years, most of us experience:

- a delayed onset of sleep (going to sleep later)
- the need for more sleep (9–10 hours' sleep per night) than an adult, and sometimes more than late childhood.

So it is not unusual for a teenager to want to go to bed later and sleep in longer in the mornings. While an adult might fall asleep at 10 p.m., a teenager may find themselves lying awake, starring at the ceiling, until midnight. It takes longer for a teenager to 'wind down' at the end of the day. Teenagers are not turning into lazy people who want to sleep all morning by choice – there are valid biological reasons for the desire to stay awake late and sleep in the next day! Try Investigate 5.4 and find out if more members of your class are owls rather than larks.

FIGURE 5.12 Teenagers have valid biological reasons for sleeping longer in the mornings.

The adolescent sleep/wake cycle is only during teenage years. The sleep patterns tend to shift back to an adult pattern around 19.5 years old for females and 21 years for males. Most adults need about eight hours' sleep per night.

INVESTIGATE 5.4

RESEARCH INVESTIGATION: ARE YOU AN OWL OR A LARK?

Are you a lark – more energetic early in the day? Or are you an owl – more energetic late in the day? Or are you somewhere in between? To find out, answer the following questions.

1 Assuming you were free to choose any time you wished, when would you prefer to wake up in the morning?

- **a** Before 6.30 a.m.
- **b** 6.30–7.30 a.m.
- **c** 7.30–8.30 a.m.
- **d** 8.30 a.m. or later

2 When do you prefer to go to bed?

- **a** Before 9.00 p.m.
- **b** 9.00–10.00 p.m.
- **c** 10.00–11.00 p.m.
- **d** 11.00 p.m. or later

3 If you always had to go to bed at midnight, would it be easy or difficult to fall asleep?

- **a** Very easy; I'd fall asleep almost at once.
- **b** Easy; I'd lie awake for some time.
- **c** Difficult; I'd lie awake for quite a while.
- **d** Very difficult; I'd lie awake for a long while.

4 If you always had to wake at 6.00 a.m., what would it be like?

- **a** Easy; it would be no problem at all.
- **b** Slightly unpleasant.
- **c** Rather difficult and unpleasant.
- **d** Very difficult and unpleasant.

5 How long does it usually take you to feel completely awake in the morning?

- **a** 0–10 minutes
- **b** 11–20 minutes
- **c** 21–30 minutes
- **d** 31–40 minutes

Scores for each answer: a = 1, b = 2, c = 3, d = 4. Add the total score.

The higher the score, the more you are a night owl. You are more likely to be alert and less fatigued later in the day. You are likely to have higher adrenalin levels later in the day, which means that your blood pressure, heart rate and arousal are likely to be higher later in the day.

The lower the score, the more you are a lark. You are more likely to be alert and less fatigued earlier in the day. You are likely to have higher adrenalin levels earlier in the day, meaning that your blood pressure, heart rate and arousal are likely to be earlier in the day.

Adapted from Torsvall & Akerstedt, 1980.

Teenagers need 9–10 hours of sleep per night. Not surprisingly, most teenagers don't get this much sleep. There are a number of reasons for not getting enough sleep – school, homework, part-time jobs, social activities and family commitments. In addition, electronic devices, social networking sites, television and playing sport late at night keep our brains stimulated and prevent sleep. The link between sleep and stress was highlighted once more in a study of Year 12 students (Robinson *et al.* 2009).

In the month before their external examinations, a sizeable minority of students reported high levels of stress, severe symptoms of depression, anxiety and stress, and very inadequate sleep.

The release of sleep/wake hormones such as melatonin at night (inducing sleepiness) and cortisol in the day (encouraging alertness) are often delayed for up to two hours in teenagers. This means that the common bedtime of 9.30–10.30 p.m. is pushed back later and most teens report not being tired at this time. Therefore, most teenagers like to stay up later and have a tendency to sleep longer in the morning. This leads to a behaviour that is seen as typical of teenagers: that is, preferring to go to bed late (on average around 11 p.m.) and, therefore, to wake up later. A sleep time of 11 p.m. and a wake time of 7 a.m. will leave a teenager at least one hour short of the optimal amount of nine hours' sleep. Over the period of one week, this adds up to a sleep debt of at least five hours. If this happens, teenagers can be chronically sleep-deprived – which might explain the lack of enthusiasm many show in having to get up on a school morning!

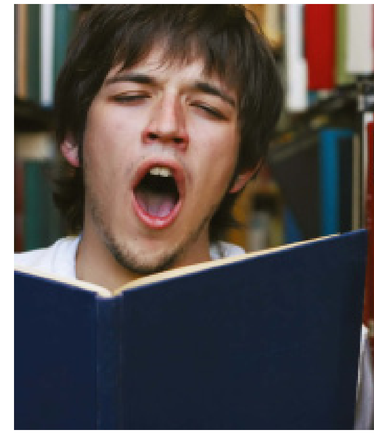


FIGURE 5.13 Some Year 12 students can suffer from inadequate sleep leading up to exams.

SUPPORTING UNDERSTANDING

Open the curtains: Melatonin's involvement

Melatonin is a hormone that causes sleepiness in humans. It is secreted by the pineal gland, a small structure in the brain, when it is dark. Thus, we naturally feel sleepy at night. This fact cannot be ignored by shift workers; it is not uncommon for them to experience difficulties working in the early hours of the morning and to have difficulties sleeping well in daylight hours.

Light stops melatonin secretion and, therefore, prevents sleepiness. Knowing this fact can help us wake up in times of need.

- If you can't wake up in the morning, open the curtains and turn on the light. Give it at least 10 minutes – this way you can wake up naturally.
- Replace your alarm clock with a light clock – one that turns on when it is time to get up.
- If you are feeling a bit down, maybe due to a gloomy winter, or feeling sleepy during the day, try being near natural light settings and bright lights. A long walk, a cold environment and being around attention-grabbing stimuli also helps!

Teenagers are getting almost two hours less sleep now than they did 70 years ago (Maas 1998).

This can have serious consequences; lack of sleep can lead to poor health and well-being. The associated lapses in concentration and judgments can be dangerous, mood disturbances can damage relationships, and feelings of boredom and memory problems can impede school work. This can make teenagers more at risk of depression and other serious conditions.

Some schools, especially those in the US which traditionally have a very early start time, are taking this sleep research seriously and are starting school later. Studies are demonstrating that students with a later start time are getting almost one hour more sleep, are less sleepy during the day and are showing improved grades. In addition, there are fewer school absences (Carskadon *et al.* 1998; Wahlstrom 2002; Wolfson *et al.* 2007). These improvements were almost immediate and this highlights the dramatic effect good sleep can have on a teenager's life.

INVESTIGATE 5.5

DEBATE: SHOULD SCHOOL START LATER?

The question 'Should school start later?' is a politically charged and extremely complex one. Many aspects of school, family, student and teacher requirements need to be considered before making your decision. Schools across the world have battled with this question. Take a moment to think about the issue before making your decision.

1 Where do you fit on this line?

 Definitely YES ----------------- UNSURE------------------- Definitely NO

2 Write a few sentences to support your point of view.
3 Create the line above in the classroom. Nominate one side of the room for Definitely YES and the other for Definitely NO. Put UNSURE in the middle of the room. Members of the class should move to the spot on the line.
4 Your teacher will then ask different members of the class their opinion.
5 Take note of the arguments raised for and against changing the start time to school. Has the class discussion changed your point of view?

Being a night owl is less than ideal in our school environment. Further research has found that night owls (those who go to bed late and are late to rise) tend to experience more emotional stress than early birds (Ong *et al.* 2007). In this study, night owls held more negative and rigid beliefs about the need for sleep and what their sleep should be like. They felt less in control of their sleep and did not go to bed or wake up at regular times. Consequently, they felt sleepier during the day and were more at risk from depression and insomnia.

Can we change our sleep habits?

Understanding sleep/wake cycle shifts and the need for sleep can help teenagers avoid sleep deprivation. Just an extra 30 minutes' sleep each night on a regular basis can make a significant difference. You need to be patient and persistent because it takes about four weeks to set up an earlier sleep time but the potential benefits are worth it. Read the tips for a better night's sleep below and start improving your quality of sleep today!

TIPS FOR A BETTER NIGHT'S SLEEP

- Follow a regular routine. Go to bed and get up at the same time each day.
- Have a relaxing bedtime routine, such as a bath followed by a warm milk drink.
- Avoid staying up too late on weekends.
- Sleep in on weekends, but try to limit it to one morning only. Staying up late and sleeping in too much is likely to shift your sleep/wake cycle and you will go to bed later on Sunday and find it hard to get up Monday morning.
- It is best to go to bed early on Sunday night – try to avoid being sleep deprived at the start of the school week. Avoid 'Monday morningitis'!

- Avoid stimulating activities just before bedtime, such as computer games, arguments, physical exercise, loud music, homework and television. Turn off all screens well before bedtime!
- Avoid caffeinated products, especially after 3 p.m. (Skip that can of Coke, hot chocolate or late night coffee.)
- Don't worry if you can't sleep straight away. It is normal to take 15 minutes or more to fall asleep at night. And sleeping poorly one night is not the end of the world – you will probably find you sleep better the following night.
- Keep your room dark at night and brighten it (e.g. by opening curtains or turning on lights) when you want to wake up in the morning.

If you have persistent trouble sleeping then it is time to seek professional help. Your family doctor, psychologist or school counsellor are good starting points.

FIGURE 5.14 If you have persistent trouble sleeping, see a doctor.

5.3 REVIEW

1. The sleep/wake cycle is often delayed during adolescence. What does this mean in terms of when a teenager is more likely to want to go to bed at night?
2. How does the required length of sleep change during adolescence?
3. When is the delay in the sleep/wake cycle likely to shift back to an adult sleep/wake cycle?
4. Can we change our sleep habits, including the time we fall asleep at night?
5. The release of certain hormones is delayed during adolescence and this affects the sleep/wake cycle. Name two such hormones and state what effect each has on the body.
6. Outline some tips that can help you get a better night's sleep.
7. Secondary school should start later in the morning. What do you think? Use psychological evidence to justify your point of view.

Conclusion

Good quality sleep can lead to better health, better relationships, better school marks and fewer accidents. Researchers have developed pills to *prevent* sleep and pills to *make us* sleep, but as yet they have not succeeded in creating a pill to stop us *needing* sleep. While life is exciting and full of opportunities, we need to make sure we don't sacrifice sleep and we need to put aside at least nine hours each day for sleep.

→ CHAPTER SUMMARY

05:

- The amount of sleep we need varies from person to person. When we are not getting the amount we need, we are sleep deprived.
- Sleep needs vary between individuals and depend on factors such as age, lifestyle and genetics.
- Partial sleep deprivation (having some sleep in a 24-hour period but not getting enough to meet your needs) and total sleep deprivation (going without sleep for an entire 24-hour period) may occur for one night or for several nights. Both partial and total sleep deprivation can have serious consequences.
- Total sleep deprivation leads to discomfort and can be hard to sustain after one night. Tasks requiring concentration (sustained attention) are seriously impaired, especially if they are simple, repetitive or boring. Periods of microsleep (about 3 seconds of staring blankly into space and losing awareness) are unavoidable after three days. After four days, the 'hat phenomenon' occurs, a feeling of tightening around the head as though a hat that is too small is being worn. There may be irritability, confusion and even delusions. Day six typically makes us become depersonalised with a loss of sense of personal identity and increased difficulty with coping with other people and the environment. This is known as 'sleep deprivation psychosis'.
- Total sleep deprivation for one or two nights is unlikely to cause long-term psychological and physiological effects providing that we

are in a safe environment (so accidents can be avoided), a good night's sleep follows and there are no other individual problems (risk factors). On the other hand, going without sleep for an extended period of time may be detrimental to your health (and even lead to death).

- Partial sleep deprivation can lead to psychological (affective, cognitive and behavioural) effects and physiological effects. Chronic sleep deprivation (not having enough sleep over an extended period of time) is associated with several serious conditions such as cardiovascular disease, mood disorders and immune deficiencies including cancer.
- REM sleep deprivation has been linked with memory and learning problems, mood disturbances such as grumpiness, irritability and sadness, and interfering with protein synthesis in the brain. NREM sleep deprivation has been linked with disturbances in growth and restoration of the body's resources. The evidence for the purpose of REM and NREM sleep is not conclusive and still hotly debated. It is important not to overgeneralise by thinking REM sleep is just for psychological well-being and NREM sleep is only for physiological well-being. Physiological and psychological processes interact and overlap, and both stages of sleep are important for psychological and physiological well-being.
- Usually a good night's sleep and being able to sleep in (i.e. sleep longer than usual) is enough to recover from sleep deprivation. Depending on the amount of sleep deprivation, a few nights of slightly more sleep than usually needed may be required. Most sleep deprivation effects are temporary and we are likely to fully recover without any long-term psychological and physiological problems.
- When we sleep after being deprived of REM sleep, we experience a significantly larger amount of time in REM sleep. This is known as REM rebound. Dream intensity tends to be increased during REM rebound.
- A microsleep is a brief involuntary period of sleep in the midst of a wakeful activity – we tend to drift off and stop concentrating on what we are doing. Microsleeps assist us in overcoming or preventing sleep deprivation and usually last 3–15 seconds. We are usually unaware of a microsleep.
- During teenage years, most of us experience:
  - a delayed onset of sleep (going to sleep later)
  - the need for more sleep (9–10 hours' sleep per night).
- The sleep/wake pattern shifts towards the evening in adolescence. Increased need for sleep tends to be universal (found in all cultures), suggesting that the shift in sleep patterns is biological and a normal part of life in the teenage years.
- Good quality sleep can lead to better health, better relationships, better school marks, and fewer accidents. Researchers have invented pills to prevent sleep and pills to make us sleep, but as yet they have not succeeded in creating a pill to stop us needing sleep. While life is exciting and full of opportunities, we need to make sure we don't sacrifice sleep and put aside at least nine hours a day for sleep.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP

- Sleep deprivation
  - Total sleep deprivation
    - Total sleep psychological and physiological effects
  - Partial sleep deprivation
    - Short-term psychological and physiological effects
    - Loss of REM and NREM sleep
    - Chronic (long-term) psychological and physiological effects
  - Sleep recovery patterns
    - Amount of sleep required
    - REM rebound
    - Microsleeps
  - Sleep/wake patterns
    - Changes during adolescence
    - Delayed onset of sleep (phase delay)
    - Need for sleep

KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

chronic sleep deprivation
microsleep
partial sleep deprivation
REM rebound
sleep debt
sleep deprivation
sleep deprivation psychosis
the 'hat' phenomenon
total sleep deprivation

KEY IDEAS

For the exam, you must know:

- that sleep needs vary between individuals and give examples of how sleep needs can depend on factors such as:
  - age
  - lifestyle
  - genetics
- the effects of total sleep deprivation
  - likely effects of one night to a few days without sleep
  - recovery patterns, including after one night without sleep
- the effects of partial sleep deprivation
  - psychological effects (affective, cognitive and behavioural) and physiological effects
  - chronic sleep deprivation effects

- REM and NREM sleep are both important for psychological and physiological well-being
  - the possible effects of loss of REM sleep
  - the possible effects of loss of NREM sleep
  - the purpose of REM and NREM sleep is not conclusive and still debated.
- sleep recovery patterns after sleep deprivation
  - the amount of sleep required
  - microsleeps
  - REM rebound
- adolescent sleep/wake cycles
  - a delayed onset of sleep (going to sleep later)
  - the need for more sleep (between 9 and 10 hours' sleep per night)
  - the difference between adolescent sleep/wake cycles and child and adult sleep/wake cycles.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- understand how non-human studies are used for understanding sleep deprivation
- be aware of ethical considerations relating to studying sleep deprivation.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 The amount of sleep a person needs:
  a remains stable throughout life.
  b varies depending on age, lifestyle and genetics.
  c is greatest during late adulthood.
  d increases with an inactive lifestyle.

2 Not getting the amount of sleep that you need is called:
  a sleep debt.
  b sleep/wake cycle.
  c REM sleep.
  d sleep deprivation.

3 On average, a teenager needs __________ of sleep per night.
  a 7–8 hours
  b 8–9 hours
  c 9–10 hours
  d 10–11 hours

4 Good sleepers are more likely to have a __________ than poorer sleepers.
  a regular bedtime and rise time
  b varying bedtime and rise time
  c regular bedtime but varying rise time
  d varying bedtime but regular rise time

5 Having some but not enough sleep in a 24-hour period is called ________ sleep deprivation and going without sleep for an entire 24-hour period is called ________ sleep deprivation.
- a partial; total
- b total; partial
- c partial; partial
- d total; total

6 When you are sleep deprived, you are more likely to
- a think you performed better on a task than you actually did.
- b think you performed worse on a task than you actually did.
- c find it easier to stay awake after a few days.
- d find it harder to fall asleep after a few days.

7 Which of the following statements about REM rebound is correct?
- a There is likely to be REM rebound after a psychologically exhausting day.
- b Dreams in REM rebound tend to be more vivid than normal.
- c REM rebound is associated with an increase in the percentage of NREM sleep than normal.
- d Fewer dreams than normal are experienced in REM rebound.

8 Performance on ________ and ________ tasks tends not to be greatly affected by sleep deprivation.
- a short; complex
- b lengthy; complex
- c simple; monotonous
- d simple; concentration

9 Connor was out celebrating his basketball team's grand final victory on Saturday night. He stayed awake for the rest of the weekend and arrived at school on Monday morning without having had any sleep. On Monday at school, due to lack of sleep, Connor is likely to be experiencing:
- a the 'hat phenomenon' and 'sleep deprivation psychosis'.
- b extreme tiredness and delusions.
- c very low heart rate and hallucinations.
- d increased sensitivity to pain and a struggle to stay awake.

10 The release of sleep/wake hormones, such as ________ which induces sleepiness and ________ which encourages alertness, tend to be delayed for up to ________ during adolescence.
- a melatonin; cortisol; 2 hours
- b cortisol; melatonin; 2 hours
- c melatonin; cortisol; 4 hours
- d cortisol; melatonin; 4 hours

Questions 11, 12, 13 and 14 relate to the following statement:

Sasha has not been sleeping well for the past week. As a result, she is sleep deprived and experiencing a number of psychological and physiological effects.

11 A cognitive effect that Sasha is likely to be experiencing is:
- a irritability.
- b droopy eyelids.
- c increased creativity.
- d poor decision making.

12 An affective effect that Sasha is likely to be experiencing is:
- a clumsiness.
- b memory problems.
- c feelings of alertness.
- d previously enjoyed activities seem dull and boring.

13 A behavioural effect that Sasha is likely to be experiencing is:
- a feelings of fatigue.
- b lack of motivation.
- c problems performing simple and monotonous tasks.
- d problems performing short, complex and difficult tasks.

14 A physiological difficulty that Sasha is likely to be experiencing is:
- a irritability.
- b hand tremors.
- c less sensitivity to pain.
- d difficulties concentrating.

SHORT ANSWER

15 Name and discuss three factors that influence the amount of sleep that an individual needs.

6 marks

16 Discuss the likelihood of long-term psychological and physiological effects that result from a person staying awake for one or two nights.

2 marks

17 What is partial sleep deprivation? How is it related to chronic sleep deprivation?

2 marks

18 Outline the link between sleep loss and stress-related conditions. Include a statement about cortisol and its affect on arousal and immunity.

3 marks

19 Answer the following questions.

a What is a microsleep?

1 mark

b When do most people experience microsleeps?

1 mark

20 Why is it an overgeneralisation to state that REM sleep is just for psychological well-being and NREM sleep is only for physiological well-being?

2 marks

21 Using an example, such as Randy Gardner's experience, discuss:

a the effects of total sleep deprivation, both psychological and physiological

3 marks

b the amount of sleep needed to recover from total sleep deprivation

2 marks

c the long-term psychological and physiological effects following a period of total sleep deprivation.

1 mark

22 Discuss the ethical issues associated with research investigating the effects of total sleep deprivation.

2 marks

23 Non-human studies have been used to demonstrate the effects of total sleep deprivation.

a Outline a non-human study that has investigated the effects of total sleep deprivation.

2 marks

b Why have non-human studies been used to investigate the effects of total sleep deprivation?

1 mark

c What have non-human studies suggested about the importance of sleep compared to food?

1 mark

d Why is it difficult to distinguish between the effects of stress-related illnesses and those due to sleep loss in non-human studies?

1 mark

24 How can sleep deprivation interfere with driving a vehicle? Outline two psychological effects and two physiological effects.

4 marks

25 Outline how adolescent sleep/wake cycles differ from child and adult sleep/wake cycles.

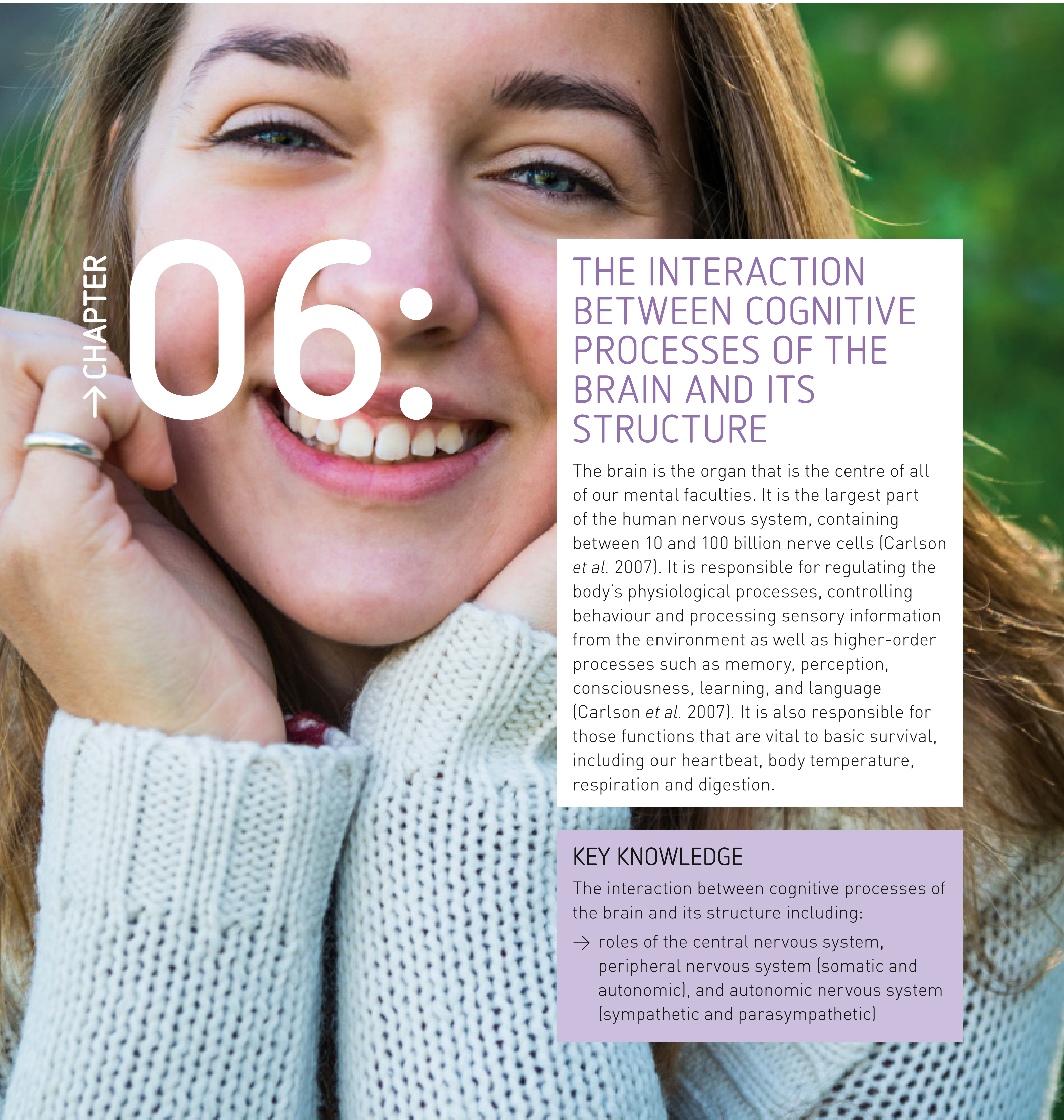
2 marks

26 Hugh is recovering from sleep deprivation. Describe the features of sleep needed for him to recover.

2 marks

27 What can we do to prevent sleep deprivation? Outline five tips for better sleep.

5 marks



→ CHAPTER 06:

THE INTERACTION BETWEEN COGNITIVE PROCESSES OF THE BRAIN AND ITS STRUCTURE

The brain is the organ that is the centre of all of our mental faculties. It is the largest part of the human nervous system, containing between 10 and 100 billion nerve cells (Carlson *et al*. 2007). It is responsible for regulating the body's physiological processes, controlling behaviour and processing sensory information from the environment as well as higher-order processes such as memory, perception, consciousness, learning, and language (Carlson *et al*. 2007). It is also responsible for those functions that are vital to basic survival, including our heartbeat, body temperature, respiration and digestion.

KEY KNOWLEDGE

The interaction between cognitive processes of the brain and its structure including:

→ roles of the central nervous system, peripheral nervous system (somatic and autonomic), and autonomic nervous system (sympathetic and parasympathetic)

- → 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.

(VCE Study Design 2013)

Cognitive processes of the brain and its structure

CHAPTER OVERVIEW

Cognitive processes of the brain and its structure	Components of the brain
Roles of the CNS and PNS in cognitive processes	The central nervous system The peripheral nervous system > Somatic nervous system > Autonomic nervous system
Roles of the four lobes of the cerebral cortex in cognitive processes	The cerebral cortex > Structure of the cerebral cortex Lobes of the cerebral cortex > Primary cortices Roles of the lobes in cognitive processes > Frontal lobes > Parietal lobes > Temporal lobes > Occipital lobes > Association areas of the cortex
Hemispheric specialisation	

SUPPORTING UNDERSTANDING

Components of the brain

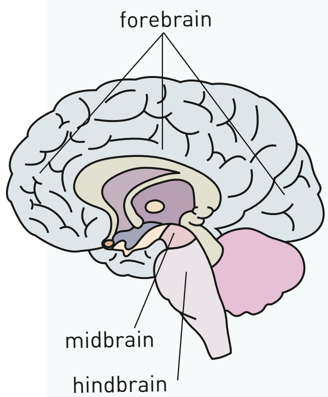


FIGURE 6.1 This is a cross-section of the right-hand side of the human brain if it was sliced through from top to bottom. Note the three main components of the brain: the hindbrain, the midbrain and the forebrain.

The brain comprises three parts: the **hindbrain**, the **midbrain**, and the **forebrain** (see Figures 6.1 and 6.2). These structures interact and work together to enable our body to behave and function in accordance with our thoughts and feelings.

The hindbrain is the link between the **spinal cord** and the brain, and is important for movement and balance. It includes the brainstem, medulla, pons, cerebellum, and parts of the reticular formation.

The forebrain is responsible for higher-order thinking processes including problem solving and planning, as well as memory, language, emotions and body movement. The outer area of the *cerebrum* is called the *cortex* (also known as the **cerebral cortex**). The cortex comprises two *hemispheres* which are connected to each other by the **corpus callosum**. Each of these hemispheres has four lobes. In Area of Study 2, you will learn about the functions of two structures – the amygdala and hippocampus – in the formation of memories; these structures will also be considered very important in Unit 4 if you are studying phobias as the option in the 'Mental Health' section.

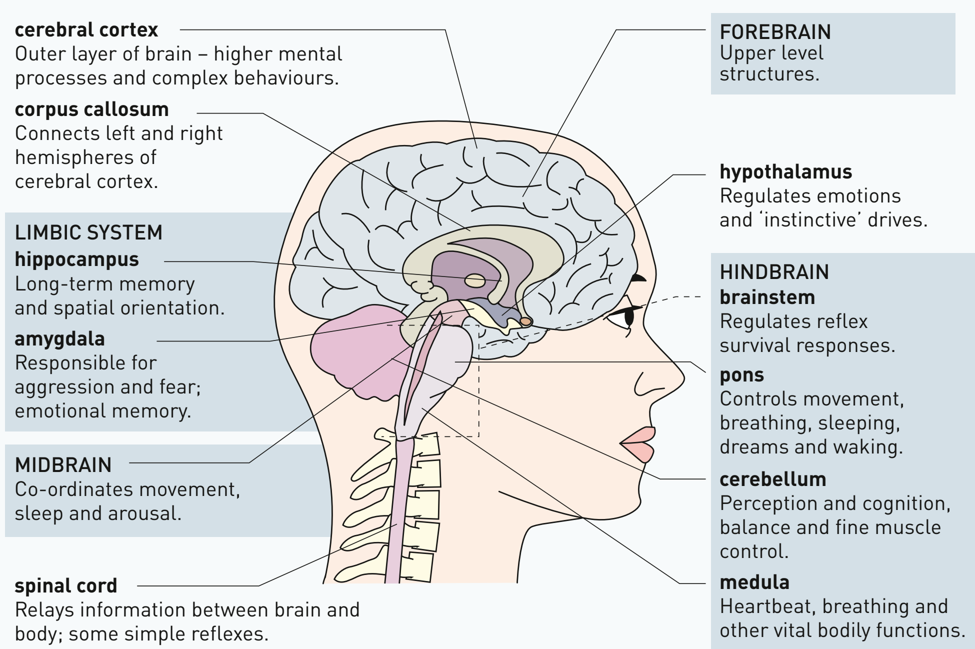


FIGURE 6.2 Some substructures of the forebrain, midbrain and hindbrain

In studying the interaction between the cognitive processes of the brain and its structure, it is easier to consider each of the structures of the brain as separate entities with individual responsibilities. However, this is not how the nervous system operates in reality. Neuro-imaging techniques have enabled scientists to observe the parts of the brain that are active during different types of cognitive processes, and it is apparent that many parts of the brain are active at any given time during cognitive processing. Therefore, it is important to remember that different parts of the brain interact with each other and are not discrete, isolated structures.

Roles of the CNS and PNS in cognitive processes

Having reviewed the basic structures of the brain, let us turn our attention to the roles of parts of the brain in cognitive processes. The brain does not act in isolation. It needs to receive information from the body's sense organs – the eyes, ears, skin, nose and tongue – which are constantly receiving information from the environment. The brain is also connected with the muscles and glands in the body so that an organism is able to respond to and act on the environment.

The two major divisions of the nervous system are the **central nervous system (CNS)** and the **peripheral nervous system**. The peripheral nervous system also has two subdivisions: the **somatic nervous system** and the **autonomic nervous system**, which has two branches known as the **sympathetic** and **parasympathetic nervous systems**. Figure 6.3 illustrates the nervous system and its divisions.

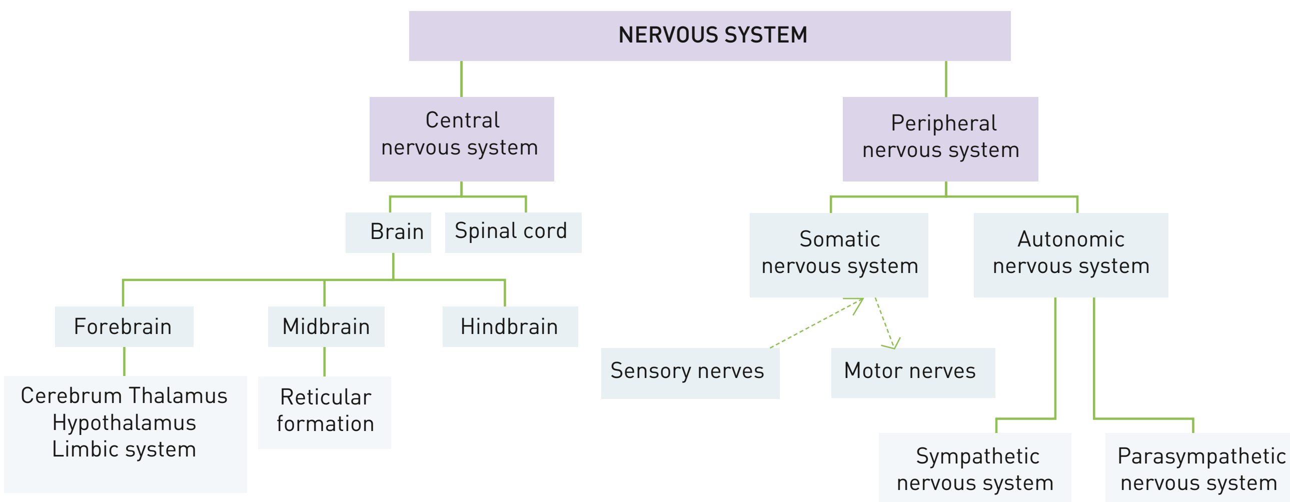


FIGURE 6.3 The overall structure of the nervous system

The central nervous system

The CNS comprises the brain and the spinal cord. The spinal cord runs from the base of the brain (brain stem), inside the bones of the spine (vertebrae) to the lower middle section of the spine. It enables the brain to communicate with the rest of the body by conveying messages from the brain to the peripheral nervous system, and from the peripheral nervous system to the brain. The spinal cord is segmented, with the upper section responsible for communication between the brain and the upper parts of the body, and the lower section responsible for the lower parts of the body such as legs, toes and feet (see Figure 6.5).

The peripheral nervous system

The peripheral nervous system has two functions:

- to communicate information from the body's organs, glands and muscles to the CNS, including information from the outside world (such as environmental temperature and sensation on the skin, via sensory neurons) and from the inside world (such as aches and pains)

- to communicate information from the CNS to the body's organs, glands and muscles, via motor neurons.

The peripheral nervous system has two subdivisions: the somatic nervous system, and the autonomic nervous system.

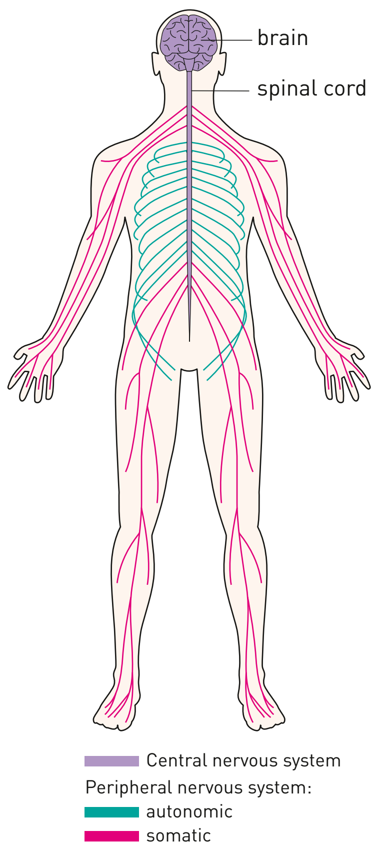


FIGURE 6.4 The human nervous system includes the central nervous system (brain and spinal cord) and the peripheral nervous system (somatic and autonomic nervous systems).

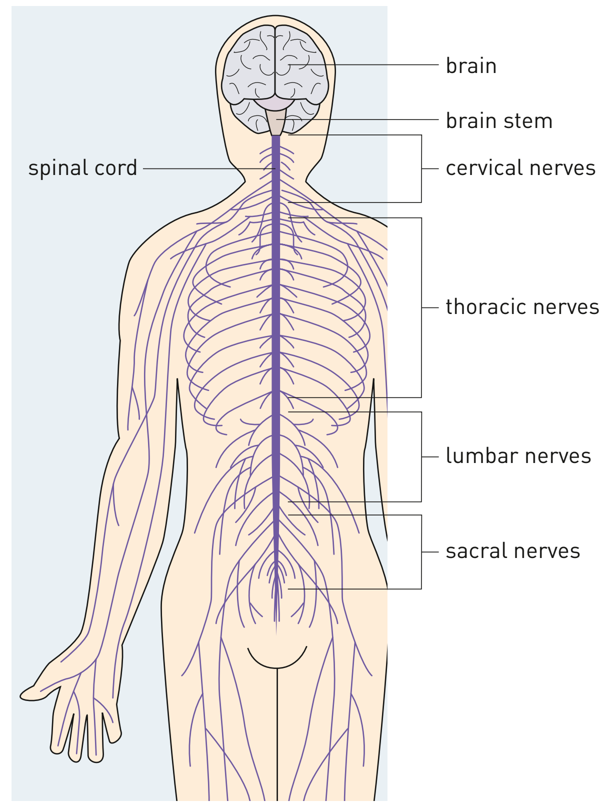


FIGURE 6.5 The upper section of the spinal cord is responsible for communication between the brain and upper parts of the body, while the lower section is responsible for communication between the lower parts of the body and the brain.

SOMATIC NERVOUS SYSTEM

The somatic nervous system is responsible for the voluntary movement of skeletal muscles (striated or 'striped' muscles). **Motor neurons** (nerves) communicate messages from the CNS to the particular muscles that an organism intends to move at any particular moment.

The CNS and the peripheral nervous system work together to enable an organism to interact with the environment. For example, when a child pats a dog, the motor neurons are responsible for initiating the movement of the muscles of the arm and hand of the child so he or she can pat the dog. The child's **sensory neurons** (nerves) convey the sensation of the dog's fur from the sensory receptors in the skin on the child's hand to the brain, where this information (the sensation of the touch of the fur) would be processed as feeling soft.

Did you know?

Motor and sensory neurons do not communicate directly with each other but through interneurons.

FIGURE 6.6 When this girl pats a dog, her motor neurons carry information from her brain to the muscles in her arm and hand that allow her to move to pat the dog. The sensory neurons carry information about the feel of the dog from the sensory receptors in her skin to her brain for processing.

AUTONOMIC NERVOUS SYSTEM

The autonomic nervous system of the peripheral nervous system is mostly responsible for the communication of information between the CNS and the body's non-skeletal muscles (also known as 'smooth' or 'visceral' muscles), as well as the internal organs and glands which carry out the basic bodily functions necessary for survival, such as digestion and heartbeat. Because the autonomic nervous system operates without voluntary control or conscious awareness, it enables the organism to have the cognitive resources to pay attention to other matters, such as responding to threats or other survival needs in the external environment.

The autonomic nervous system controls the function of internal organs (viscera) through:

- muscles
- the skin (around hair follicles; smooth muscle)
- blood vessels (smooth muscle)
- the eye (the iris; smooth muscle)
- the stomach, intestines and bladder (smooth muscle)
- the heart (cardiac muscle)
- gastrointestinal tract
- gall bladder
- liver
- glands
- pancreas
- adrenal medulla (adrenal gland)
- sweat gland.

Even though the actions of the autonomic nervous system are usually involuntary, some, such as breathing and blinking, can be influenced voluntarily – you are generally unaware of each time you inhale and exhale but you can deliberately hold your breath during a medical examination and breathe out on demand.

The sympathetic and parasympathetic branches of the autonomic nervous system

The autonomic nervous system is further divided into two branches: the sympathetic nervous system and the parasympathetic nervous system. These two systems work together in complementary ways but have different roles.

The sympathetic nervous system is like an emergency system which becomes active when the organism perceives itself to be in danger or in times of stress. It has an essential role in an organism's survival because it readies the body for action, such as running away, fighting the threat, or remaining (freezing). This is known as the **fight, flight or freeze response** but is more commonly known as the fight-or-flight response.

In contrast, the parasympathetic nervous system operates in circumstances where it is relatively calm. It is responsible for maintaining automatic day-to-day bodily functions such as digestion, normal heart rate, and normal breathing. This normal bodily functioning is also known as **homeostasis.**

FIGURE 6.7 The fight-or-flight response. The threatened animal's sympathetic nervous system is activated.

FIGURE 6.8 Homeostasis: the animal's parasympathetic nervous system maintains the body's metabolic balance during times of low arousal and no threat.

Both the sympathetic and parasympathetic nervous systems affect the same tissues and organs, but in the opposite way. While the parasympathetic nervous system allows us to go about our everyday tasks and keeps the body functions in a state of balance, the sympathetic nervous system prepares the same organs to deal with threats or stressors.

The sympathetic and parasympathetic nervous systems in action

Figure 6.9 indicates the way in which the autonomic nervous system activates parts of the body in different states of autonomic arousal.

When the parasympathetic nervous system is in action, heart rate, blood pressure, digestion and respiration are relatively normal, there is sufficient blood flow to the internal organs to enable them to operate at a normal level, and eye pupils are not overly dilated. The parasympathetic nervous system also regulates blood-sugar levels, secretion of saliva, bowel and bladder function, and maintenance of the body's energy stores. This can quickly change, however. The sympathetic nervous system is activated when you get a fright, such as when a fierce dog barks at you as you are walking along a footpath. Once the threat has passed, the parasympathetic nervous system takes over again, restoring the body functions to homeostasis.

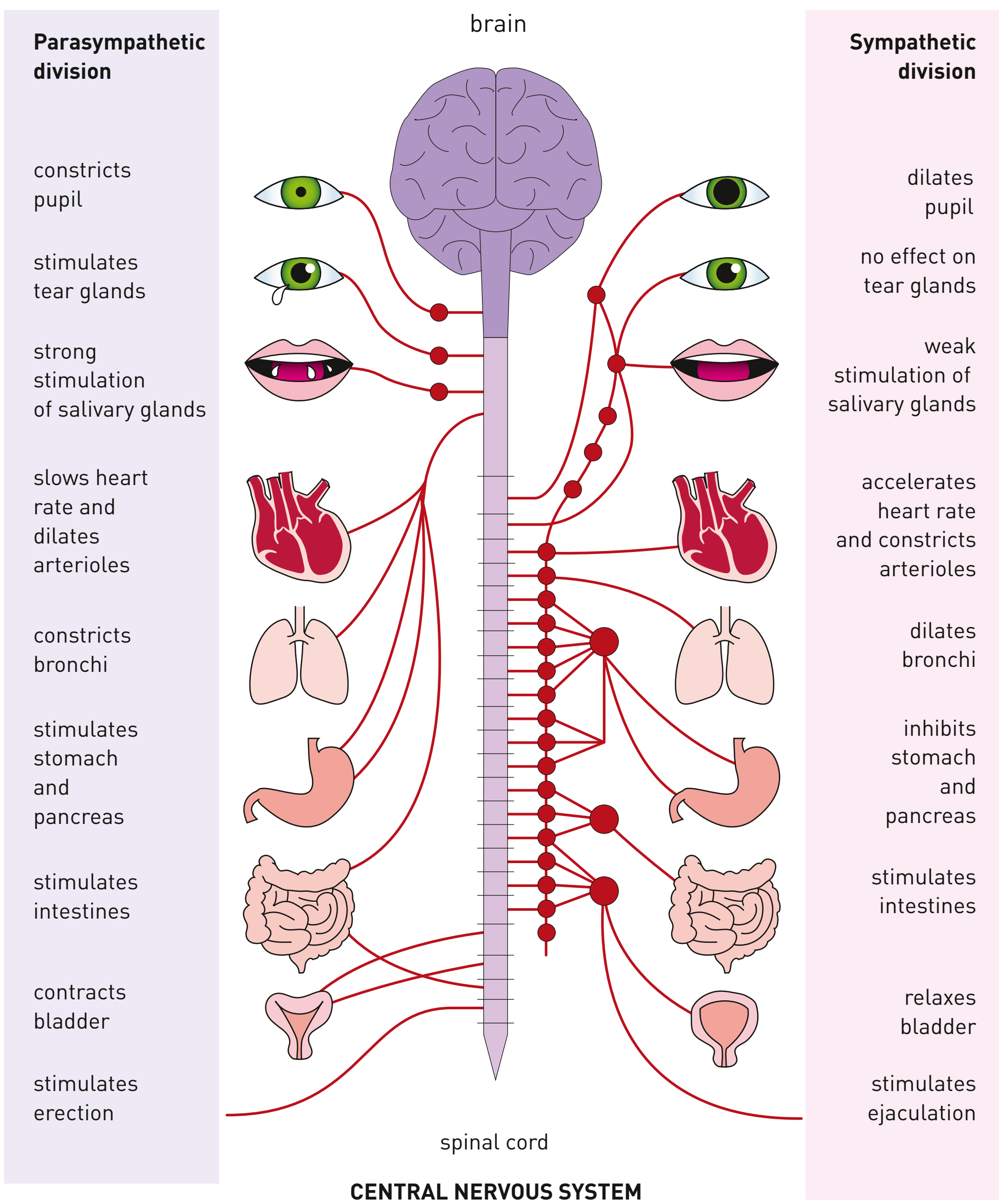


FIGURE 6.9 The role of the autonomic nervous system during different levels of arousal

SUPPORTING UNDERSTANDING

Role of the fight-or-flight response

Although the fight-or-flight response has evolved to facilitate survival in times of danger, sometimes the activity of the sympathetic nervous system can be an unwanted cause of anxiety or even panic attacks, such as sweaty hands when you are nervous in a social setting, the urgent need to relieve your bladder before an exam or a dry mouth when you have to deliver a speech.

The fight-or-flight response is an innate and evolutionary phenomenon. It is critical for survival and, as such, is referred to as an 'adaptive response'. In the early days of human evolution, those with quick instinctual responses that were activated by the sympathetic nervous system (fight-or-flight response) had a greater chance of survival. This is also true for other living creatures.

Is the activation of the fight-or-flight response always due to some frightening event? The answer is no. That nervous feeling when you are about to enter an exam or begin a debating speech are both examples of 'sympathetic arousal' in response to a stressful situation. Is this a bad thing? Absolutely not! In fact, it is important that we are a little aroused when we enter an exam or prepare to dive into the water for a swimming race, so that our body mobilises its resources (through activating the fight-or-flight response) to provide us with the energy necessary to achieve our goals.

The relationship between stress and the autonomic nervous system

When we are exposed to a stressor, the fight-or-flight response is activated. If the stressor does not go away, then the sympathetic nervous system remains active. Depending on the period of time the stressor remains, it can make it difficult for the parasympathetic nervous system to play its part in regulating bodily functions.

The body's activity in the fight-or-flight response

Figure 6.10 shows the interaction of the brain and the body's organs as part of the autonomic nervous system. When confronted by a threatening situation, the sympathetic nervous system prepares the body for the fight-or-flight response because the brain, in perceiving the threat, triggers the release of hormones by the adrenal medulla. Epinephrine and norepinephrine are secreted into the bloodstream. Norepinephrine can function both as a neurotransmitter and a hormone. Most cells in the body have receptor sites that can be stimulated by these substances and, once they are released, there is an increase in heart rate, blood pressure, respiration rate, perspiration and muscle tone. Another effect is raised hair on the body; this is particularly noticeable in furry animals such as cats and dogs when they are threatened.

The hypothalamus, pituitary gland and adrenal cortex are also stimulated one after the other, leading to the production of cortisol, a naturally occurring steroid. Its presence increases the availability of glucose to the body for energy, enables greater blood flow and significantly increases an organism's ability to respond to the threat. However, the presence of cortisol can also have a negative effect. In the short term, it is essential in mobilising the body's resources to deal with the threat, but the long-term presence of cortisol in the bloodstream can damage muscle tissue, lead to increased blood pressure or diabetes and hinder the body's immune system, making the body vulnerable to bacterial or viral infections.

Activation of the pituitary gland also results in the release of beta-endorphins, naturally occurring painkillers that improve a person's mood and decrease sensitivity to pain during physical injury. Frequent release of beta-endorphins has also been linked to the suppression of the immune system. When the sympathetic nervous system is activated, functions such as digestion are decreased (see Figure 6.9).

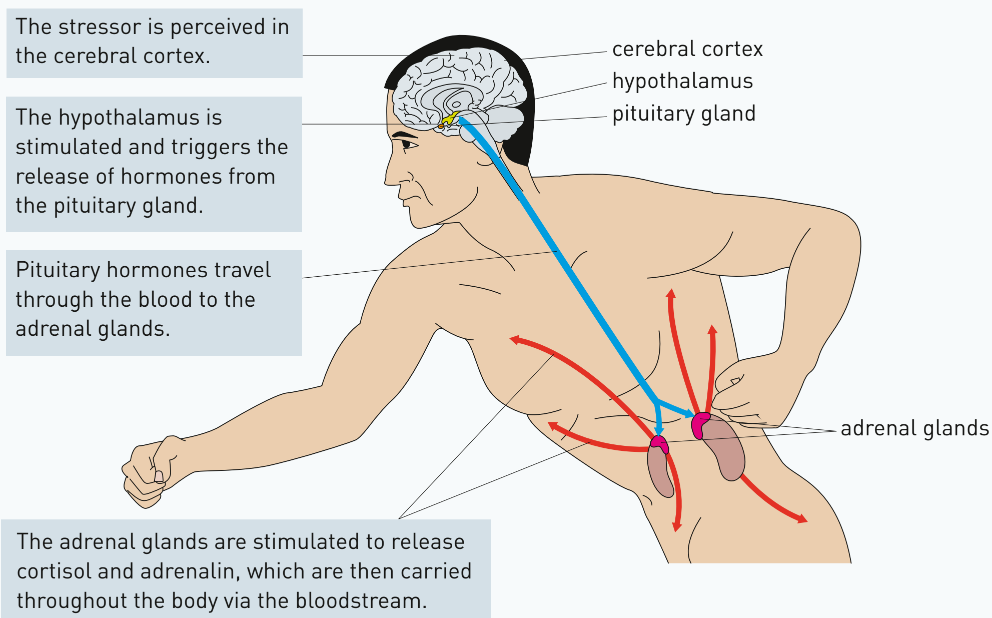


FIGURE 6.10 Activity of the brain and organs of the body in the autonomic nervous system

6.1 REVIEW

1. Draw a labelled diagram (similar to Figure 6.3) to illustrate your understanding of the structure and function of each component of the human nervous system. Make sure that you include:
   - nervous system, CNS (brain, spinal cord), peripheral nervous system, somatic nervous system, autonomic nervous system (sympathetic; parasympathetic)
   - the role of each system (you can use dot points).
2. What is the fight-or-flight response?
3. Which branch of the autonomic nervous system is responsible for arousal?
4. Explain the physiological processes involved in autonomic arousal (fight-or-flight response).
5. Draw a well-labelled cartoon or a directional flow chart to show the physiological processes involved once the flight-or-fight response is activated. Think about a situation that causes a person or animal to respond with autonomic arousal.
6. Refer to Figure 6.3. Explain what would happen for each section of the nervous system if a person was suddenly confronted with a frightening situation.
7. Define motor and sensory neurons.
8. Explain the role of the autonomic and somatic nervous system.

Roles of the four lobes of the cerebral cortex in cognitive processes

The cerebrum in the forebrain is separated into the left and right cerebral hemispheres, which are separated by the longitudinal fissure – the deep groove which runs from the front to the rear of the cortex. These hemispheres are almost symmetrical in appearance and are joined by the corpus callosum, a set of neural fibres which bridges the gap between the two (see Figure 6.11).

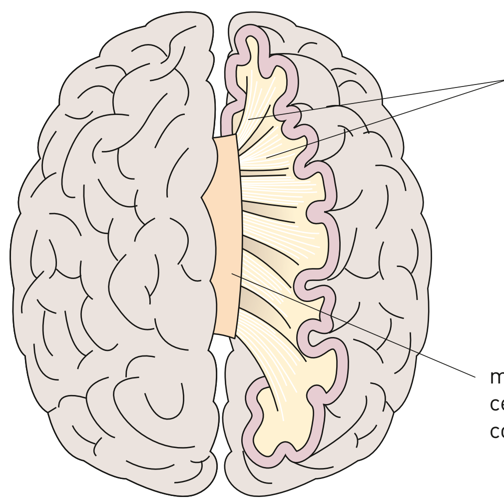


FIGURE 6.11 The two hemispheres of the cerebrum as seen from above. Part of the cortex has been removed to show the corpus callosum, which joins the two together.

The cerebral cortex

The cerebral cortex of humans is much larger in proportion to body mass than any other animal; it is the point of difference between humans and animals in terms of intellectual functioning. It enables us to plan and carry out a series of body movements and use words to make intelligible conversation. It allows us to undertake a range of tasks, from the simple (like making toast) to the complex (like constructing buildings and developing computers). It also allows us to detect the difference between pieces of information, to understand the meaning of this information and to think in abstract and symbolic ways, enabling creativity in art, writing, debating and the use of metaphor (Burton *et al.* 2009).

Did you know?

The word *cortex* is a Latin word meaning the bark or outer covering of a tree trunk.

STRUCTURE OF THE CEREBRAL CORTEX

The cerebral hemispheres are covered by the cerebral cortex (also referred to as the 'cortex'). The cortex is very thin (approximately 3 millimetres) and contains billions of neurons. Humans have the greatest number of cognitive abilities and this is why they also have the largest, most convoluted cortex of all organisms. Its convolutions – the many folds, grooves and bulges – make the surface area (and volume) of the cortex large enough to contain an enormous number of neurons and blood vessels that can supply energy. The bulges are known as gyri (singular: gyrus), and the valleys are called sulci (singular: sulcus).

Each hemisphere has a very deep groove that runs from the top and down the sides, which separates the front (anterior) of the cortex from the rear (posterior) section. This very deep groove is known as the central fissure.

FIGURE 6.12 Diagram of a human's left cerebral hemisphere and hindbrain. Note the folds of each of the cortices.

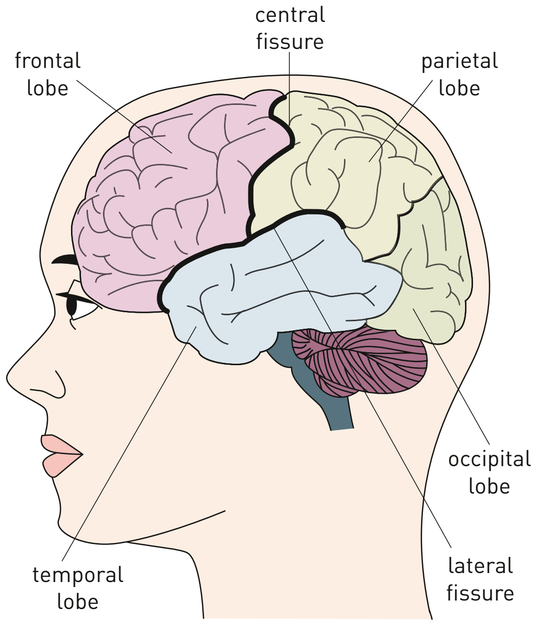


FIGURE 6.13 Diagram of the left-hand side of the human cerebral cortex. Note the central fissure.

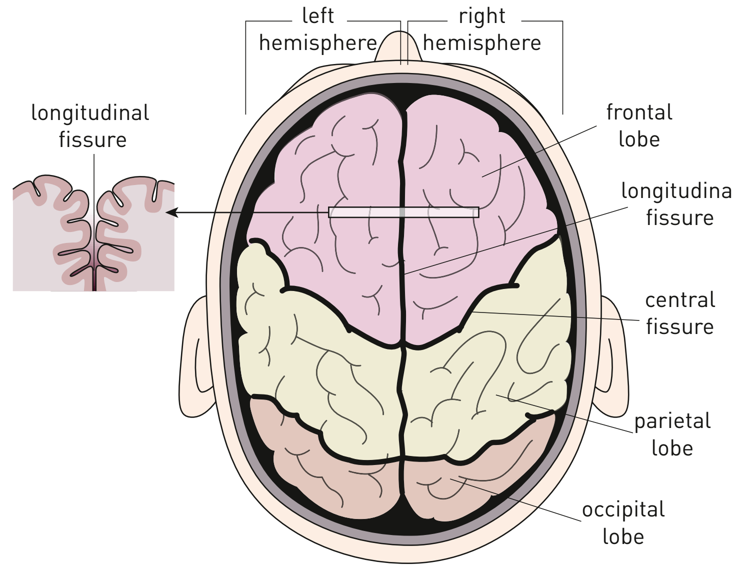


FIGURE 6.14 A diagram of the left and right human cortices viewed from above. Note the longitudinal fissure that separates the brain into the right and left hemispheres.

6.2 REVIEW

1 Describe the structure of the cerebral cortex. In your answer refer to the thickness of the cortex, its size, the convolutions, and fissures.
2 Explain the role of the corpus callosum.

6.1 INVESTIGATE

COMPARING CORTICES

Using the internet, find pictures to compare the size of the cortices of mammals, birds and fish. Compare these with the cortex of a human brain. Note the number of folds or grooves in the human cortex compared to those in the cortices of animals.

Lobes of the cerebral cortex

The cortex of each cerebral hemisphere comprises four distinct regions called lobes. These are the frontal lobe, parietal lobe, occipital lobe and temporal lobe (each named after the plate of the skull protecting it).

Visually, the lobes appear symmetrical for each hemisphere. The left and right hemispheres each have a frontal, parietal, occipital and temporal lobe, making eight lobes in total.

It is important to remember that, while the cortex is studied as a series of separate lobes, in reality the lobes work together and the region of one lobe may have a similar or related function to the neighbouring region of another lobe. The sections of the cortex are given particular names to make the brain easier to study.

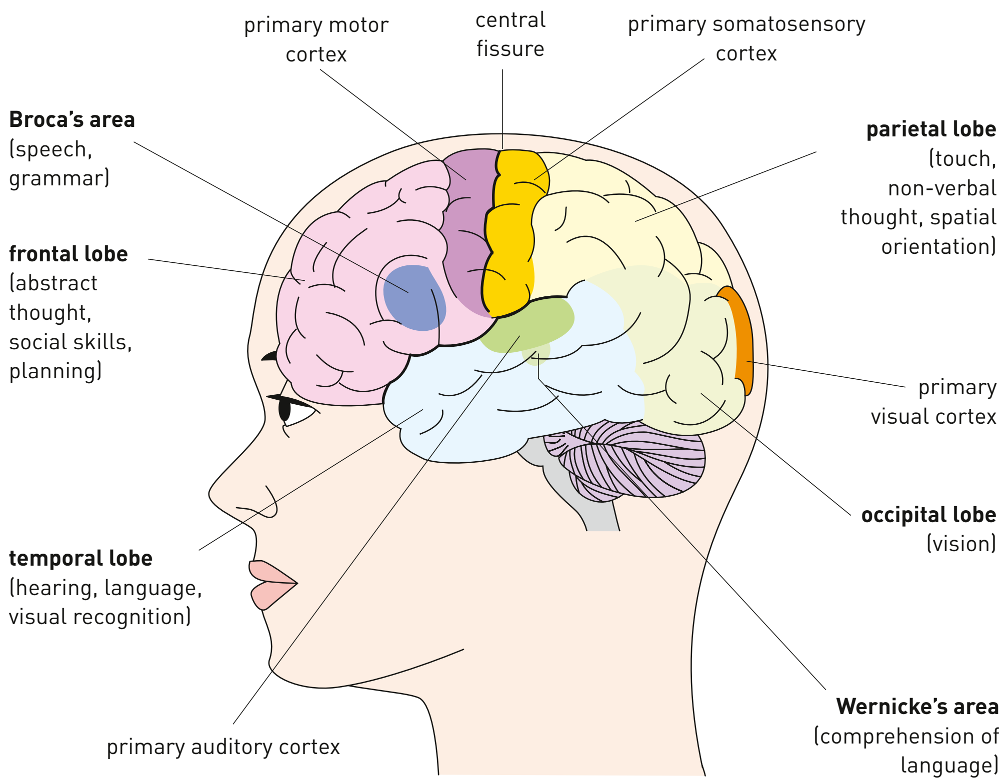


FIGURE 6.15 The main functions of the lobes of a typical left cerebral cortex. Although most people have Broca's and Wernicke's areas in their left hemisphere, some people (about 3–5 per cent) have them in their right hemisphere.

PRIMARY CORTICES

When the senses first receive information from the environment, the information is sent to the thalamus, which then relays it to the *primary cortex* of the relevant lobe (refer to Figure 6.16). The primary cortex begins processing and interpreting incoming sensory information. For example, the **primary visual cortex** in the occipital lobe receives visual information from the eyes, the **primary auditory cortex** in the temporal lobe receives sound information from the ears, and the **somatosensory cortex** in the parietal lobe receives information from sense receptors in the skin.

The primary areas of the cortex take up approximately 25 per cent of the total cortex. They are responsible for the initial processing of information that is relayed to them by the thalamus after it is received from the sensory receptors.

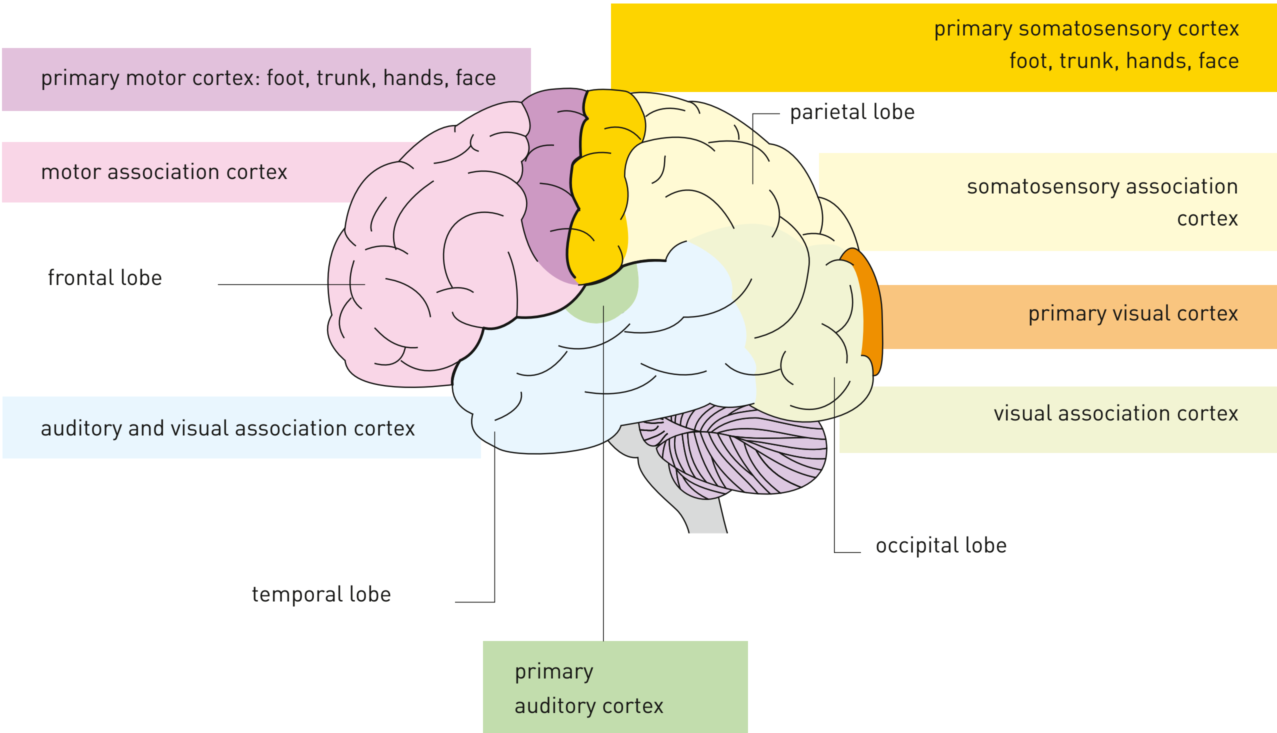


FIGURE 6.16 The location of primary cortices and association areas of the left hemisphere. Note the location of the primary cortices and association areas.

Roles of the lobes in cognitive processes

FRONTAL LOBES

The frontal lobes are the largest of the lobes and have several functions, including initiating movement of the body (motor functions), language, planning, judgement, problem solving, aspects of personality and emotions. The association area of the left frontal lobe (Broca's area) is also responsible for the production of speech. Much of the frontal lobe is the association area. This is the part of the frontal lobe responsible for cognitive processes such as attention, planning, and problem solving, as well as aspects of personality. Frontal lobes each include the **primary motor cortex** for each hemisphere.

People with damaged frontal lobes may be unable to learn from experiences; for example, if they attempt a problem-solving task they will be unable to evaluate which of their problem-solving strategies was most successful and will therefore have to go through the whole trial-and-error process of solving the problem each time they are confronted with it. This is known as 'perseverating' (as opposed to perseverance). People with frontal lobe damage also are likely to make mistakes in planning because they lack foresight.

Did you know?

Animals have a smaller cortical area than humans, relative to body size, and therefore do not have the same level of intellectual functioning. Try to imagine the cortex as a piece of fabric set out flat on a table, then scrunched up to fit inside a box. This is a bit like what happens to the cortex to be able to fit inside the human skull; spread out, the cortex covers an area the size of a 70-centimetre television screen.

The primary motor cortex is situated at the rear of each frontal lobe, adjacent to the central fissure. It is the part of the frontal lobe that is responsible for movement of the skeletal muscles of the body. It functions contralaterally, meaning that the left primary motor cortex is responsible for the movement of the right-hand side of the body, and vice versa. If the right primary motor cortex is damaged, a person will be unable to move parts of their body on the left side such as their left hand and leg; the reverse will happen if the left primary motor cortex is damaged. During brain surgery, very mild electrical stimulation can be applied to parts of the motor cortex and the patient might move the particular body part controlled by the section of the motor cortex that has been stimulated. Note that in Figure 6.17, the part of the primary motor cortex responsible for the movement of toes is located at the top, while the area responsible for movement of the mouth is located at the bottom.

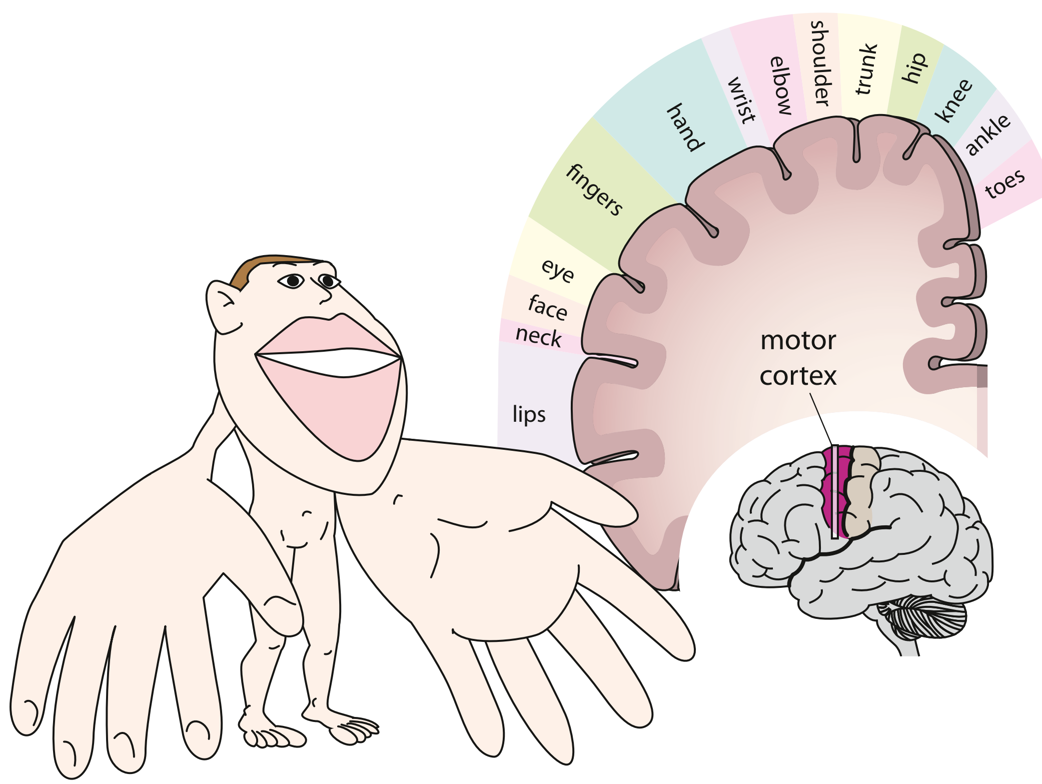


FIGURE 6.17 Homunculus of the primary motor cortex in the left frontal lobe. The primary motor cortex of the left frontal lobe is responsible for movement of the right-hand side of the body. Note that the amount of the cortex devoted to the different parts of the body is in proportion to the number of neurons required to move different anatomical parts. The mouth and hands require more motor neurons to move the many small muscles for fine motor activity, whereas other parts of the body require fewer neurons and therefore have less space on the primary motor cortex.

CASE STUDY

PHINEAS GAGE

Phineas Gage was a railway worker who, in 1848, was involved in a workplace accident that resulted in a metal rod being thrust through the top of his skull, behind his left eye socket and through his left cheekbone. Miraculously, he survived the accident and was able to speak and move because the motor cortex and Broca's area had not been affected. However, Gage was left with permanent brain damage to his prefrontal cortex. The brain damage resulted in personality changes; he went from being a calm and responsible man (prior to the accident), to one who was emotionally volatile, impulsive, irresponsible, incapable of making good judgments or carrying out planned behaviours. Gage's unfortunate accident, while tragic for him, gave researchers valuable information about the functions of the prefrontal cortex.

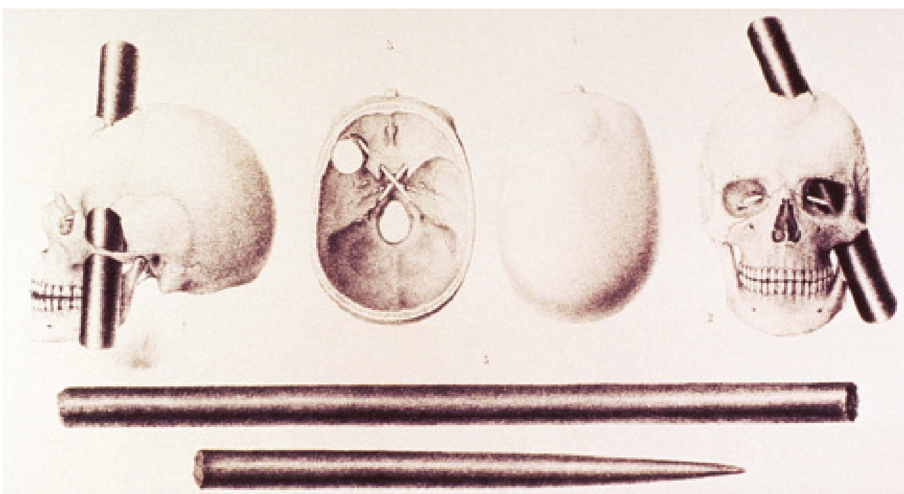


FIGURE 6.18 Phineas Gage was involved is a serious accident at work. A metal rod was thrust through his skull behind the eye socket, penetrating the prefrontal cortex of his frontal lobe.

PARIETAL LOBES

The main function of the parietal lobes is to enable a person to perceive their own body, and to perceive where things are located in their immediate environment. This information is sent to the parietal lobe mostly from the visual system. The right parietal lobe enables a person to perceive three-dimensional shapes and designs, necessary, for example, in drawing a picture of an object.

People with damage to their right parietal lobe might tend to draw only parts of a picture, rather than the whole (see neglect, in Chapter 8). The right parietal lobe helps a person to be aware of space around themselves and the location of objects in the environment.

The left parietal lobe has a role in reading, writing and performing mental arithmetic. A person with a damaged left parietal lobe would be unable to perform long multiplication mentally because they are unable to visualise the equation and mentally move the numbers around. If the person had a paper and pencil to perform this task, however, it would be possible for them to complete the arithmetic (Carlson et al. 2007). If the left parietal lobe is damaged, a person is unlikely to be able to point to their own body parts or remember where something is in a room.

Much of the parietal lobe is taken up by the **primary somatosensory cortex** (see Figure 6.16). It is situated at the front of each parietal lobe, adjacent to the central fissure. It is the part of the parietal lobe responsible for processing sensation such as touch, pressure, temperature and pain from the body. Like the primary motor cortex of the frontal lobe, it functions contralaterally – the left primary somatosensory cortex is responsible for processing sensation in the right-hand side of the body and vice versa. It receives the information from parts of the body via the thalamus.

If the right primary somatosensory cortex is damaged, a person will be unable to process sensation from parts of the body on the left side, and the relevant body part will be numb. The reverse will happen if the left primary somatosensory cortex is damaged. During brain surgery, very mild electrical stimulation can be applied to parts of the somatosensory cortex and the conscious patient may report feeling sensation in the body part related to the area of somatosensory cortex that has been stimulated. Like the primary motor cortex, the cortical area responsible for sensation on the toes is located at the top of the somatosensory cortex, and the area responsible for sensation in the mouth is located at the bottom (see Figure 6.20).

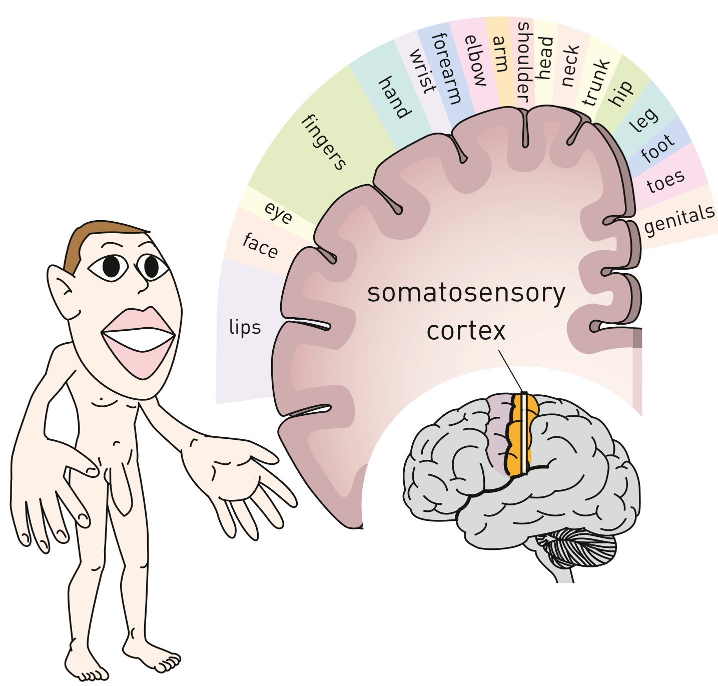


FIGURE 6.20 Homunculus of the primary somatosensory cortex in the left parietal lobe. The primary somatosensory cortex of the left parietal lobe is responsible for processing sensation from the right-hand side of the body. Note that the amount of the cortex devoted to the different parts of the body is in proportion to the number of neurons in different anatomical parts. The mouth and hands have many more sensory neurons, while the other parts of the body are less sensitive and therefore have less space on the primary somatosensory cortex.

INVESTIGATE 6.2

MAPPING THE BRAIN

Find out more about mapping the brain. Search online for 'Probe the brain' and have a go at probing the brain yourself! You will need Adobe Shockwave for the activity to run.

FIGURE 6.19 Insertion of an electrode during deep brain stimulation surgery on a patient with Parkinson's disease

TEMPORAL LOBES

The temporal lobe is mainly responsible for processing auditory information – sensations received in the ears. The **primary auditory cortex** is in the upper part of the temporal lobe (see Figure 6.15). The temporal lobe performs the complex auditory analysis that is necessary for understanding human speech or listening to music. Parts of the lobe are specialised in sensitivity to particular types of sounds. Patients whose temporal lobes are electrically stimulated are likely to report hearing sounds, even if there is no actual sound in the room for their ears to hear. People with a damaged right temporal lobe tend to be unable to recognise songs, faces or paintings. The association areas of the temporal lobes are also important for the processing of memory, and it should be noted that this part of the temporal lobe is directly connected with the hippocampus, which is vital for encoding information into long-term memory.

A person with a damaged primary auditory cortex is likely to experience forms of deafness. People with a damaged right auditory association cortex are unable to recognise the pattern of sounds that do not have words or to locate a sound in space, for example finding a ringing mobile phone in a room.

OCCIPITAL LOBES

The occipital lobes are entirely concerned with vision. Information from the left side of each retina is processed in the left occipital lobe and information from the right side of each retina is processed in the right occipital lobe. Information from the centre of the visual field and the centre of each retina is processed in both occipital lobes (see Figure 6.21).

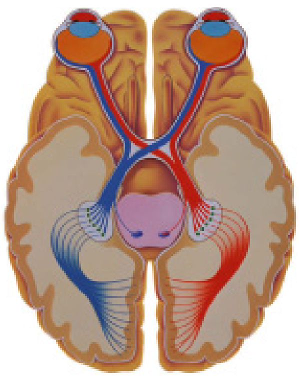


FIGURE 6.21 Visual pathways from the eyes to the brain. Note that some nerve fibres carry visual information ipsilaterally from each eye to the occipital lobe in the hemisphere which is on the same side of the eye, and other nerve fibres carry information contralaterally to the opposite occipital lobe in the opposite hemisphere.

Different parts of the **primary visual cortex** of the occipital lobe process different types of visual stimuli, and the association areas organise these into more complex forms to enable interpretation (perception).

A person who has a completely damaged primary visual cortex but no eye damage would not actually be blind but would be unable to process any visual stimuli that their eyes see. Therefore, it would be as though the person is blind. If just a part of an occipital lobe is damaged, the person would have a gap in their visual field where there would be some specific visual stimuli that would not be processed. When different parts of the visual cortex are electrically stimulated, the patient might report random patterns of light, just like those you see when you shut your eyes and rub your eyelids (Sternberg 1995).

ASSOCIATION AREAS OF THE CORTEX

In addition to the four lobes, the remaining part of the cortex includes the **association areas**. These are involved in the integration of the information between the motor and sensory areas and higher-order mental processes. This includes complex cognitive processing such as decision-making, thinking, planning, initiating movement, analysis, synthesis and language.

The neurons in the primary areas are typically quite specific in their function compared to neurons in the association areas. The association areas which are located closest to a primary cortex for a specific sense usually specialise in analysing and interpreting that particular sensory information (see Figure 6.15); however, association areas which are further from a primary cortex might be more involved in the integration of information from several senses and memories. Interestingly, when association areas of the brain are electrically stimulated, there is no clear, observable reaction by a patient, but damage to the association areas often causes difficulty speaking, thinking and behaving normally (Sternberg 1995).

The association area of the left frontal lobe includes **Broca's area**. It is responsible for the movement of the mouth muscles for articulation of the sequence of words for meaningful speech (see Figure 6.16). It also relies on other parts of the frontal lobe for planning sentences and the muscle movement necessary to produce meaningful speech (see Chapter 8 for information about Broca's aphasia). Broca's area is located near the primary motor cortex of the left frontal lobe, and also near **Wernicke's area** of the left temporal lobe. This close proximity of the language and motor areas enables these parts of the brain to communicate quickly with each other, enabling a person to engage in conversation and communication. People with damage to their left temporal lobe are likely to have difficulty in comprehending language. The left temporal lobe in most people contains **Wernicke's area**, which is responsible for interpreting the meaning of language. See Chapter 8 for information about Wernicke's aphasia.

If a person's *association cortex* of the occipital lobe is damaged, it is unlikely to cause blindness or a gap in the sight; however, the person is unlikely to be able to *recognise* things by sight. For example, when shown a picture of a dog, the person might say it has four legs, big teeth and fur but is unable to recognise it as a dog. When people with this type of damage are unable to recognise the faces of familiar people but can recognise them by the sound of their voice, they are said to have visual agnosia.

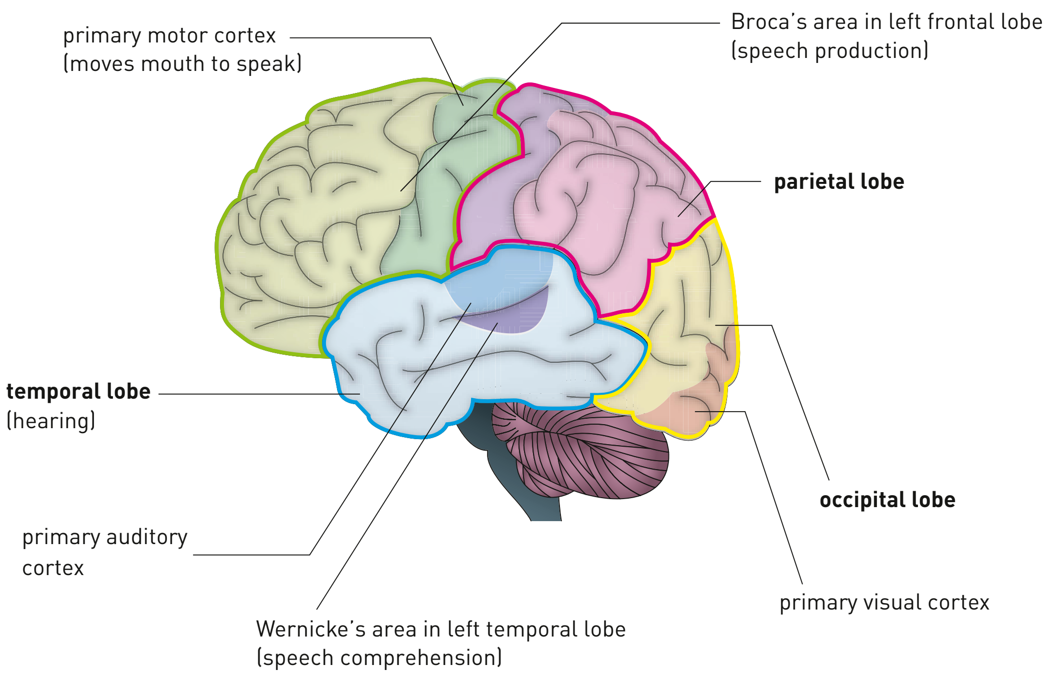


FIGURE 6.22 The four lobes, the sensory and motor areas and the areas responsible for speech. Human conversation is an example of how many parts of the cerebral cortex are integrated rather than operating as separate and isolated from each other.

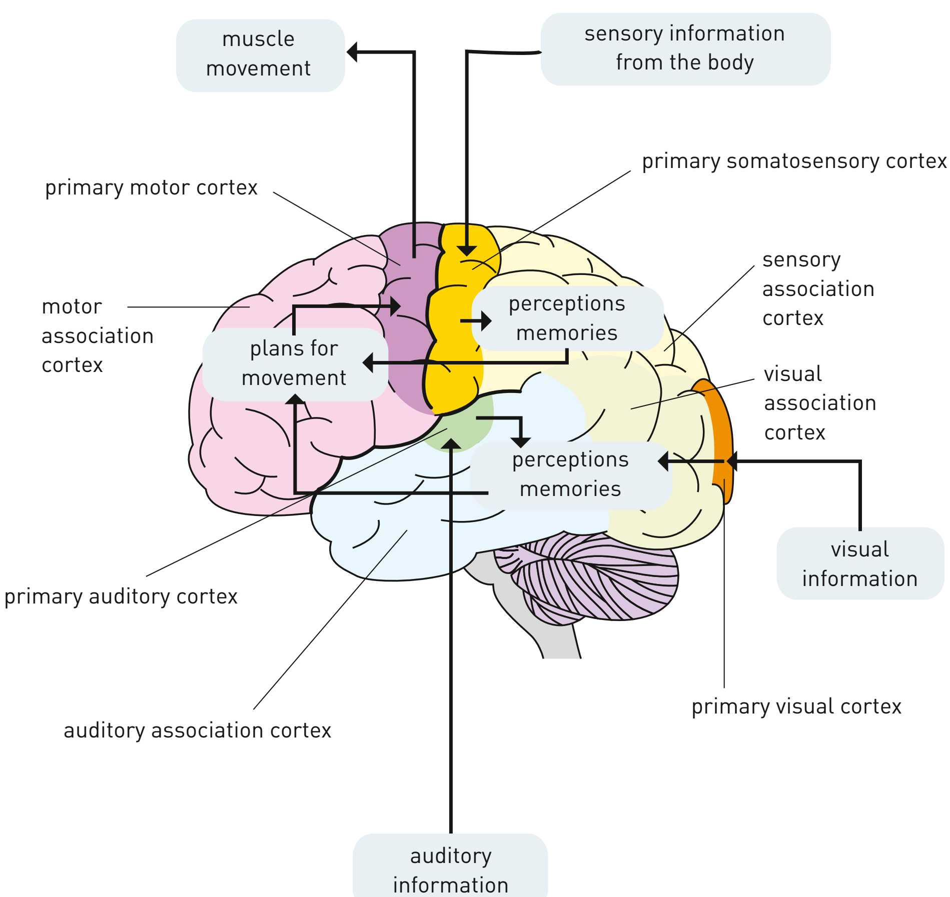


FIGURE 6.23 The association areas in action. Note the arrows indicating the communication between the association areas in the left hemisphere.

Hemispheric specialisation

As discussed previously, the lobes and the primary cortices in each hemisphere receive information from the opposite side of a person's (or animal's) body, and the primary motor cortices are responsible for movement of the opposite sides of the body. The primary motor cortex in the right parietal lobe initiates the movement of the left hand to pick up the mug of coffee; the somatosensory cortex of the *right* parietal lobe receives information about the feel of a warm mug of coffee in our *left* hand. The term for describing this organisation is 'contralateral' (meaning opposite side).

As also discussed above, the left and right hemispheres of the cerebral cortex are symmetrical in appearance and in many, but not all, functions. Therefore, although most functions are contralateralised, some are 'lateralised', meaning that some neural activities only take place in one particular hemisphere. A clear example of lateralisation is language, which is mainly the responsibility of the left hemisphere (for most people).

Although the hemispheres have particular specialisation, it is important to remember that they rarely work in complete isolation. Instead, it is better to think of them as working to complement each other in their functions. They are able to communicate with each other and work together through the corpus callosum that connects the two. Chapter 8 explores the consequences for people who have been born with damage to (or even without) the corpus callosum and people who have needed to have surgery to cut their corpus callosum. Try to imagine the possible consequences for a person whose hemispheres are unable to communicate with each other.

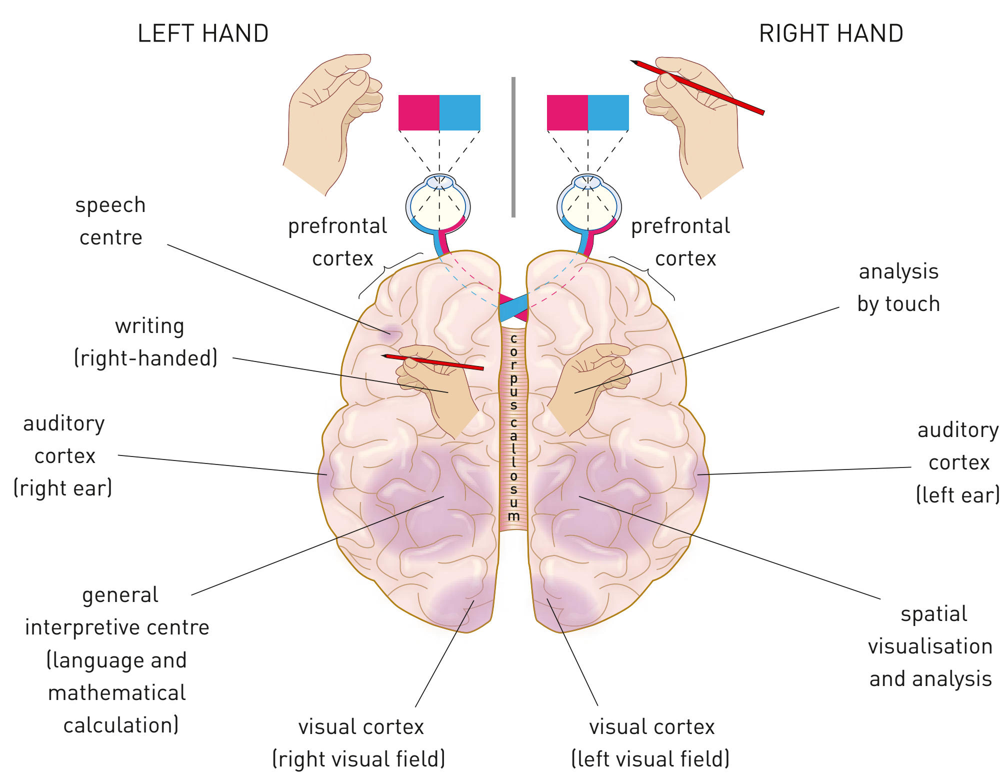


FIGURE 6.24 Areas of the hemisheric specialisation

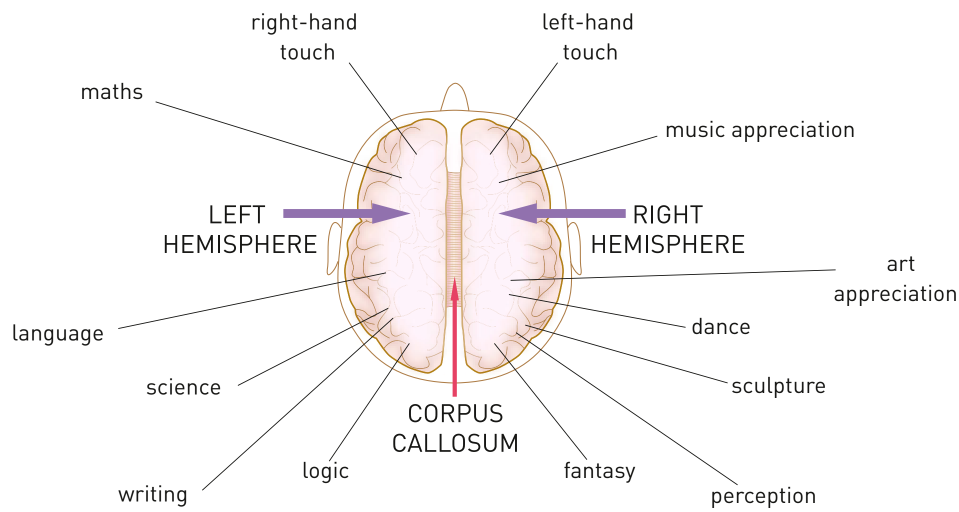


FIGURE 6.25 Lateralisation of cognitive functions of the cerebral hemispheres

6.3 REVIEW

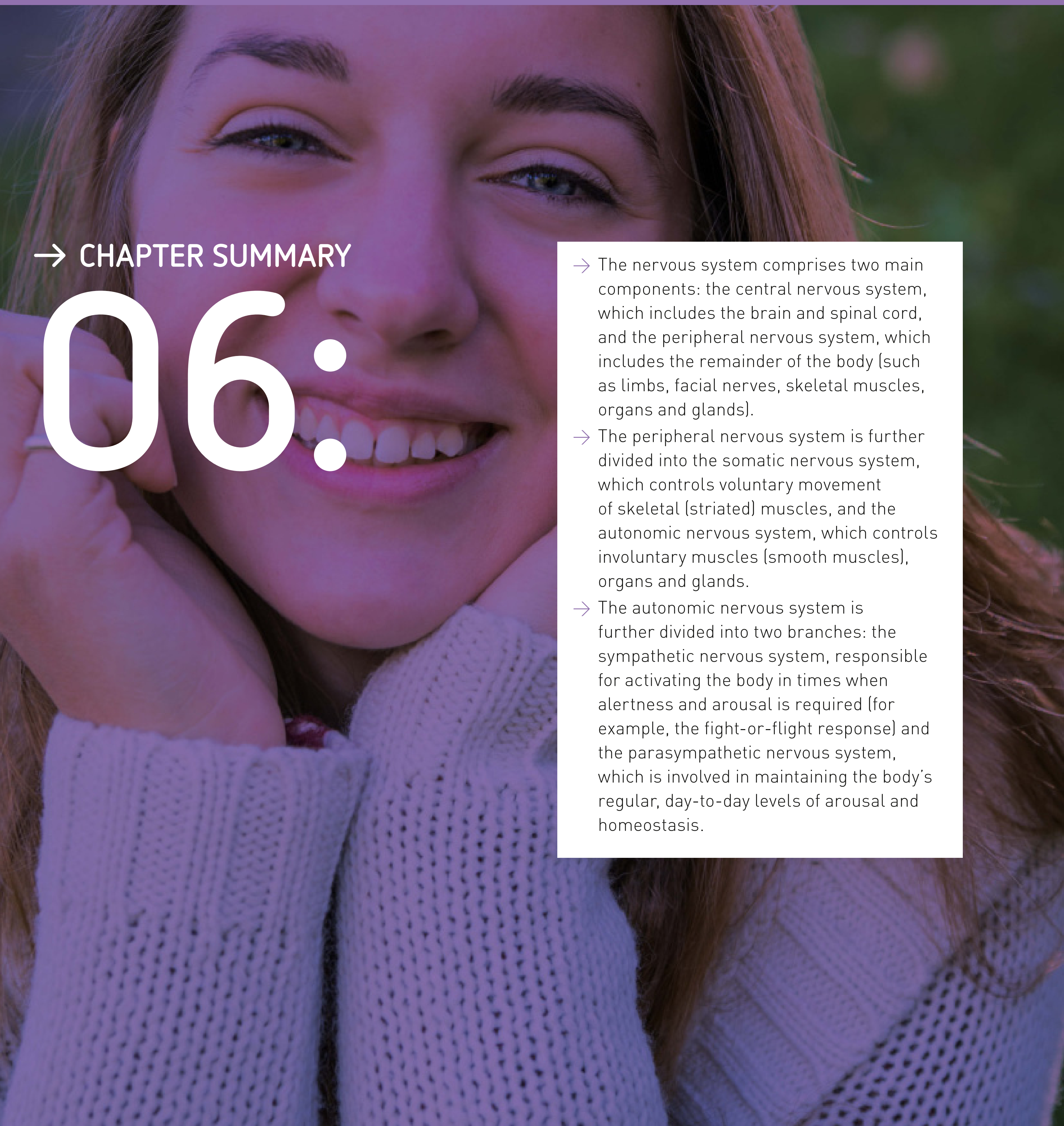
1 Complete the following summary tables:

a

FUNCTIONS OF THE CEREBRAL CORTEX	LEFT HEMISPHERE	RIGHT HEMISPHERE
FRONTAL LOBE		
Main		
Primary cortex		
Association area		
________________ LOBE		
Main		
Primary cortex		
Association area		
________________ LOBE		
Main		
Primary cortex		
Association area		
________________ LOBE		
Main		
Primary cortex		
Association area		

b

FUNCTION	RIGHT HEMISPHERE	LEFT HEMISPHERE
Cognitive		
Behavioural		



→ CHAPTER SUMMARY

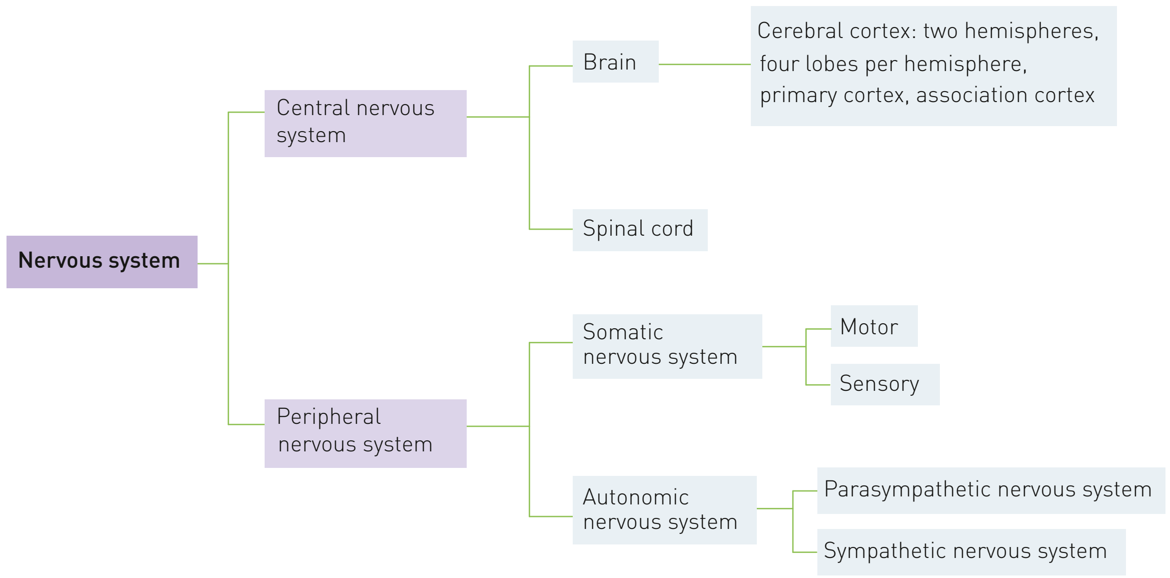
06:

- The nervous system comprises two main components: the central nervous system, which includes the brain and spinal cord, and the peripheral nervous system, which includes the remainder of the body (such as limbs, facial nerves, skeletal muscles, organs and glands).
- The peripheral nervous system is further divided into the somatic nervous system, which controls voluntary movement of skeletal (striated) muscles, and the autonomic nervous system, which controls involuntary muscles (smooth muscles), organs and glands.
- The autonomic nervous system is further divided into two branches: the sympathetic nervous system, responsible for activating the body in times when alertness and arousal is required (for example, the fight-or-flight response) and the parasympathetic nervous system, which is involved in maintaining the body's regular, day-to-day levels of arousal and homeostasis.

- The brain comprises the hindbrain, midbrain and forebrain. The forebrain includes the cerebral cortex.
- The cerebral cortex is the 3-millimetre-thick outer covering of the cerebrum. It is highly convoluted and covers the interior of the cerebrum. It is the centre of human capacity to think, solve problems, plan, and communicate using formal language. It comprises two hemispheres, each of which has primary cortices, association areas and four lobes. Primary cortices process raw sensory information, and association areas process and integrate more complex information from the primary cortices.
- The frontal lobe in each hemisphere is responsible for higher-thinking processes and planning. It includes the primary motor cortex, which is responsible for body movement.
- The left frontal lobe contains Broca's area, which is responsible for speech production. The parietal lobes are responsible for processing touch and sensation, and locating the body in space. They also include the somatosensory cortex. The temporal lobes are responsible for auditory processing and the left lobe contains Wernicke's area (for comprehension of speech). The occipital lobes are responsible for processing visual information.
- The left and right hemispheres of the brain are connected by the corpus callosum. In general, each hemisphere is responsible for contralateral (opposite) sides of the body, but the hemispheres are also specialised to perform particular functions. In most people, the left hemisphere seems to control language, and the right hemisphere controls types of spatial and visual processing.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the examination, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

association areas
autonomic nervous system
central nervous system
cerebral cortex
cerebral hemispheres
corpus callosum
frontal lobe
occipital lobe
parasympathetic nervous system
parietal lobe
peripheral nervous system
primary auditory cortex
primary motor cortex
primary somatosensory cortex
primary visual cortex
somatic nervous system
sympathetic nervous system
temporal lobe

KEY KNOWLEDGE

For the examination, you must be able to show your understanding and apply your knowledge of the relationship between the brain and behaviour, and describe the contribution of selected studies and brain research methods to the investigation of brain function. You must be able to demonstrate an understanding of the interaction between cognitive processes of the brain and its structure, including:

→ central and peripheral nervous systems
→ cerebral cortex, including lobes, association areas and primary cortices
→ specialisation of hemispheres of the cerebral cortex

RESEARCH METHODS

For the examination, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 The central nervous system consists of which two parts?
   - a the brain and spinal column
   - b the autonomic and somatic nervous systems
   - c the brain and spinal cord
   - d the cerebral cortex and the spinal cord

2 The peripheral nervous system consists of which two parts?
   - a the brain and spinal cord
   - b the automatic and somatic nervous systems
   - c the sympathetic and parasympathetic nervous systems
   - d the somatic and autonomic nervous systems

3 Moving your leg is an action that is made by which system?
   - a somatic nervous system
   - b autonomic nervous system
   - c sympathetic nervous system
   - d parasympathetic nervous system

4 Motor neurons enable us to:
   - a feel the silky coat of a puppy.
   - b smell the scent of a flower.
   - c play the piano.
   - d see a ball when it is thrown.

5 Sensory neurons in your toes are part of which nervous system?
   - a central
   - b peripheral
   - c autonomic
   - d sensory

6 Which of the following is a true statement about the parasympathetic nervous system?
   - a In normal daily life it has nothing to do; it is used to return the body functions to their normal levels after sympathetic arousal.
   - b In normal daily life it works all the time to ensure that the body's metabolic systems are in balance.
   - c It operates at a level of conscious awareness.
   - d It is part of the somatic nervous system that operates on the body.

Questions 7 and 8 relate to the following information:

Henry was on a hike when he saw a tiger snake. He quickly picked it up with a stick and tried to hit it. His friend Tom, who also saw the snake, quickly ran away to a safer place on the track.

7 Which division of the nervous system was most likely in control of their reactions to the snake?
   - a parasympathetic
   - b sympathetic
   - c somatic
   - d limbic

8 Henry and Tom were demonstrating the:
   - a reticular activating system.
   - b fight-or-flight response.
   - c reflex response.
   - d sympathetic arousal response.

9 The cerebral cortex of the human brain is a much-folded layer covering the cerebrum. What is the advantage of this folding?
  a it allows a greater volume and thus number of brain-cells to be contained within the human skull
  b it allows greater blood flow to the cortex and therefore more oxygen can be available.
  c it allows greater blood flow to the cortex and therefore more blood sugar can be available.
  d all the above answers are correct.

10 Which of the following statements about hemispheric specialisation is true?
  a The right hemisphere controls all the language functions in all humans.
  b The left hemisphere controls all spatial interpretation in all humans.
  c Most functions are performed by the left and right hemispheres working together: the left hemisphere dominates in logical, sequential thought and the right hemisphere dominates in intuitive and creative processing.
  d Most functions are performed by the left and right hemispheres working together: the left hemisphere dominates in artistic appreciation and the right hemisphere dominates in mathematical processing such as algebra.

11 The left cerebral hemisphere generally controls the right side of the body and vice versa. This is ____________ organisation.
  a unilateral
  b contralateral
  c ipsilateral
  d bilateral

12 If your temporal lobes were electrically stimulated, you would probably:
  a hear sounds.
  b see visual stimuli.
  c feel sensations in your skin.
  d move parts of your body.

13 How does the left hemisphere process information?
  a analytically
  b visuospatially
  c globally
  d independently

14 Damage to the ____________ can result in deficits in the ability to plan, problem solve, and make sound judgments.
  a temporal lobe
  b occipital lobe
  c thalamus
  d association area

SHORT ANSWER

15 In the peripheral nervous system, the ____________ nervous system involves voluntary activity whereas the ____________ nervous system is involuntary.

2 marks

16 Complete the following table:

	STRUCTURE	FUNCTION
Cerebral cortex		
Corpus callosum		
Primary cortices		
Association areas		

16 marks

17 A patient has a head injury that resulted in an inability to move his left hand. Which part of his brain is most likely to have been damaged?

1 mark

18 Complete the table below to show the functions of the lobes indicated (for the majority of people).

LOBE OF THE BRAIN	SENSORY/MOTOR CORTEX	ASSOCIATION CORTEX
Left temporal		
Right frontal		

4 marks

19a i Which parts of the head and body have the greatest area of the primary somatosensory cortex devoted to them?

2 marks

ii Explain why this distribution occurs.

2 marks

b i Which parts of the head and body have the greatest area of the primary motor cortex devoted to them?

2 marks

ii Explain why this distribution occurs.

2 marks

→ CHAPTER 07:

STUDIES OF COGNITIVE PROCESSES

We can gain fascinating insights into the way our brain works from looking at cases where the brain is not working in a typical way. Abnormalities may result from brain injury, invasive surgery or unusual neural connections. All these situations affect cognitive processes, some of which typically occur without conscious awareness. All these situations offer insight into the way the brain works and give us understanding of our conscious experience.

KEY KNOWLEDGE

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.

(VCE Study Design 2013)

Conscious and cognitive processes

CHAPTER OVERVIEW

Studies of aphasia	What is aphasia? Broca's aphasia Wernicke's aphasia Comparison between Broca's and Wernicke's aphasia Contribution of aphasia studies
Spatial neglect	Contribution of spatial neglect studies
Split-brain studies	Contribution of split-brain studies

In this chapter, we look at the fundamental question 'What is it like to be you?' How does your conscious experience differ from other people's? While it is impossible to fully appreciate and understand other people's conscious experience, we can gain some insights by studying unusual or unexpected cognitive thoughts and perceptions.

Cognition refers to our knowledge and the beliefs, thoughts and ideas that we have about ourselves and our environment. **Cognitive processes** include those mental processes involved in acquiring, retaining and using knowledge. Therefore, a major aspect of cognition involves attention, perception, memory, language and learning, and these are clearly associated with our conscious experience. For instance, a person may hear some music in a shop (perception) and remember a friend who enjoys this song (memory), while another person may fail to notice (attend to) the music in the first place.

Investigating how the damaged brain works can help researchers find out how the normal, undamaged brain functions. In this chapter, we will consider the effects on cognition and consciousness for people who suffer from particular types of language difficulties (Broca's and Wernicke's aphasia) and attention difficulties (spatial neglect) as a result of brain damage. In addition, we will look at the implications for patients who have had to undergo a rare type of brain surgery in order to treat severe epilepsy – the split-brain operation.

As you read through the case studies outlined in this chapter, think about the implications for the understanding of consciousness. What is it like to be these people?

Studies of aphasia

Take a moment to think about how you have communicated with others today. Then consider how important it is for you to communicate with others.

An important cognitive function is the use of language. Language involves far more than just being able to speak. It allows us to communicate via written, spoken and non-verbal means. It is central to our conscious experience and our well-being. Being able to communicate with others aids survival and social relationships. We feel connected to others in our society through conversations, reading and understanding body language. We need to learn these skills although they seem dependent on specific areas in the brain. Damage to these specific areas in the brain can impede some or all of these functions. Can you imagine being deprived of the ability to communicate?

Most of the early understanding of how different structures of the brain are involved with language came from studies of individuals with brain damage. Modern brain-scanning techniques on healthy brains are currently providing new insights into the function of areas of the brain that are used for language.

What is aphasia?

Are writing, reading and speaking all controlled by the same area of the brain? To answer this, consider the following puzzling cases:

- Isabel can speak fluently but cannot read, despite having excellent vision.
- Peter can comprehend what he reads but cannot speak fluently.
- Therese can write but cannot read.
- Shirley can read but cannot write.
- Roger can sing but has difficulty speaking.

From these examples, you have probably concluded that there are several areas of the brain involved in the use of language. These areas are generally found in the left hemisphere and intricate coordination of these areas allows us to communicate effectively.

Aphasia (pronounced *a-FAZE-yuh*) is the impairment of language caused by damage to the brain (usually by stroke). The Australian Aphasia Association estimates that about 80 000 Australians have aphasia as a result of stroke (2010). Aphasia can affect talking, reading, writing and understanding others but it does not affect intelligence. It is also likely that a person with aphasia can experience problems with relationships and self-identity.

INVESTIGATE 7.1

PERSONAL STORIES

Go online to find out more about aphasia on the websites for the Australian Aphasia Association and the National Aphasia Association of the United States.

1 Read at least one personal story about aphasia. What does this story reveal to you about people's experience with aphasia?

2 Write down at least three facts about aphasia.

3 What are the common misconceptions about aphasia?

There are several types of aphasia, with the two most commonly discussed types being **Broca's aphasia** and **Wernicke's** (pronounced *VARE-nek-ees*) **aphasia.** These two types of aphasia impair language differently. Broca's aphasia is caused by damage to an area in the left frontal lobe, while Wernicke's aphasia is caused by damage to an area in the left temporal lobe.

Broca's aphasia

In 1861, Paul Broca, a young surgeon, was working in a hospital at Bicêtre in Paris, when a patient was transferred from the insane asylum to the surgical ward because of gangrene in his right leg. This patient had great difficulty speaking and was only able to make a few sounds, the most common being one that sounded like 'tan'. In fact, 'tan, tan' was his answer to most questions and led to the hospital staff nicknaming him Tan. Tan was able to communicate by gestures but occasionally would angrily blurt out the phase 'Sacré nom de Dieu!' ('Holy name of God!') in extreme frustration.

FIGURE 7.1 Pierre-Paul Broca (1824–1880), French physician

Broca was fascinated with his new patient. Tan was 51 years old and had been in hospital for 21 years following a head injury in which he lost the ability to speak. Apart from Tan's lack of speaking ability, he was otherwise intellectually normal. In addition, he was developing paralysis in his right arm and right leg.

Tan died just six days after becoming Broca's patient. Broca performed an autopsy on him and found significant damage to Tan's left hemisphere. The lesion (tissue damage) was centred in Tan's left frontal lobe near the motor cortex region that controls the muscles used in speech.

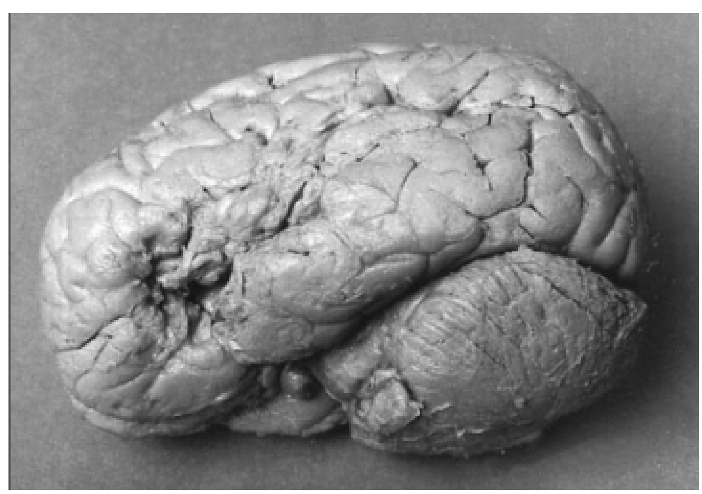


FIGURE 7.2 Tan's brain is on display at the Museum de l'Homme et Musée Dupuytren in Paris.

Broca pinpointed this specific location of the brain as being responsible for the function of speech production – an area of the brain now known as 'Broca's area'. Broca's case study led to an important breakthrough. While such case studies lack control (refer to Chapter 1 for limitations with case studies), Broca was able to study Tan's case in detail because he had been a patient for such a long time.

Broca went on to study another eight patients with similar language difficulties (people unable to speak fluently but able to comprehend language) and found similar brain damage. This specific deficit in the brain destroyed speech in an otherwise normal healthy person. Broca provided the first compelling clinical evidence that clearly connected a specific behaviour to a specific brain area, an example of **location of function** (linking a location of the brain with a specific function).

Broca's aphasia is a result of damage to Broca's area (located in left frontal lobe) and, often, surrounding areas, and is referred to as **expressive aphasia**. A person with Broca's aphasia has difficulty expressing themselves in words or sentences but their ability to comprehend speech is largely unaffected. Typically, little speech is produced and what is produced tends to be slow; words are generated with considerable effort and are poorly articulated, and short words are often left out.

'Here … head … operation … here … speech … none … talk … what … illness' is an example of slow, laboured and fragmented speech by a person with a less severe case of Broca's aphasia than Tan (Luria 1966).

Did you know?

A deaf person with Broca's aphasia experiences difficulty using sign language.

Broca's aphasia has the following characteristics:

- speech is non-fluent. Typically, there are pauses between words, especially those that are not well-rehearsed. As a result, speech tends to be broken, with some people managing only a couple of words at a time. Speech involves great effort and is laboured
- partial or complete loss of the ability to recall names (**anomia**). The person may have trouble finding and naming the right words
- articulation difficulties and words may be mispronounced
- speech lacks grammar (**agrammatism**). Speech does not follow the grammatical rules – it lacks syntax. Speech tends to contain nouns (naming words) and verbs (action words) but lacks other words that give grammar or function. For example 'Drive car' is spoken instead of 'I want to drive the new car' and 'Send money' instead of 'Can you please send me some money?' Speech is severely limited but not necessarily to just one word – Tan's case was especially extreme. Depending on the severity of the damage, the meaning of the speech can often still be grasped despite sentences being grammatically incorrect. This is similar to the telegraphic speech used by the average child at 24 months of age – it sounds like basic information given in a telegram (for example 'give toy')
- difficulty with writing
- there may be mild comprehension difficulties. People with Broca's aphasia can usually comprehend spoken and written language. Occasionally, comprehension is impaired and, in these cases, it is usually in relation to complex sentences that depend on grammatical words. For example, the question 'Is it cold in winter?' is understood but 'Richmond was beaten by Geelong' can present difficulties as only the words 'Richmond', 'beat' and 'Geelong' may be recognised and interpreted as 'Richmond beat Geelong'.

Did you know?

'No ifs, ands, or buts' is the hardest phrase for a Broca's aphasic to pronounce.

Norman Geschwind, pioneering behavioural neurologist

Paul Broca thought that damage to Broca's area impaired motor instructions for vocalising words. However, some people with Broca's aphasia can still speak well-rehearsed phrases, recite poems, sing, and even curse and swear with relative ease. These phrases are typically spontaneous (they just 'pop' out of our mouths) or well-memorised (singers often sing in languages they do not understand) and require little, if any, conscious effort. Therefore, the ability to vocalise is not lost but the ability to translate information into speech patterns and express meaning is compromised.

There is some hope for people with Broca's aphasia. Within the first 12 months after the brain trauma, a few people may get back some words or even recover spontaneously. Until recently, recovery was seen as extremely unlikely when there is no improvement during the first year following the damage; however, a recent study on patients with long-term Broca's aphasia found some improvement after therapy that focused on relearning the rules (syntax) of language (Pulvermüller 2005). Despite irreversible damage to Broca's area, there was improvement in these participants' ability to communicate using language because different areas of the brain took over the task of communicating language. This shows that function can develop in a different region of the brain following injury and is known as **plasticity** of the brain, a concept discussed in more detail in Chapter 14.

Did you know?

Dance is a language of gestures. The area that corresponds to Broca's area in the right frontal lobe is involved in dancing.

WHAT WOULD IT BE LIKE TO BE TAN?

INVESTIGATE 7.2

Take a moment to imagine that you are unable to speak properly but can fully comprehend what others are saying.

What implications do you think this would have for your conscious experience? How would you think, feel and behave? How would others behave towards you?

Think about Tan's experience during his 21 years in a mental hospital. How did his brain injury affect his speech? How do you think this affected his conscious experience?

Wernicke's aphasia

At the time, Broca's findings received some criticism because the idea of a single area of the brain being responsible for certain behaviours (location of function) had not been accepted. However, further support for Broca came just 12 years later; in 1873, a German physician named Carl Wernicke examined a patient with a different language difficulty that he attributed to damage in a different region of the brain – the area now known as Wernicke's area.

Wernicke's aphasia results from damage to Wernicke's area, located in the left temporal lobe near the parietal lobe boundary. A person with **Wernicke's aphasia** has difficulty understanding written and spoken language *and* in producing written and spoken language that makes sense to others. It is often referred to as **receptive aphasia**, a misleading term because the difficulty is not just limited to understanding language. Speech is fluent but does not make sense. The words are articulated and flow one after another but combinations of words are nonsensical. Unlike Broca's aphasia, people with Wernicke's aphasia talk freely and rapidly but, while they utter many words, they say very little that makes sense. They are tragically cut off by language – what they hear is gibberish to them and what they say sounds like gibberish.

The following example is taken from a conversation between Howard Gardner, a well-known cognitive psychologist, and a patient with Wernicke's aphasia.

'What kind of work have you done, Mr Johnson?' I asked.

'We, the kids, all of us, and I were working for a long time in the … you know … it's the kind of space, I mean place, rear to the spedwan …'

At this point, I interjected, 'Excuse me, but I wanted to know what work you have been doing.'

'If you had said that, we had said that, poomerm near the fortunate, forpunate, tamppoo, all around the fourth of martz. Oh, I get all confused,' he replied, looking somewhat puzzled that the stream of language did not appear to satisfy me. (Gardner 1978)

Wernicke's aphasia has the following characteristics:

- speech is fluent. To a casual listener, someone who is not listening for understanding, the speech flows quite normally
- there is partial or complete loss of the ability to recall names (anomia). The person may have trouble finding and using the right words
- nonsense words are used. While sentences may seem grammatical, the person may use meaningless words and nonsense syllables, or mispronounce words
- difficulty understanding both written and spoken language
- difficulty producing both written and spoken language that makes sense to others.

Comparison between Broca's and Wernicke's aphasia

The typical patterns that characterise Broca's and Wernicke's aphasia are outlined in Table 7.1.

People with Wernicke's aphasia often seem blissfully unaware that what they say does not make sense or that they have not correctly understood what others are saying (Garrett 2009). It is possible for them to read body language though – many can identify a grimace, understand posture and identify false tones of voice (Sacks 1985). As seen in the conversation reported by Gardner above, they may grasp the fact that they are not being understood.

People who have recovered from Broca's aphasia report that they were able to understand and reason as they could before the brain damage but they were simply unable to express themselves. It must be enormously frustrating and demoralising to know what you want to say but not be able to say it. Overall, those with Broca's aphasia tend to be more frustrated and unhappier than those with Wernicke's aphasia.

TABLE 7.1 Comparison between Broca's and Wernicke's aphasia

	BROCA'S APHASIA	WERNICKE'S APHASIA
Location of brain damage	Left frontal lobe near motor cortex	Left temporal lobe near parietal cortex
Language difficulties	Difficultly expressing themselves in words or sentences but their ability to understand written and spoken language is largely unaffected	Difficulty understanding written and spoken language and producing written and spoken language that makes sense to others
Fluency of speech	Non-fluent, slow, deliberate and effortful	Very fluent but makes no sense
Ability to find and use correct names for words	Moderate to severe difficulty	Mild to severe difficulty
Repetition of words	Moderate to severe	Mild to moderate

Contribution of aphasia studies

The ability to communicate through language is a complex cognitive function. For the majority of us, hearing, reading and speaking words is a smooth and effortless process most of the time and happens largely outside our conscious awareness. At times, when language is tricky and complex, we need to think consciously about it.

Case studies, such as those of people with aphasia, show us that language can be compromised in different ways depending on which area of the brain has been damaged and the severity of this damage. People with Broca's aphasia are usually conscious of their impairment while those with Wernicke's aphasia often seem blissfully unaware of their difficulties in communicating with others.

FIGURE 7.3 People with Wernicke's aphasia seem blissfully unaware that what they say does not make sense or that they have not understood what others are saying.

Aphasia case studies reveal that language and speech functions are primarily performed in the left hemisphere of the brain. Recovery from aphasia caused by brain trauma or surgery offers insights into the way the brain compensates for this damage. Other parts of the brain, usually in nearby areas but even areas in the right hemisphere, have been known to take over these language functions (Guerreiro, Castro-Caldas & Martins 1995).

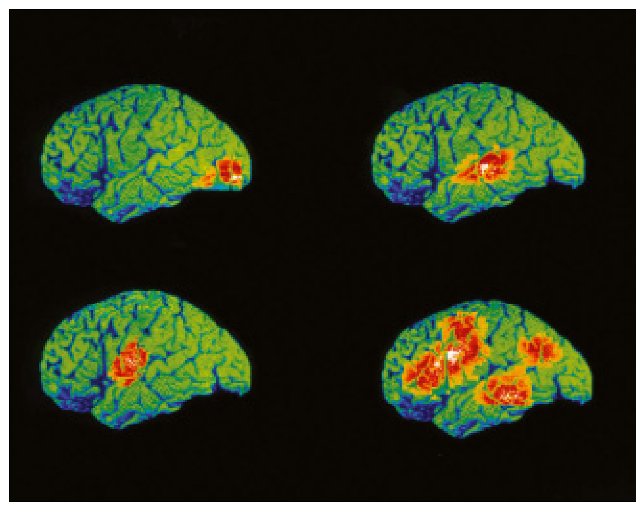


FIGURE 7.4 PET scan showing the seeing, hearing, thinking and speaking areas of the brain

Brain scans, such as PET or SPECT scans, can detect activity of different areas of the brain involved in hearing, seeing or speaking words. Specialised brain areas are involved and highly specialised neural pathways, sometimes nicknamed superhighways, allow communication between these brain areas; these complex processes allow language use.

The experience and severity of aphasia varies considerably between people. Generalising the findings of case studies has its limitations.

- Firstly, our brains are unique and the precise location of Broca's and Wernicke's area varies (sometimes considerably) between people.
- Secondly, brain scans reveal that many areas of the brain are associated with language use and this pattern of brain activation changes depending on the person and how language is being used at any given the moment (Demonet, Wise & Frackowiak 1993).
- Thirdly, aphasia results from brain damage, usually due to a stroke. The extent of brain damage varies between people, and often is widespread and affects several areas of the brain. Therefore, the extent of the effects on language will be different in different people.

REVIEW 7.1

1. Are the following statements true or false?
   - Aphasia is caused by brain damage, such as a stroke.
   - Aphasia lowers intelligence.
   - The severity of aphasia can vary between people.
   - People with aphasia rarely, if ever, show any signs of recovery.
   - There are different types of aphasia, including Broca's aphasia and Wernicke's aphasia.
2. Decide whether each of the following statements relates to Broca's aphasia, Wernicke's aphasia, both or neither.
   - Caused by damage to a specific area usually in the left frontal lobe.
   - Caused by damage to a specific area usually in the left temporal lobe.
   - Speech is slow, laboured and fragmented.
   - Speech tends to contain nouns and verbs only.
   - Speech is fluent.
   - Speech is non-fluent
   - A person's ability to write is impaired.
   - A person's ability to read is impaired.
   - Able to talk freely and rapidly but what is said makes little sense.
   - Likely to be able to read body language.
   - Can understand spoken language.
   - Cannot understand spoken language.
   - Unable to express themselves using body language.
   - More likely to be consciously aware of their language difficulties.
   - More likely to be unaware of their language difficulties.
3. Why is Broca's aphasia sometimes called expressive aphasia?
4. Wernicke's aphasia is sometimes referred to as receptive aphasia. Why is this term misleading?
5. Tan, the subject of Broca's famous case study, was known to curse at times of frustration. He was able to do this with relative ease despite being unable to say anything else but 'tan'. What does blurting out a curse with relative ease suggest about Broca's aphasia, in terms of the ability to vocalise sounds?

Spatial neglect

Imagine getting ready to go out and only brushing the hair on one side of your head or arriving at school wearing only one shoe.

Acquired brain damage, caused by stroke or injury, has been known to disrupt the way a person attends to the world. In some situations, a person may systematically ignore certain aspects of their world. Well-respected psychiatrist Oliver Sacks has written extensively about some of his most intriguing patients, always with the utmost respect. The following extract is about Mrs S, an intelligent woman in her sixties who had suffered a massive stroke that affected her right hemisphere.

She sometimes complains to her nurses that they have not put dessert or coffee on her tray. When they say, 'But Mrs S, it is right there, on the left,' she seems to not to understand what they say, and does not look to the left. If her head is gently turned, so that the dessert comes into sight, in the preserved right half of her visual field, she says, 'Oh, there it is – it wasn't there before.' She has totally lost the idea of 'left', both with regard to her world and her own body. Sometimes she complains that her portions are too small, but this is because she only eats from the right half of the plate – it does not occur to her that it has a left side as well. Sometimes, she will put on lipstick, and make up the right half of her face, leaving the left half completely neglected: it is almost impossible to treat these things, because her attention cannot be drawn to them and she has no conception that they are wrong. She knows it intellectually, and can understand, and laugh: but it is impossible for her to know it directly (Sacks 1985).

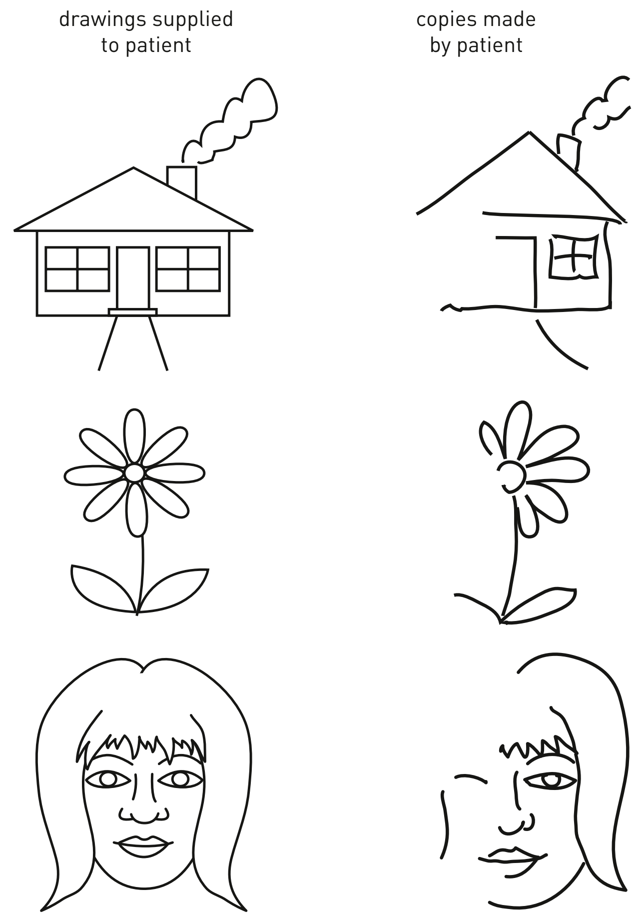


FIGURE 7.5 Drawings copied by a spatial neglect patient.

Mrs S's problem is a striking case of **spatial neglect**. Spatial neglect, also known as neglect syndrome, is a disorder in which the person affected systematically ignores stimuli on one side of their body. There is usually spatial neglect after brain injury. In most cases, there is damage in the posterior region of their right parietal lobe and results in the person ignoring stimuli on their left side. Spatial neglect mainly relates to visual stimuli. They are 'blind' but this is no ordinary blindness because the eyes function normally. Curiously, most sufferers are blissfully unaware that they have a deficit (a condition known as **anosognosia**). Others may know they have this problem, as did Mrs S, but seem unconcerned about it (a condition known as **anosodiaphoria**).

A person with spatial neglect might read compound words such as 'baseball' or 'toothpick' as 'ball' and 'pick'. They might draw only the right side of a picture and fail to notice people walking up to them to their left. When dressing, shaving or applying makeup, they might fail to dress the left side of their body: they ignore the left shirt sleeve and the left pants leg, or shave or make up the right side of the face only (Kolb & Whishaw 1996). Interestingly, this deficit is not just limited to stimuli in their surrounding environment. When asked to describe a memory, only the right side of a familiar scene is recalled. If this is a street, for instance, they may only describe houses on one side. If they are asked to imagine walking the other way down the street, they can usually recall the other side!

TOOTHPICK
FOOTBALL
LANDMARK
PAPERCLIP
FINGERTIP
PLAYGROUND

FIGURE 7.6 How would someone with spatial neglect read this list of compound words?

Mrs S's intelligence remained intact and she developed some strategies to partially overcome her problem. She requested a rotating wheelchair and would often swivel the chair to the right, often almost completing a whole circle, until the view she had missed came into sight. You might ask why she doesn't simply turn slightly to her left. Although Mrs S has been told that the left exists and, intellectually, understands that this must be so, instinctively to her the left doesn't exist – just as she is unable to view things on her left, she cannot turn to the left.

INVESTIGATE 7.3

BLIND SPOT – A TOUCH OF NEGLECT!

Why does a spatial neglect patient continue to ignore stimuli on one side of their body after being told it exists? One way to help us understand is to consider our blind spot. Each eye has a blind spot that corresponds with the area of the retina where the optic nerve leaves the eye. When a visual image falls on this blind spot, it is not detected because there are no photoreceptors in this area. We are not consciously aware of our blind spot. We live under the impression that our visual field is complete, not one that has a 'blank area' in it.

Find your blind spot

1 Cover your left eye and hold this book at arm's length.
2 Focus on the plus sign and slowly move the textbook towards you. (Maintain your focus on the plus sign).
3 At some point, the black circle will disappear from view. Its image has fallen on your blind spot. Move the textbook closer and the black circle will reappear.

Discuss

1 In terms of conscious awareness, what are the similarities (albeit superficial) between the blind spot and spatial neglect?
2 In terms of 'blindness', what are the differences between the blind spot and spatial neglect?
3 What difficulties would a person with spatial neglect have with everyday actions?

Pseudoneglect

Ignoring the left-hand side causes a person with spatial neglect to bisect (halve) lines to the extreme right of the true centre. While this is not surprising, did you know that it is extremely likely that you will get this seemingly simple task wrong as well?

Most normally functioning people display a leftward attentional bias. This bias, known as pseudoneglect, causes us to bisect lines slightly to the left of the true centre. Studies conducted by Jewell and McCourt (2000) reveal that most people show a bias to the left, where they think the left side is longer that the right.

A possible explanation relates to the fact that the right hemisphere is more involved in visual–spatial tasks. As a result, we are likely to be more attuned to objects in our left visual field.

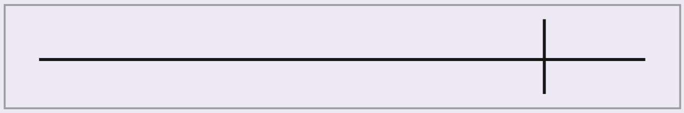


FIGURE 7.7 A person with left spatial neglect bisects (halves) a line incorrectly to the right, an example of extreme rightward bias.

Test five people to see if they suffer from pseudoneglect

1. On 25 small strips of paper, draw a horizontal line approximately 12 cm long.
2. Seat your participant and ask for informed consent.
3. Give the following instructions:

   Five sheets of paper, one at a time, will be placed directly in front of you.

   > *A horizontal line is drawn on each sheet of paper.*

   > *Please place a small vertical line to indicate the middle of the horizontal line.*

   > *You have 10 seconds to complete all five sheets.*
4. Carry out the instructions.
5. Thank and debrief your participant. Repeat with four other participants.
6. Using a ruler, carefully measure from the left side of the small vertical line. Record your measurement to the nearest millimetre. Repeat for the right side of the line. Make note of how far left or right the mark was from the centre of the horizontal line.
7. Collate your results.
8. Did your results support Jewell and McCourt's (2000) findings? Did you identify pseudoneglect, a tendency to bisect the line slightly to the left of centre?
9. Were there any confounding variables that may have influenced the results?

Contribution of spatial neglect studies

Spatial neglect can be a result of brain damage. The location and extent of the damage is likely to influence the degree of neglect, which can range from mild to severe. Spatial neglect has serious implications for consciousness; it can limit perceptions, thoughts, behaviours and feelings. A person with spatial neglect will have difficulty performing most everyday activities that we take for granted. Because the degree of brain damage may be widespread and affecting other functions, sufferers are usually unaware of their condition and often the symptoms are first noticed by caregivers or therapists. Being unaware or not caring about their condition may seriously limit an individual's participation in rehabilitation.

Spatial neglect can result from a number of areas of the brain being damaged, usually the right posterior parietal lobe. While we can study the effects of spatial neglect, the exact reasons for these effects are unclear. Many possibilities have been identified and recent brain imaging studies suggest that a widespread network of areas and neural pathways are involved (Husain and Rorden 2003).

Did you know?

We often speak of 'left neglect' – does this mean there is rarely damage to the right parietal lobe, causing 'right neglect'?

No! When the left parietal lobe is damaged, the more adaptable right hemisphere usually compensates for lost functions, so 'right neglect' is seldom shown.

REVIEW 7.2

1. What is spatial neglect?
2. Give an example of behaviour that a person with spatial neglect is likely to exhibit.
3. Which part of the brain is more likely to be damaged in a person suffering spatial neglect?
4. Does spatial neglect damage a person's eyes?
5. Can spatial neglect vary in degrees of severity between sufferers?
6. Do people with spatial neglect tend to be aware that they have the condition? If they are aware, are they likely to be concerned or traumatised by the condition?

Split-brain studies

Investigating how the damaged brain works can help researchers find out how the normal, undamaged brain functions. Current methods of investigating the brain can be broadly divided into *invasive* methods, where the experimenter physically interferes with the brain, and *non-invasive* methods, where the brain is researched without physical interference. Invasive brain surgery for research purposes alone is unethical because it can be risky, radical and irreversible. When a patient requires brain surgery for health reasons, however, an opportunity exists for scientifically researching the brain and behaviour.

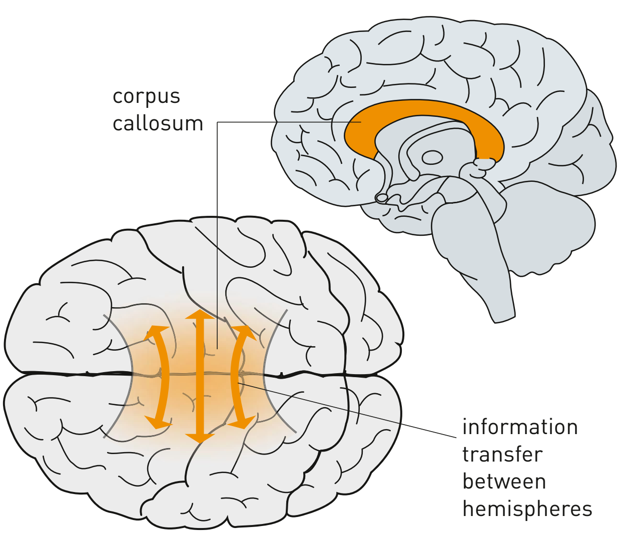


FIGURE 7.8 The corpus callosum transfers information back and forth between the two hemispheres. Split-brain patients have had their corpus callosum severed.

Imagine that you suffer from a rare form of severe epilepsy. You have numerous seizures a day, sometimes over 100. These seizures cause a loss of consciousness and memory loss and may cause serious injury. Activities most of us take for granted such as going to school, visiting friends, playing sport or dining at a restaurant are virtually impossible. Throughout your lifetime, you have visited leading specialists and tried all sorts of medication, with little success. Now you hear of an operation that could reduce your seizures to fewer than three per day – perhaps get rid of them altogether – a life-changing operation that will not alter your intelligence or personality. What would you do?

In **split-brain** studies, patients undergo surgery to sever the **corpus callosum**, the thick band of about 200 million nerve fibres connecting the right and left hemispheres. This operation is called a **commisurotomy** and prevents communication between the two hemispheres on higher cortical levels. The patients now have what is known as a split brain. The two sides of the brain are still connected at the subcortical (deeper) level but the cerebral hemispheres are separated. This invasive method is undertaken to prevent the spread of severe epileptic seizures from one side of the brain to the other. Split-brain surgery is performed as a last resort to help patients and has been very successful in limiting seizures. Not many patients had this surgery in the past and it is rarely done today because of improved medications and other forms of treatment; even so, split-brain surgery has been a positive, life-changing experience for some people.

Remarkably, split-brain patients do not seem to have any major side effects as a result of their surgery, despite the fact that, after the operation, the two hemispheres virtually act as two independent brains. The patient's subsequent personality and behaviour in most cases appears normal.

Roger Sperry pioneered research on split-brain patients and received a Nobel Prize for his work. For the first time in history, an understanding about the specialisation of the left and right hemispheres was revealed. Sperry became interested in discovering the purpose of the corpus callosum in the 1950s. Until then, very little was known about it. Split-brain patients appeared to function as normal after the operation.

Before this, opinions of the purpose of the corpus callosum varied: McCulloch (1940) suggested its role was 'to aid in the transmission of epileptic seizures from one to the other side of the body' while Lashley (1951, cited by Sperry 1963) believed its purpose was 'mainly mechanical … to keep the hemispheres from sagging'.

Initially, Sperry mainly worked with cats and monkeys. Then, Sperry and his colleague, Michael Gazzaniga, began to work with human participants. They devised an experimental situation in which different stimuli could be presented to either of a person's two hemispheres independently. To do this, they relied on the visual input from the eyes.

To understand Sperry's work, we must understand the visual pathways from the **retina** in the eye to the brain. Visual stimuli fall on the retina at the back of each eye. The retina contains a layer of nerve cells called **photoreceptors** that convert visual light energy (electromagnetic radiation or light waves within our visual spectrum) into electrochemical energy (nerve impulses). This conversion of energy is called **transduction** and the energy is then transmitted along the optic nerve to the brain. Interestingly, both the retina and the optic nerve are often considered to be part of the brain.

Each eye has its own optic nerve and these meet and cross over information at the **optic chiasm**. Here, information from the *left* visual field of each eye (that falls on the *right* side of each retina) is transmitted to the *right* primary visual cortex in the occipital lobe for processing. Conversely, information from the *right* visual field of each eye (that falls on the *left* side of each retina) is transmitted to the *left* primary visual cortex in the occipital lobe for processing.

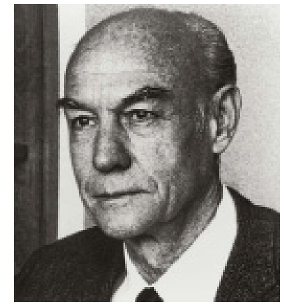


FIGURE 7.9 Roger Sperry, American neurologist

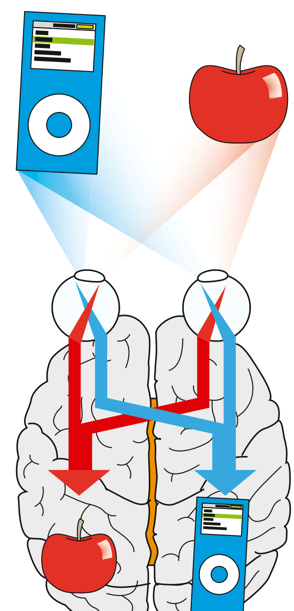


FIGURE 7.10 The visual pathways. Information presented in the left visual field of each eye falls on the right side of the retina of each eye and goes to the right primary visual cortex in the occipital lobe for processing. Information presented in the right visual field of each eye falls on the left side of each eye's retina and goes to the left primary visual cortex in the occipital lobe for processing.

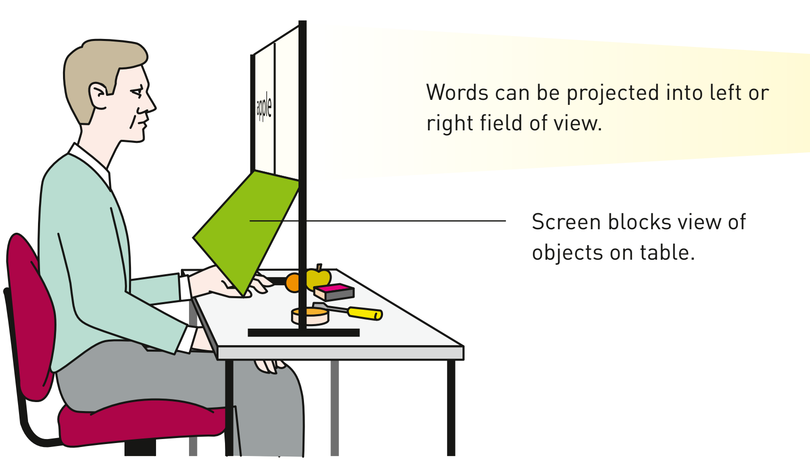


FIGURE 7.11 Sperry's experimental apparatus for testing split-brain patients

KEY STUDY

SPLIT-BRAIN STUDIES

Visual information presented to each eye is relayed to each hemisphere, with the information from the left visual field being processed in the right visual cortex and information from the right visual field being processed in the left visual cortex.

Sperry and Gazzaniga used this knowledge of the visual pathways to devise the experimental situation in which split-brain patients' responses could indicate the functions of the left and right hemisphere of the brain. When the corpus callosum is cut, information presented to one side of the visual field will be processed in one visual cortex and cannot be communicated to the other hemisphere. This is not usually a problem for a split-brain patient because they move their eyes, allowing the visual information to fall on both halves of the retina. Therefore, the visual information from each eye is transported to both sides of the brain. Split-brain patients may also say things out loud – this sound is then detected by both ears and so the information is shared between both hemispheres.

Sperry's ingenious idea was to present a visual image to one side of the visual field for a very brief period (0.1 of a second) before the eyes could move so that the image fell on only one half of the retina. He set up an apparatus (see Figure 7.11) in which a person would sit in front of a screen staring straight ahead and images could be flashed to the left or right visual field. Sperry could place objects behind the screen, out of sight from the patient but within reach of either hand. The ability of the person to report what they had seen or respond in various other ways provided an indication of what each hemisphere can process.

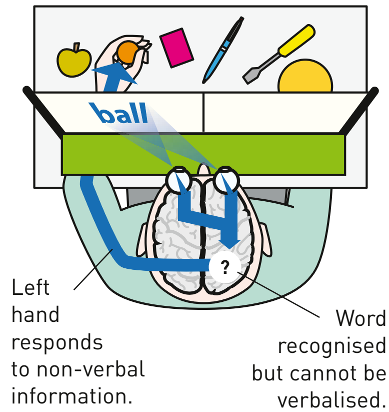


FIGURE 7.12 Split-brain study 1: words were presented to the right or left visual field.

Split-brain study 1

Procedure

Split-brain patients were presented with words to their right or left visual field and asked to report what they had seen (see Figure 7.12).

Results

- When words were presented to the right visual field and therefore processed in the left hemisphere, patients were able to read and report the words verbally.
- When words were presented to the left visual field and therefore processed in the right hemisphere, patients were unable to report the words verbally. They were able to select the item by touch from behind the screen, but were unable to say why they had selected the item.

Conclusion

- The left hemisphere can identify words and name them.
- The right hemisphere can identify words but cannot name them.

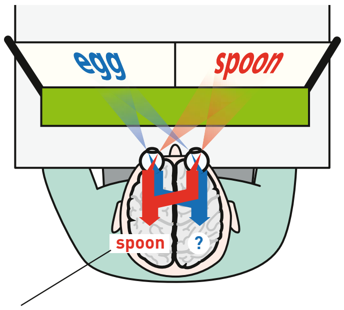


FIGURE 7.13 Split-brain study 2: different words were presented on each side of the screen at the same time.

Split-brain study 2

Procedure

Split-brain patients were presented with different words on each side of the screen at the same time. They were asked to report what they had seen (see Figure 7.13).

Results

- The patients were able to read and verbally report the word presented to the right visual field (processed in the left hemisphere).
- The patients were unable to verbally report the word presented to the left visual field (processed in the right hemisphere).

Conclusion

- The left hemisphere can identify words and name them.
- The right hemisphere can process words but cannot name them.

Split-brain study 3

Procedure

Split-brain patients were presented with a picture of an object to their right or left visual field and asked to verbally identify the object or reach under the screen and select the object by touch.

Results

- When a picture, say a hammer, was flashed to the left visual field (right hemisphere), the patient was unable to verbally name the object but could grasp the hammer with his left hand. Interestingly, the patient often denied seeing anything at all.
- In contrast, when a picture, say an apple, was flashed to the right visual field (left hemisphere), the patient could easily name it verbally (see Figure 7.14).

Conclusion

- The left hemisphere can identify pictures and name them.
- The right hemisphere can identify pictures by touch but cannot name them.
- The left hemisphere appears to make the executive decisions concerning whether an item was present or not.

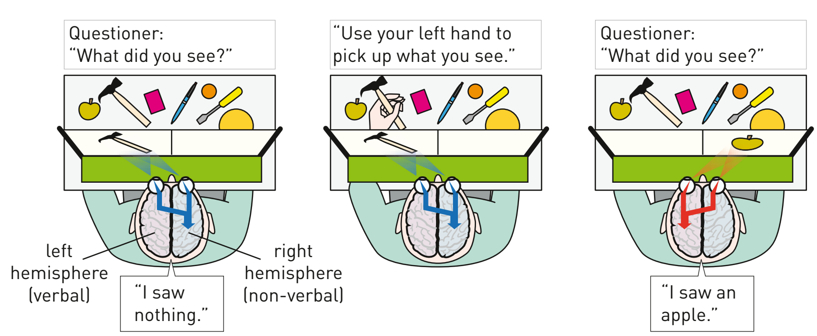


FIGURE 7.14 Split-brain study 3: pictures of objects were presented to the left or right visual field.

Sperry and Gazzaniga's experiments suggest that the left and right hemispheres have different language skills. The left hemisphere is able to read, identify and name items while the right hemisphere is able to read and identify items but not name them. Sperry's work reconfirms the specialised language abilities of the left hemisphere first proposed by Broca and Wernicke over a hundred years earlier, although the right hemisphere can still process information and express itself nonverbally.

Interestingly, in one of Gazzaniga's early studies (1967), a split-brain patient was asked to pick a certain object out of a pair of objects: one flashed to the right visual field and the other to the left. The patient abruptly pointed to the correct object in the left visual field with his left hand (governed by the right hemisphere) and, at the same time, indicated the correct object in the right visual field either by verbally saying it or pointing with his right hand (governed by the left hemisphere). Later, when discussing this response, the patient had no recollection of having pointed to the object with his left hand. His left hemisphere seemed completely ignorant of what went on in the right hemisphere.

INVESTIGATE 7.4

PLAY THE SPLIT-BRAIN EXPERIMENT ONLINE

Go to the Nobel Prize website, search for and play the Split-Brain Experiments animation.

What did the online activity reveal about the differences between the left and right hemispheres of the brain?

Further work on tasks that do not require the use of words has highlighted this lack of communication between the hemispheres as seen in this account:

A snow scene was presented to the right hemisphere and a picture of a chicken claw was simultaneously presented to the left hemisphere. The subject selected from an array of objects those that 'went with' each of the two scenes. With his right hand, he pointed to a shovel. The patient reported that the shovel was needed to clean out the chicken shed (rather than to shovel snow). Because the left brain was not privy to what the right brain 'saw' because of the severed corpus callosum, it needed to explain why the left hand was pointing at the shovel when the only picture the left hemisphere was aware of seeing was a chicken claw. The left brain's cognitive system provided a theory to make sense of the behaviour of different parts of the body (Gazzaniga 1985).

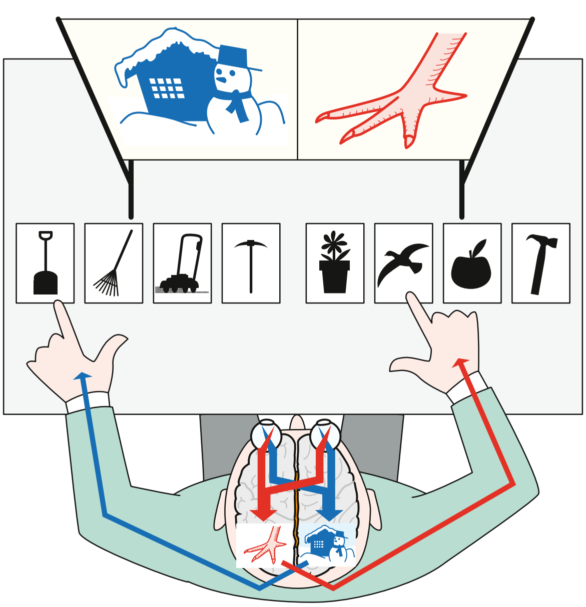


FIGURE 7.15 The left hemisphere attempted to justify why the left hand pointed to the shovel when all it 'saw' was a picture of a chicken claw.

This raises a number of intriguing questions about the role of the two hemispheres and their role in the cognitive processes of learning, perception and attention. When they are unable to communicate, each seems to work independently, with its own memories. While many tasks are automatic and carried out before we are consciously aware of them, we still believe that we are ultimately in charge of our thoughts, feelings and behaviours. Our left hemisphere appears to allow us to construct theories about the relationship between perceived events, actions and feelings (Gazzaniga 2000).

Gazzaniga labelled the left hemisphere 'the interpreter', as it allows conscious feelings to arise in response to largely automatic trains of thought that run through mental life.

There are limitations in generalising results from split-brain patients to the normal population. Most patients are male and right-handed. In general, right-handed people have their main language centres in their left hemisphere while left-handed people may have main language centres in either the left or right. The patients all suffered from severe epilepsy and this may have affected their performance. They were all on long-term medication, and the surgery itself may have had side effects and exaggerated the results.

ACT LIKE A SPLIT-BRAIN PATIENT

INVESTIGATE 7.5

To play this game, you need a large bag and a number of different items that can be held in your hand, for example, a pen, book, note pad, sticky tape, ruler, cup, comb.

In pairs, one person is the experimenter and the other is the split-brain patient. The split-brain patient closes their eyes (or has them blindfolded), faces straight ahead and places their hands behind their back.

1. The experimenter then places an item of their choice in the right hand of the split-brain patient. According to research, can the split-brain patient identify the object by name? The split-brain patient acts accordingly.
2. The experimenter then places an item of their choice in the left hand of the split-brain patient. According to research, can the split-brain patient identify the object by name? The split-brain patient acts accordingly.
3. The experimenter writes the name of one item on a piece of paper and flashes this in the left visual field of the split-brain patient. According to research, can the split-brain patient select the item from others in a large bag? The split-brain patient acts accordingly.
4. The experimenter writes the name of one item on a piece of paper and flashes this in the right visual field of the split-brain patient. According to research, can the split-brain patient select the item from others in a large bag? The split-brain patient acts accordingly.
5. Create another scenario that demonstrates your understanding of the split-brain studies.

CASE STUDY

THE WOMAN WITH THE ALIEN HAND

In 1908, a woman with severe mental disturbances repeatedly tried to choke herself with her left hand. At the same time her right hand would try to pull her left hand away from her throat. She also engaged in other destructive behaviour, such as ripping up her bed sheets and clothes. However, she only ever did this with her left hand. This became known as the 'alien hand' syndrome.

This woman's brain was studied when she died and it was found that her corpus callosum was severely damaged. Communication between the two hemispheres was disrupted. Her right hemisphere, controlling her left hand, responded in a catastrophic (highly emotional) way while her left hemisphere, controlling her right hand, seemed indifferent to the situation and continued on without an emotional reaction. This reported case, which took place over 100 years ago, highlights the need for the right and left hemispheres to communicate.

Contribution of split-brain studies

The split brain gives clues to the nature of conscious experience. Insights into the brain's hemispheric specialisation and location of function have been gained through studying split-brain patients. Research suggests that our hemispheres operate differently, with our left hemisphere more involved in verbal processes and constructing theories about the relationship between perceived events, actions and feelings. The studies reveal that the right hemisphere is also capable of verbal processing and can express itself non-verbally.

The right and left hemispheres may have different skills, but the two hemispheres work together in an integrated way, constantly exchanging information. This work continues today using modern brain-imaging techniques with participants with intact brains and other techniques. We know that the differences between the right and left hemispheres are not absolute differences; both hemispheres of our brain are activated to some extent as we perform virtually any task. In addition, we know that primary sensory and motor areas are symmetrical. They are located in the same place and perform in the same way for each hemisphere.

Further research on split-brain patients has found that they are better than non-split-brain participants at performing two tasks at once. For example, in the scrambled search activity, a different object is placed in each hand but out of sight and is then removed. The task is to find each object out of a scrambled pile of items with the same hand. Split-brain patients are quicker at this task than non-split-brain patients. This suggests that their hemispheres operate differently from the normal population and are capable of working in a more independent way – they behave as if they have two brains!

7.3 REVIEW

1 What is the corpus callosum and what is its main function?
2 Describe the experimental situation that Sperry and Gazzaniga used to test split-brain patients.
3 Left or right? Fill in the gaps in the following sentences:
   a Information that is presented in the left visual field of each eye falls on the _____ side of each eye's retina and is transmitted to the _____ primary visual cortex for processing.
   b Information that is presented in the right visual field of each eye falls on the _____ side of each eye's retina and is transmitted to the _____ primary visual cortex for processing.
4 Explain why an image is only presented for a very brief period of time (0.1 seconds) when testing split-brain patients.
5 A split-brain patient undergoes Sperry's typical split-brain experiment. A picture of an object is flashed to her left visual field.
   a Is she likely to say that she saw an object? Give reasons for your answer.
   b Is she able to verbally identify the object? Give reasons for your answer.
   c Is she able to identify the object with her left hand by touch (selecting the item from behind the screen)? Give reasons for your answer.
   d Is she able to identify the object with her right hand by touch (selecting the item from behind the screen)? Give reasons for your answer.
6 A split-brain patient undergoes Sperry's typical split-brain experiment. A picture of an object is flashed to her right visual field.
   a Is she likely to say that she saw an object? Give reasons for your answer.
   b Is she able to verbally identify the object? Give reasons for your answer.
   c Is she able to identify the object with her left hand by touch (selecting the item from behind the screen)? Give reasons for your answer.
   d Is she able to identify the object with her right hand by touch (selecting the item from behind the screen)? Give reasons for your answer.

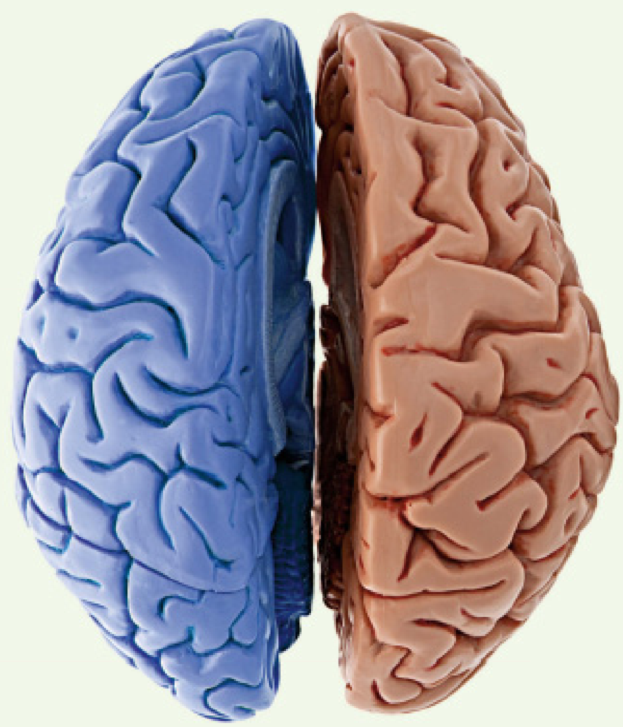


FIGURE 7.16 A concept image of a split brain.

Conclusion

What is it like to have spatial neglect? What is it like to suffer from Broca's aphasia? These questions are as difficult to answer as 'What is it like to be you?'

The level of intensity, range of experiences and degree of awareness can vary between conditions and phenomena, and this will impact on the conscious thoughts, feelings and behaviours of people with the conditions. Some, such as those with Broca's aphasia, can be very frustrated by their condition; others, such as those with spatial neglect, may be aware of their condition but not bothered by it while those with Wernicke's aphasia tend to be blissfully unaware of their condition and we all experience a slight degree of pseudoneglect. Studying the damaged brain has generated a great deal of knowledge about the working of the normal brain. Brain-damage effects such as aphasia and spatial neglect provide us with a unique opportunity to study attention, perception, language, memory and learning – all complex cognitive processes that have an impact on consciousness.

Brain areas are so interconnected and behaviour is so complex that no one area of the brain can be considered entirely responsible for any particular behaviour. Adding to the complexity is that brains differ between individuals and everyone's brain is capable of change (plasticity). Areas of the brain being investigated may be part of a neural pathway that coordinates behaviour rather than the prime organiser of that function. Modern scanning techniques (refer to the Brain research methods spread on p 216) are further opening up research possibilities and implications for consciousness – we are living in a fascinating time of discovery about the workings of the brain.

FIGURE 7.17 Spatial neglect can impact daily tasks such as shaving or applying makeup.

TABLE 7.2 Summary of cognitive conditions

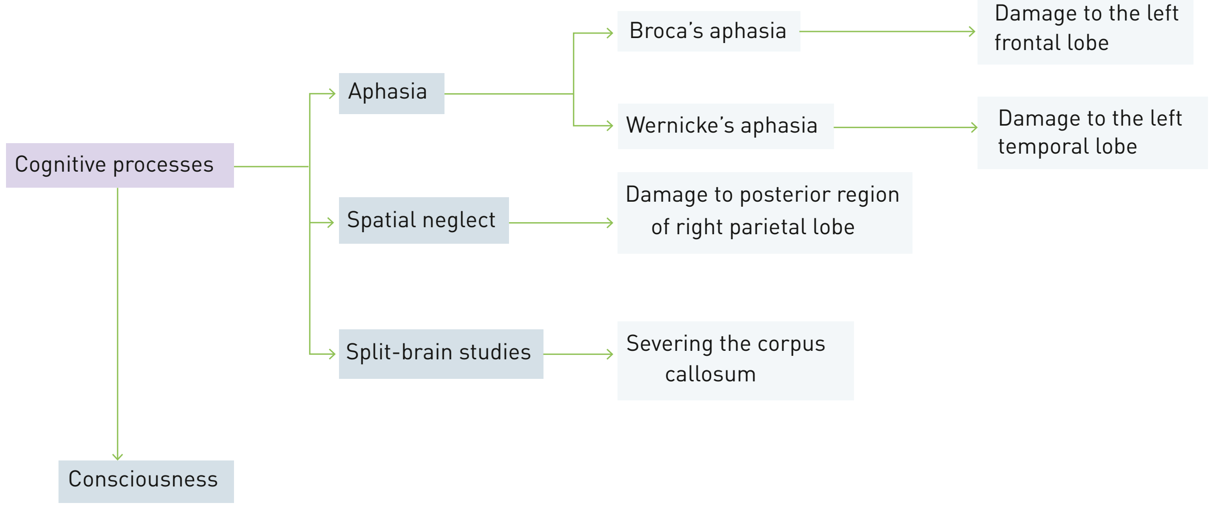
NAME	DESCRIPTION	CAUSE	WHO EXPERIENCES IT?
Broca's aphasia	Difficulty in expressing messages in words or sentences but comprehension of speech is largely unaffected.	Damage to Broca's area, an important area for language.	People with brain damage to Broca's area, usually as a result of a stroke.
Wernicke's aphasia	Difficulty with understanding written and spoken language, and difficulty with producing written and spoken language that makes sense to others.	Damage to Wernicke's area.	Those with brain damage to Wernicke's area, usually as a result of a stroke.
Spatial neglect	Systemically ignoring stimuli on one side of the body, in most cases the left-hand side.	In most cases, damage to the posterior region of the right parietal lobe.	Those with brain damage, usually to the posterior right parietal lobe, as a result of a stroke.
Split brain	Left hemisphere is more involved in verbal processes and constructing theories about what is going on around them. Right hemisphere can verbally process information and express itself non-verbally.	The corpus callosum is severed.	Those who undergo split-brain surgery (rare operation for people with certain type of severe epilepsy).


→ CHAPTER SUMMARY
07:

- Aphasia is the impairment of language caused by damage to the brain (usually by a stroke). There are several types of aphasia.
- Broca's aphasia is caused by damage to an area in the left frontal lobe. A person with Broca's aphasia has difficultly expressing themselves in words or sentences but their ability to comprehend speech is largely unaffected. Typically, little speech is produced and what is produced tends to be slow; words are generated with considerable effort and are poorly articulated; short words are often left out.
- Wernicke's aphasia is caused by damage to an area in the left temporal lobe. A person with Wernicke's aphasia has difficulty with understanding written and spoken language, as well as with producing written and spoken language that makes sense to others.
- Spatial neglect is a disorder in which the affected person systematically ignores stimuli on one side of their body. If there is spatial neglect after brain injury, in most cases the injury is to the posterior region of their right parietal lobe.
- A commisurotomy is a rarely performed operation in which the corpus callosum is severed. The patient is then said to have a 'split brain' as the severing prevents communication between the two hemispheres. Split-brain studies by Sperry and Gazzaniga demonstrate the importance of communication between the two hemispheres and show that, although the hemispheres work together on tasks, each processes information differently and has specialised functions.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

aphasia
Broca's aphasia
corpus callosum
cognition
cognitive processes
left visual field
optic chiasm
optic nerve
perception
photoreceptors
pseudoneglect
retina
right visual field
spatial neglect
split brain
split-brain studies
split-brain surgery
Wernicke's aphasia

KEY IDEAS

For the exam, you must have:

- an understanding of Broca's aphasia
  - the causes of Broca's aphasia
  - the language difficulties associated with Broca's aphasia
  - at least two studies concerning Broca's aphasia
  - implications for the understanding of consciousness

- an understanding of Wernicke's aphasia
  - the causes of Wernicke's aphasia
  - the language difficulties associated with Wernicke's aphasia
  - at least two studies concerning Wernicke's aphasia
  - implications for the understanding of consciousness
- knowledge of the comparison between Broca's aphasia and Wernicke's aphasia
- an understanding of spatial neglect
  - what spatial neglect is
  - the causes of spatial neglect
  - at least two case studies concerning spatial neglect
  - implications for the understanding of consciousness
- an understanding of the split-brain studies
  - Sperry and Wernicke's experimental situation
  - the visual pathways
  - research findings involving the words presented in the left or right visual fields and implications for naming and identifying the items by touch; the pictures of items presented in the left or right visual fields and implications for naming and identifying the items by touch; the touching of items by the right or left hand and implications for naming and identifying the items by touch
  - the roles of the left and right hemispheres
  - the limitations with using split-brain patients and generalising results to the normal population
  - implications for the understanding of consciousness

RESEARCH METHODS

For the exam, you must be able to:

- understand the value and limitations of case studies and why they can contribute to our understanding of cognitive processes and consciousness
- understand the value and limitations of studies involving patients with damaged brains and why they can contribute to our understanding of cognitive processes and consciousness
- use your knowledge of research methods to evaluate a research study
- use research studies to demonstrate your understanding of:
  - Broca's aphasia
  - Wernicke's aphasia
  - spatial neglect
  - split-brain studies
- be aware of ethical considerations relating to studying cognitive processes and consciousness.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 __________ aphasia is caused by damage to an area in the left frontal lobe while __________ aphasia is usually caused by damage to an area in the left temporal lobe.
   a Broca's; Wernicke's
   b Wernicke's; Broca's
   c Sperry's; Wernicke's
   d Wernicke's; Sperry's

2 Richard, a patient with severe epilepsy, had a rare operation in which his corpus callosum was severed to divide the right and left hemispheres of his brain. What is a likely consequence of this operation?
   a a noticeable change in eyesight
   b a noticeable change in memory
   c a noticeable change in personality and memory
   d very little noticeable change in day-to-day activities

3 The corpus callosum:
   a is found in the cerebral cortex.
   b is commonly severed to prevent epilepsy.
   c is primarily responsible for verbal communication.
   d transfers information between the cerebral hemispheres of the brain.

4 Visual images in the right visual field:
   a are detected by photoreceptors on the right side of each eye's retina.
   b are detected by photoreceptors on both sides of each eye's retina.
   c are processed in the right occipital lobe.
   d are processed in the left occipital lobe.

5 The partial or complete inability to articulate ideas or understand spoken or written language because of brain injury or damage is known as:
   a anomia.
   b aphasia.
   c spatial neglect.
   d a commisurotomy.

6 Petria is recovering from brain injury, caused by a stroke. She now finds it difficult to speak and, when she does talk, her speech is slow and poorly articulated. What is Petria likely to be suffering from?
   a synaesthesia
   b spatial neglect
   c Broca's aphasia
   d Wernicke's aphasia

7 A person with __________ is more likely to be aware of their condition than a person with __________.
   a Broca's aphasia; Wernicke's aphasia
   b Wernicke's aphasia; Broca's aphasia
   c spatial neglect; Broca's aphasia
   d Wernicke's aphasia; spatial neglect

8 Monty suffers from Wernicke's aphasia. As a result, it is likely that:
   a he is consciously aware of his inability to communicate.
   b he produces speech that contains nouns and verbs only.
   c his ability to read is unaffected.
   d he is able to speak fluently.

9 Typically, a person with spatial neglect:
   a ignores stimuli on the right-hand side of their body.
   b ignores stimuli on the left-hand side of their body.
   c has suffered permanent damage to their retinas.
   d has suffered temporary damage to their retinas.

10 If there is spatial neglect after brain injury, the injury is most often to the:
   a posterior region of the right occipital lobe.
   b anterior region of the left occipital lobe.
   c posterior region of the right parietal lobe.
   d anterior region of the left parietal lobe.

SHORT ANSWER

11 Simon, a right-hander, had a split-brain operation to help control his epileptic seizures. Afterwards, he was asked to participate in a series of experiments. During the experiments, he was asked to stare at a dot painted on the centre of a screen while pictures were briefly flashed on the left or right side of the screen.

a What is a split-brain operation?

1 mark

b Why was Simon asked to stare at the dot painted on the centre of the screen during the experiments?

1 mark

c During one experiment, a picture of a hammer was flashed to the right side of the screen. Could Simon name what was in the picture? Give reasons for your answer.

3 marks

d During another experiment, a picture of a nail was flashed to the left side of the screen. Could Simon name what was in the picture? Give reasons for your answer.

3 marks

12 In terms of the ability to speak, describe the differences between Broca's and Wernicke's aphasia.

2 marks

13 Tan, Broca's famous case study, was known to curse with relative ease at times of frustration. Other people with Broca's aphasia have been able to sing as they did before their brain damage. What does blurting out a curse with relative ease and the ability to sing suggest about Broca's aphasia and the ability to vocalise sounds?

2 marks

14 a Who is more likely to be conscious of their difficulties to communicate: a person with Broca's aphasia or Wernicke's aphasia?

b How might this conscious awareness affect their general happiness?

2 marks

15 a What cognitive difficulties arise as a result of aphasia?

1 mark

b How could these difficulties have an impact on consciousness?

2 marks

16 Complete the following.

a Outline Broca's case study of Tan.

3 marks

b Explain how this case study of Tan contributed to our understanding of cognitive processes and consciousness.

3 marks

17 Outline one study of Wernicke's aphasia and explain how it contributes to the understanding of cognitive processes and consciousness.

4 marks

18 Outline one study of spatial neglect and explain how it contributes to the understanding of consciousness.

4 marks

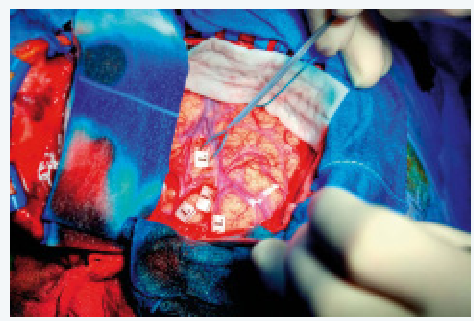
19 In terms of generalising the results to the normal population, outline two limitations of Sperry and Gazzaniga's studies on split-brain patients.

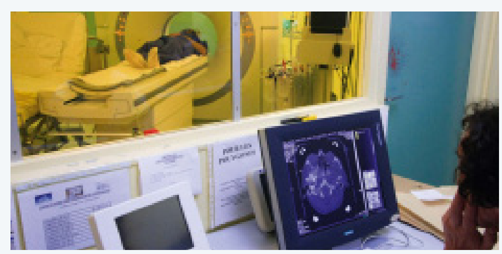
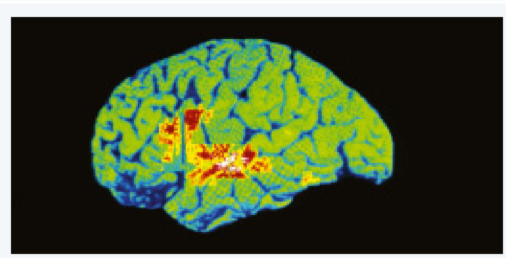
4 marks

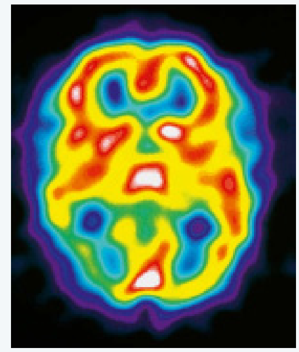
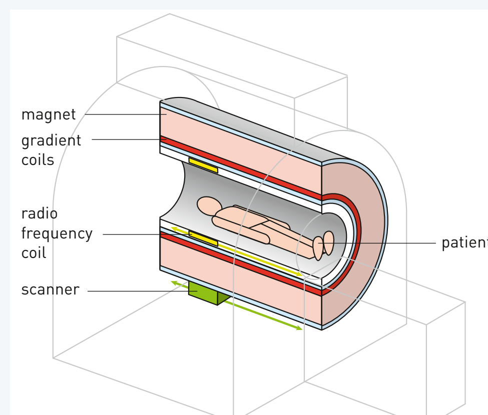
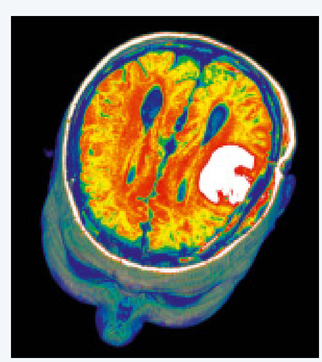
SUPPORTING UNDERSTANDING

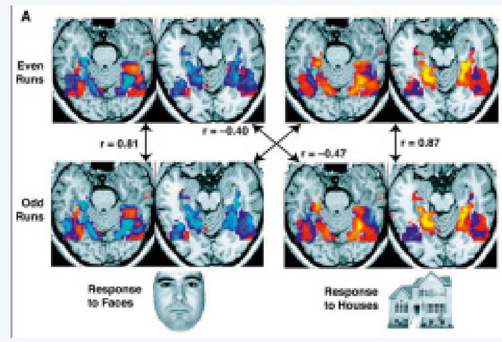
Brain research methods

Historically, our knowledge of brain structure and its functions came from case studies, autopsies and operations on damaged brains. Today, neuroimaging equipment/devices enable researchers to further their understanding from normal as well as damaged brains. In most instances, this can be done without using invasive procedures. The many technological advances in brain research methods continue to enable researchers to investigate the relationship between biological and cognitive factors of human behaviour. Some use direct brain stimulation methods while others use brain recording and imaging techniques.

DIRECT BRAIN STIMULATION METHODS	DESCRIPTION	STRUCTURE/FUNCTION
Electrical stimulation of the brain (ESB)	Electrical stimulation of the brain (ESB) involved the use of a probe that was able to emit a variable but weak electrical current directly on a person's brain. Wilder Penfield (1891–1976), an American/Canadian neurosurgeon, became well-known for his extensive use of the ESB on his patients for the treatment of severe epilepsy ('Montreal procedure'). As no two brains are identical, Penfield would meticulously map the individual's brain while they were awake on the operating table to make sure that he did not accidentally damage unaffected areas. Penfield traced the motor cortex (rear of the frontal lobe) and somatosensory cortex (front of parietal lobe) were represented in the 'homunculus' a strange human-like figure that reflected the proportion of the sensory and motor areas of the brain. He also discovered that the right hemisphere of the brain controls the left side of the body and the left hemisphere controls the right side of the body (with some functions being handled by both hemispheres).	 Image of an exposed brain during brain mapping. This was pioneered by Penfield, and he was able to show the direct link between the physical structure of the brain and its function.
Deep brain stimulation (DBS)	Deep brain stimulation (DBS) is based on the principles of electrical stimulation of the brain (EBS) and involves a surgical procedure to insert three components into a person's body under local anaesthetic: the implanted pulse generator (IPG), which is inserted under the collar bone or abdomen, the lead, which holds the electrodes that are implanted into the area of the brain that requires stimulation, and the extension that links the (IPG) and lead together. After a settling in period, the electrical current is activated to the appropriate level to decrease/control symptoms. DBS has been used in patients with Parkinson's disease to provide relief for symptoms that cannot be adequately controlled with medication.	 DBS has enabled doctors to understand the function of cortical or brain structures in greater depth.

DIRECT BRAIN STIMULATION METHODS	DESCRIPTION	STRUCTURE/FUNCTION
Transcranial magnetic stimulation (TMS)	Transcranial magnetic stimulation (TMS) is a non-invasive technique that allows researchers to either activate or stop activity in a specific area of the brain. It can therefore create a temporary interruption to particular areas of the brain. The TMS device is made up of a magnetic coil inserted into a paddle-like body. This coil creates a magnetic field that can penetrate the brain to a depth of 2 cm. The magnetic pulses can be varied according to time and duration, with the capacity to either increase or decrease the activation of neurons in the targeted area.	 A TMS in operation. This device is used to diagnose and treat a range of neurological disorders such as Parkinson's disease, writer's cramp, stroke and psychological disorders such as depression and schizophrenia. TMS measures the function of areas of the brain at a maximum depth of 2 cm.
BRAIN RECORDING AND IMAGING TECHNIQUES	**DESCRIPTION**	**STRUCTURE/FUNCTION**
Computerised tomography (CT)	Computed tomography (CT) produces a high-resolution 3-D computer-enhanced image of the brain. The patient is injected with a substance known as 'contrast' iodine that highlights the brain's blood vessels and enables the interpretation of the CT image. While the patient is lying down in the CT device, a quick succession of X-ray images are taken in an arc around the head that are then combined to produce the 3-D representation of the brain on the computer screen.	 CT scans provide detailed 2D images using X-ray images. The radiographer examines the image of the patient's brain in a screen in another room. As CT scans generate detailed images of the brain and other parts of the body, doctors are able to detect tumours, broken bones and other structural abnormalities.
Positron emission tomography (PET)	Positron emission tomography (PET) is a technique based on the understanding that there is increased blood flow and glucose consumption when particular areas of the brain are activated during cognitive processing. PET measures the volume and location of blood flow in the brain by tracking a radioactive substance, such as glucose, that has been injected into a person's bloodstream. The radioactive substance, or tracer, gives off positrons (minute particles with a positive charge) and a radiation detector camera surrounding the person's head is able to monitor the areas of the brain from which these positrons are emitted.	 Coloured positron emission tomography (PET) scan of the area of the brain involved in processing words. Active areas on the left side of the brain are in red and yellow. PET scans are a valuable tool in monitoring functional and, to a lesser extent, structural changes in patients with degenerative conditions such as Alzheimer's and schizophrenia.

BRAIN RECORDING AND IMAGING TECHNIQUES	DESCRIPTION	STRUCTURE/FUNCTION
Single photon emission computed tomography (SPECT)	Single photon emission computed tomography (SPECT) is an imaging technique that works on a similar basis to PET. It uses radioactive tracers and a scanner that detects gamma rays (radiation). The SPECT takes a succession of 2-D images that are combined to form a true 3-D computer-enhanced image that is easily manipulated on screen to see the section of the brain from different angles. SPECT tracers are measured directly as they move through the bloodstream. Although PET produces clearer images, SPECT is cheaper and more accessible than PET.	 SPECT images of a person with a migraine. SPECT provides valuable functional information about the brain.
Magnetic resonance imaging (MRI)	Magnetic resonance imaging (MRI) uses harmless magnetic fields and radio waves to produce a computer-enhanced image of brain structure. The person lies in a chamber that houses a large magnet. The magnet creates a strong magnetic field that organises the protons of hydrogen atoms into parallel lines. The aligned protons produce a faint signal that is processed by a computer that enhances them to a highly detailed 3-D image that can be manipulated to view different angles and areas of the brain. The MRI shows structures 1 mm apart. People with pace makers or metal implants cannot undergo an MRI as the implant will be affected by the magnetic field.	 An MRI scanner  The MRI provides a highly detailed 3D image of the brain that can be examined in cross-sections. It shows the structure of the brain and is powerful in enabling the detection of small tumours, or changes in the brain.

BRAIN RECORDING AND IMAGING TECHNIQUES	DESCRIPTION	STRUCTURE/FUNCTION
Functional magnetic resonance imaging (*f*MRI)	Functional magnetic resonance imaging (*f*MRI) works on the same basis as the traditional MRI with the distinction that it also monitors blood flow and oxygen consumption to reveal areas of greater brain activity – and hence, function. As the person is performing a mental task, the functional aspect of this technology produces an image every second to show the location(s) and level of brain activation as it happens in 'real time'. This allows the researcher to accurately monitor which brain regions become active and as they occur.	 The *f*MRI images show the different activity patterns of the brain on seeing a house or a face. *f*MRI provides a powerful combination of highly detailed structural images of what brain structures are activated during cognitive tasks (functional) in real time.

RESEARCH METHODS AND ETHICS IN BRAIN RESEARCH

KEY KNOWLEDGE

Research methods and ethical principles associated with the study of the brain and states of consciousness, as outlined in the introduction to the unit.

(VCE Study Design 2013)

Evaluation of research

CASE STUDY 1

Does sleep assist problem solving?

In 2013, a study has added more evidence that performance on problem solving improves over a period of sleep, as compared to wakefulness (Sio, Monaghan & Ormerod, 2013). This study predicted that sleep will increase performance on difficult tasks compared to not having a break and having a break that does not include sleep. Performance on easy tasks will not be significantly enhanced by sleep.

In this study, a total of 61 university students (27 male and 34 female, mean age of 20.5 years) were tested. All had normal vision and English as their first language. Participants were divided into 3 groups – control, incubation and sleep group. Participants were tested two times on the same test. For the control group, there was no delay between the first and second test. For the incubation group, the retest was held 12 hours later in the same day. The sleep group was retested the next day (either 12 hours or 24 hours later), following a night of sleep.

The test consisted of easy and difficult verbal insight problems. Each problem consisted of three given words and asked for a one word answer related to these words. For instance:

cottage/ swiss/ cake	Answer: cheese (easy)
child/ scan/ wash	Answer: brain (difficult)
lick/ sprinkle/ mine	Answer: salt (difficult)

The sleep group solved the greater number of difficult problems compared to the control and incubation groups. There was no difference between the three groups in problem - solving the easy questions. The researchers concluded that sleep facilitates solving difficult problems. Sleep has a profound effect on our ability to be creative and find new solutions to problems. It is probably best to 'sleep on it' but only if the problem is difficult!

Sio, U. N., Monaghan, P., & Ormerod, T. (2012). Sleep on it, but only if it is difficult: Effects of sleep on problem solving. *Memory and Cognition*, 41 (2). 159-166.

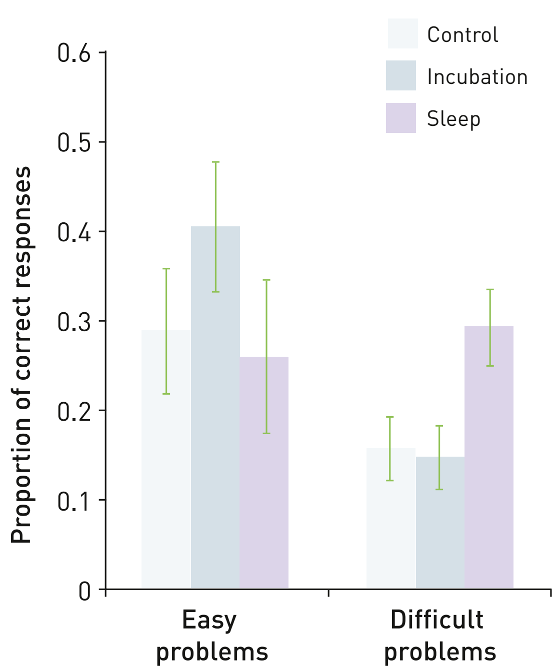


FIGURE 1 Proportions of correct responses for the control, incubation and sleep groups for the previously unsolved easy and difficult problems in the second test.

Questions

Answer the following questions with reference to this research.

1 What was the aim of this experiment?

2 What was the research hypothesis for this study?

3 What was the independent and dependent variables?

4 List the details of the participants. Why was it important to note that all participants were university students with normal vision and English was their first language?

5 The participants were divided into three groups: control, incubation and sleep. What type of experimental research design does this represent? What are the advantages and limitations of this research design compared to others?

6 What is the purpose of a control group?

7 What were the results found for the control, incubation and sleep groups?

8 What conclusions and inferences were made from these results?

9 The purpose of sleep is still very much debated, with most theories belonging to two broad categories: the survival (adaptive and evolutionary) and restorative (restore and recovery) theories of sleep. This study supports the idea that we sleep to problem solve. To what extent do you think this study represents the survival or restorative theories of sleep or do you think this study may represent another complementary theory that contributes to our understanding of the purpose of sleep? Give reasons for your answer.

10 Good quality sleep is important. What are some of the potential cognitive side effects of sleep deprivation?

11 State some ideas related to this study for future research.

CASE STUDY 2

The 'flowerpot' technique

In 1967, Jouvet published a study that highlighted the importance of REM sleep. He created a situation, known as the 'flowerpot' technique, in which he deprived cats of REM sleep. The upside-down flowerpot was just large enough to hold a cat and was placed in a pool of water.

The cat was able to sleep on top of the flowerpot during NREM sleep. When the cat entered REM sleep, however, the loss of muscle tone caused it to fall into the water and so wake up. The cat would then return to the flowerpot. Therefore, the cat was able to get some sleep but was unable to experience REM sleep.

Jouvet found that cats deprived of REM sleep eventually died. He concluded that extreme and continuous deprivation of REM sleep has serious behavioural and physical consequences.

Reference: Jouvet, M. (1967).Mechanisms of the states of sleep: a neuropharmacological approach. Research Publications of the Association for the Research in Nervous and Mental Diseases, 45, 86–126.

Questions

Answer the following questions with reference to this research.

1 What does this research suggest about the importance of REM sleep?
2 This study relates to cats. Do you think this study would be allowed to be replicated on humans today? Use psychological ethical principles to support your answer.
3 What happens to our muscles during REM sleep? What physiological device can be used to detect this change during REM sleep?
4 What have other sleep researchers suggested about the importance of REM sleep? Do they agree on why REM sleep is important? Explain.

ASSESSMENT ACTIVITIES

Outcome

On completion of this unit, the student should be able to explain the relationship between the brain, states of consciousness including sleep and behaviour, and describe the contribution of selected studies to the investigation of brain function. (VCE Study Design, 2013)

This outcome requires completion of one of the following assessment task. The assessment rubric on page 226 is designed to help guide your responses.

Report on student investigation

You are to investigate the relationship between quality of night's sleep and level of awareness during the following day. You are not allowed to manipulate (for example, deliberately disturb sleep) quality of night's sleep.

Carry out psychology background reading before you begin. This will help you work out your method and make some important decisions.

You need to make some important decisions:

1 What is your research question and aim?
2 Select your participants (for example, it may be just your own sleep and awareness you monitor)
3 Operationalise the variables.
   a How will you measure quality of night's sleep? (Check out activity on pages 105 & 134 for ideas)
   b How will you measure level of awareness? (Check out activities on pages 56, 57, 134, 137, 150 & 163 for ideas).
4 Devise a systematic method and think about the complexities surrounding this investigation, making sure it is ethically and morally sound.

You must get approval from your teacher before you begin your investigation.

Carry out your investigation.

Write up your investigation, following the method outlined in Chapter 1.

In addition, consider the following questions:

1 What are the features of a true experiment?
2 Why is this investigation NOT a true experiment?

3 In terms of ethics, why was a true experiment avoided in this case?
4 What complexities are involved in studying states of consciousness?

Annotated folio of practical activities or Test

Guided by your teacher, select a range of activities within the mind, brain and body chapters to present for assessment.

The activities do not need to be formally written up but must be presented in the manner as per instructions within the text and/or your teacher. For example, a folio may include:

- one research investigation per chapter
- responses to the test items at the end of one or more chapters
- written responses to the Review items in one or more chapters within this area of study.

Media response

Write a response to a media clip that relates to a topic of your choice within the mind, brain and body area of study. The media clip could be sourced from a film, television show, cartoon, newspaper article, book, website, painting, photograph, song, documentary, advertisement, magazine or podcast.

Critique the media clip in terms of its portrayal of a mind, brain and body topic (is it appropriate and correct?).

1 Give a brief description of the media clip.
2 Which topics of Mind, Brain and Body are covered in the media clip?
3 Which theories, issues and studies are related to the media clip?
4 Do you think the media clip portrays the mind, brain and body topic accurately? Explain with reference to the relevant knowledge and understanding.
5 Do you think the media clip might contribute to any misconceptions or negative stereotypes within our society? Explain your answer.
6 How has this media clip contributed/not contributed to your knowledge and understanding of this area of study?

Oral presentation

Select one of the following topics and present it as a PowerPoint presentation or podcast, using two or more data types, such as still images, moving images, written text or sound. You may also embed short video clips that are relevant to this topic. The presentation should be 3–5 minutes long.

- Create an advertising campaign targeted to teenagers that promotes the value of sleep and 'busts' the myths that surround sleep.
- Create an advertising campaign that highlights the issues of drink-driving or driving when sleepy. In your campaign, relate the material to the characteristics of states of consciousness and, if applicable, the need for sleep.
- Pick one of the following and use studies to explain how it affects cognitive processes and what it reveals about consciousness:
  - Broca's aphasia
  - Wernicke's aphasia
  - spatial neglect
  - split-brain studies

Visual presentation

Create a concept map, graphic organiser or poster on one of the following:

- → You are a sleep researcher investigating the effects of sunlight on sleep. You are monitoring a scientist working in a small hut in Antarctica for an entire year.
  - > What effects do you expect hours of sunlight will have on the scientist's behaviour?
  - > What are the effects of sleep deprivation?
  - > In your visual presentation, highlight how you plan to carry out this research. How will you monitor sleeping behaviour? How will you know if the scientist is awake or asleep? When they are asleep, how will you know which stage of sleep they are experiencing?
- → You are a secondary school teacher and want your students to experience an altered state of consciousness in your class. In this case, you introduce meditation, a safe altered state that is known to have positive effects including helping reduce stress (as discussed in Unit 4).
  - > Explain the benefits of meditation with reference to the characteristics of altered states of consciousness.
  - > Outline some methods used to study consciousness that could be used in this situation.
- → Imagine you want to conduct psychological research related to sleep on the *Big Brother* housemates. Choose one housemate and write them a brief letter explaining the nature of your sleep research, the ethical principles that would apply, and their rights as a participant in your research.
- → Pretend you are a neuroscientist. Create a visual representation of the brain. Highlight the different sections of the brain and the main functions that were mentioned in the mind, brain and body area of study.

Essay

Write an 800 word essay on one of the following topics. In your essay, refer to the relevant theories and studies to support your statements.

- → Is sleep a waste of time?
- → With reference to various parts of the brain, what is meant by the term 'location of function'?

Data analysis

A sleep study used 20 participants—10 aged 10 years old and 10 aged 17 years old. The researchers made a note of those who had a 'screen' (e.g. TV, computer, mobile phone) in their bedroom. The total sleep time over a week was measured and the means were put in the following table.

TABLE 1 Mean sleep time for participants aged 10 years and 17 years

PARTICIPANTS AGED 10 YEARS			PARTICIPANTS AGED 17 YEARS		
Participant	Screen in bedroom	Mean sleep time (hours)	Participant	Screen in bedroom	Mean sleep time (hours)
A	Yes	10.1	K	No	10.0
B	No	10.0	L	Yes	6.4
C	No	12.5	M	No	8.4
D	No	9.2	N	No	10.4
E	Yes	7.6	O	Yes	7.2
F	Yes	9.8	P	Yes	9.0
G	No	11.0	Q	Yes	8.0
H	No	10.5	R	No	7.8
I	Yes	9.4	S	Yes	7.4
J	Yes	10.1	T	No	9.5

1 Calculate the mean sleep time for:
   a all the 10-year-old participants
   b all the 17-year-old participants
   c the participants with screens in their rooms for each age group
   d the participants without screens in their rooms for each age group.
2 Compare the data of the 10-year-old participants with the data of the 17-year-old participants. Is there a difference?
3 Compare the data of the participants with screens in their bedrooms to the data of the participants without screen for each age group. Is there a difference?
4 Participant B represents the typical sleep time for someone aged 10 years. How do the other 10-year-old participants total sleep times compare with this figure?
5 How much sleep is recommended for a teenager? How do the 17-year-old participants' sleep times compare with this amount?
6 Describe the typical sleep pattern for a teenager. How does this compare to a child and an adult?
7 Why do sleep experts recommend not having screens in your bedroom? Is this reason supported by the data in the study?
8 Consider the amount of sleep that participants E and L are getting. In what way do you think this could be affecting their school work and relationships with their friends?

ASSESSMENT RUBRIC

CRITERION	0 TO 1
1 Psychological knowledge and understanding The work demonstrates an accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices.	Limited knowledge and correct use of psychological terminology, concepts and practices.
2 Evidence-based arguments Employs higher order thinking (analysis, synthesis, evaluation and application) to complete task. Constructs evidence-based arguments that draw on psychological research findings and theoretical models to justify the student's explanations, evaluations and applications.	Limited display of higher order thinking and/or incorrect or inappropriate application of psychological knowledge to draw relevant conclusions.
3 Locate and use of psychological information Locates and draws on a range of appropriate and legitimate (valid and reliable) psychological sources to complete the assessment task.	Limited or inappropriate use of legitimate psychology sources of information have been draw upon to complete this task.
4 Strategies to complete the task Displays initiative, independence, critical reflection and cooperation while completing the task. Develops monitors and executes effective strategies to successfully complete the task.	Little or ineffective planning and monitoring of appropriate strategies to complete the task.
5 Communicating Communicate psychological ideas and information in a concise, focussed and logical manner to meet the demands of the assessment task.	Assignment lacks logical structure and/or relevant psychological information to communicate ideas.
6 Referencing Cite and reference sources of information within body of text and reference list according to APA format (if relevant).	Sources of information are inaccurately referenced or not shown.

2 TO 3	4 TO 5	6 TO 7
Correct use of psychological terminology appropriate to the assessment task.	Correct and appropriate use and understanding of the psychological terms, concepts and practices in a manner that directly relates to meeting the demands of the assessment task.	Accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices to clearly meet the demands of the assessment task.
Demonstrates understanding of the task and summarises information to state conclusion. Relies on source material rather than transform psychological information to demonstrate higher order thinking.	Able to differentiate the key elements of the task and psychological understandings and draw logical conclusions. Uses evidence-based arguments to support student's point of view.	Able to analyse and evaluate psychological information to draw insightful, appropriate and meaningful conclusions. Constructs evidence-based arguments to explain, analyse and justify the student's point of view including explanations, evaluations and applications
Legitimate psychological sources have been located and used to address the requirements of the task.	A comprehensive range of relevant and legitimate psychological sources have been located and used effectively to address the requirements of the task.	
Development of strategies to complete the task.	Develops monitors and executes of strategies to successfully complete the task. Displays initiative, independence, critical reflection and cooperation while completing the task.	Displays initiative, independence, critical reflection and cooperation throughout the process of completing the task. Develops, monitors and executes effective and efficient strategies to successfully complete the task.
Logical structure is used to communicate psychological ideas in an appropriate manner suitable for the intended audience.	Focussed and logical structure is used to communicate psychological ideas and information in a clear and concise manner suitable for the intended audience.	
Sources of information are correctly referenced and cited using APA format.		

* Teachers will indicate to their students which aspects of each criterion are applicable to the relevant assessment task that has been set for their class.

AOS 2 MEMORY

Memory … is
the diary that
we all carry about
with us.

Oscar Wilde

What makes us remember some things and forget others? How do we remember? Do we ever really forget? Friedrich Nietzsche said: 'the existence of forgetting has never been proved: we only know that some things don't come to mind when we want them.' perhaps he was pointing out a fundamental truth – it certainly would be hard to prove.

In this area of study, we examine the biochemical and psychological mechanisms of memory formation and the ways in which a person's abilities in the memory processes vary across the lifespan. Different models of memory and studies of forgetting are examined.

Finally, we consider ways in which memory can be improved and conversely we study some aspects of eyewitness testimony to examine how memories may be reconstructed, manipulated and distorted.

OUTCOME

On completion of this unit, the student should be able to 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.

(VCE Study Design, 2013)

→ CHAPTER 08:

MODELS FOR EXPLAINING HUMAN MEMORY

Memory is a psychological concept that can be interpreted in several different ways. The main models that used to describe memory are complementary, no one model explains all of human memory, but by considering several models together, we can build up a picture of what human memory is and how it works.

The models do not describe the physical reality of memory, but they help our understanding, communication and research in the area.

KEY KNOWLEDGE

Models for explaining human memory:

- Atkinson and 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, visuospatial sketchpad, episodic buffer
- levels of processing as informed by Fergus Craik and Robert Lockhart
- organisation of long-term memory including declarative (episodic and semantic) and procedural memory, and semantic network theory.

(VCE Study Design 2013)

Foundation for the study of memory

CHAPTER OVERVIEW

Foundation for the study of memory	The processes of memory > Encoding > Storage > Retrieval
Atkinson and Shiffrin's multi-store model of memory	Sensory memory > Functions of sensory memory > Iconic memory > Echoic memory Short-term memory > Chunking and capacity > Maintenance rehearsal and duration Long-term memory > Duration and capacity > Encoding and storage: Elaborative rehearsal > Baddeley's study of encoding Evidence to support the multi-store model of memory > The serial position effect
Baddeley and Hitch's model of working memory	Investigating working memory > Working memory and multi-tasking > Working memory and intelligence
Levels of processing: Craik and Lockhart	Structural (features – shallow) Phonemic (sounds – moderate) Semantic (meaning – deep)
Organisation of long-term memory	Procedural memory Declarative memory > Episodic memory > Semantic memory Semantic network theory Organisation of information in the LTM: Other theories

One well-understood model of memory was proposed by Atkinson and Shiffrin (1968) who suggested that memory comprises three stores: a brief and fleeting **sensory memory**, a slightly longer-lasting **short-term memory**, and a **long-term memory** store that is virtually unlimited in both capacity and duration. This is referred to as the information processing model.

Although it is commonly used, this is not the only model of memory and some other models help to explain functions of memory that are not explained by the information processing model. Some psychologists view short-term memory (STM) and long-term memory (LTM) differently. British psychologist Alan Baddeley (Baddeley, Eysenck & Anderson 2009; Baddeley & Warrington 1970) emphasises **working memory,** which explains STM and its links to LTM. According to this model, working memory contains items that have entered STM from sensory memory as well as pieces of information retrieved from LTM. Working memory also refers to the mental operations we are performing on this information.

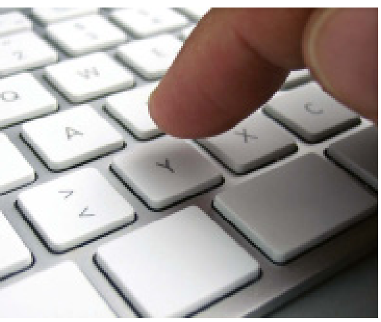


FIGURE 8.1 Encoding – putting into memory

Another way of looking at memory is the **levels-of-processing** model which was proposed by Craik and Lockhart (1972). They suggested that memory does not comprise any specific store but runs along a continuous dimension related to the depth (complexity) of **encoding**. This model proposes that there are many levels at which information can be encoded. The more elaborate and deliberate the encoding of information, the more likely it is to be remembered later on, and the easier it is to retrieve.

As well as the different models of memory in general, psychologists also have different ways of conceptualising **semantic memory** – the model of the way in which memories are stored in LTM. Allan Collins and Ross Quillian proposed the **semantic network** model of LTM, which suggests that memory storage of facts and knowledge takes the form of a hierarchical tree of concepts that are related to each other (Collins & Quillian 1969).

The processes of memory

To understand the different models of memory, it is helpful to be familiar with the processes of memory.

The whole process of memory is really similar to the way we use a computer. Memory depends on three sequential processes called **encoding**, **storage** and **retrieval**.

FIGURE 8.2 Storage is keeping information in the brain so that we can use it later on – like saving it to the hard drive of a computer or to a memory card.

ENCODING

Encoding refers to the process of putting information into a form that will allow it to fit in with your personal storage system. If you strike the 'X' key on your computer keyboard and press 'Enter', an electronically coded message representing 'X' goes into the computer memory. The same happens when we put an idea into our brain, but for us the idea is changed into an electrochemical code.

Memory may be improved by improving the quality and depth of encoding.

STORAGE

Storage is keeping information in the brain so that we can use it later on – like saving it to the hard drive of a computer. We store the information in an organised way to make it easier for us to recover memories when we need them.

One type of system of organisation is called a 'semantic network' and this is discussed later (page 260).

RETRIEVAL

Retrieval is the process of getting information back from memory so that we can use it – like opening a file on a computer and getting a document on the screen.

Retrieval relies on using the right cues so that we can get to the correct location in our semantic networks; again, just like using the correct folder and filename to open a computer file.

Although we can describe encoding, storage and retrieval as if it is a computer, this is only an analogy. The brain does not store a memory like an object in one place. Each memory is spread out over a huge population of cells throughout different regions of our brain.

The analogy of a computer for memory fits quite well for encoding and retrieval but it is inadequate for storage. Storage is a dynamic process whereby human memories change over time and, unlike a computer hard drive, human memories are rough copies rather than exact replicas of information.

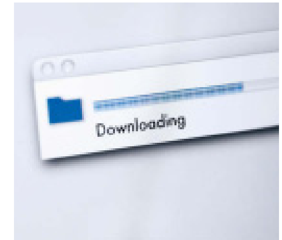


FIGURE 8.3 Retrieval is the process of getting information back from memory so that we can use it – like opening a file on a computer and getting a document on the screen.

8.1 REVIEW

1 What are the three key processes involved in memory? Explain what happens in each process.
2 What analogy can be used for explaining 'retrieval'?

Atkinson and Shiffrin's multi-store model of memory

The analogy of a computer as a model for human memory has been a useful and popular way to help researchers understand memory. This analogy is also useful because, as research progresses, it can be modified and adapted to include new findings.

The most common version of this analogy for memory was originally proposed by Atkinson and Shiffrin (1968) who called it the **multi-store model** (or modal model) of human memory.

The multi-store model of memory describes three stores of memory. These three stores function simultaneously and interact with each other. They were referred to by Atkinson and Shiffrin as:

- sensory memory
- short-term memory
- long-term memory.

Sensory memory is a very brief memory store (like a computer's buffer). Information enters this register and may then transferred to STM if the person pays attention to it.

Short-term memory is a limited store of actively conscious memory (like the computer's RAM). Information is then transferred to LTM if it has been encoded.

Long-term memory (like a computer hard drive) is a store of information that is virtually limitless in capacity. It needs retrieval to bring it back into conscious awareness.

These three levels of memory are separate but they work together to create our ability to encode, store and retrieve information.

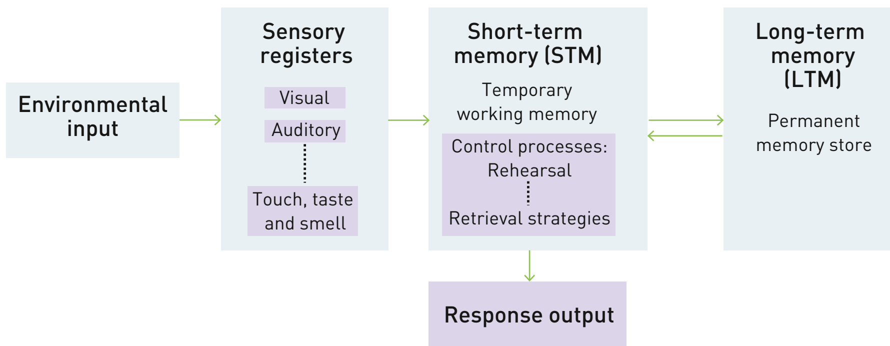


FIGURE 8.4 The Atkinson and Shiffrin multi-store model of memory

Sensory memory

According to the multi-store model of memory, sensory memory is the first stage of memory. Sensory memory relates to memory *within our sense organs*. It is where information in our environment is received by our senses. If the information is unique, different, interesting, relevant or in some other way attracts our attention, then it is transferred to STM. Sensory memory is different to short-term and long-term memory because it has an unlimited capacity but only a very brief duration.

We have a sensory store for each of the five senses. Each sensory store is able to hold information for anything between a fraction of a second and several seconds (it varies from one sense to another). The information held in sensory memory has not yet entered our awareness and, if we don't pay attention to it, it never will! The information in sensory memory is not processed; we say that the energy is briefly stored in its raw form before the traces fade or decay.

FUNCTIONS OF SENSORY MEMORY

Sensory memory prevents us from being overwhelmed by the huge amounts of incoming sensory information. Its duration is very brief, but long enough for our brain to determine whether the incoming sensory information is important enough to be transferred to our short-term memory. Our senses are bombarded with incoming information every second of our normal waking consciousness. It is impossible – and unnecessary – for us to pay attention to all of this information, so our sensory registers act like filters for incoming information that is relevant to whatever we might be doing or thinking at any given moment. The brief duration (rapid decay) of sensory memory is necessary; otherwise, we would be unable to process new incoming information. The rapid decay also allows us to perceive our world as smooth and ongoing, and to hear sounds just long enough to understand whole words and sentences.

Just imagine what it would be like if sensory memory was not short in duration – while you were listening to the end of your teacher's lesson on psychology, you would still be hearing the first words she uttered – there would be chaos in your mind!

Two examples of sensory memory that relate respectively to our visual and auditory sensory systems are iconic memory (vision) and echoic memory (hearing).

FIGURE 8.5 Sensory memory is of brief duration.

Did you know?

The short duration of sensory memory is essential, as it acts as a filter.

8.2 REVIEW

1 Draw a labelled diagram to illustrate your understanding of Atkinson and Shiffrin's multi-store model of memory. Make sure that you include sensory, short-term and long-term memory.
2 Explain two key differences between sensory memory and short-term memory.
3 Outline the function of sensory memory.
4 What happens to information that is not attended to in sensory memory?

ICONIC MEMORY

Iconic memory refers to visual sensory memory. *Icon* is from the Greek word meaning 'image'.

Iconic memory lasts for about 0.3 seconds. This explains why we can see moving pictures from a series of still shots projected onto a movie screen. We are still storing the image of one still shot when it is replaced by the next frame, so the illusion of movement is created. This is why movies run at 64 frames per second. Research on people with reading disorders such as dyslexia suggests that the duration of the iconic sensory memory is too long for these people and therefore the images of words and letters persist too long to enable the processing of the next words in a reading passage (DiLollo, Hanson & McIntyre 1983).

INVESTIGATE 8.1

APPLICATION OF ICONIC MEMORY

Try the following activities.

- Shut your eyes and try to describe what after-image remains. It is likely that you will be unable to describe all of it because it has faded faster than you have the time to remember all of it.
- When at home, use a torch or a sparkler in the dark: wave it around in circular movements. You will notice an after-image in circles of light in the dark atmosphere.
- Hold a pencil loosely between your thumb and index finger and shake it. The pencil will appear to be floppy because of the after-image it leaves on the sensory receptors in the retinas of your eyes.

ECHOIC MEMORY

Echoic memory refers to our auditory (sound) sensory memory. It stores sounds for 3–4 seconds. This comparatively long time helps to explain why sometimes we may appear not to hear a question but then we pay attention and answer it a few seconds later!

TABLE 8.1 Summary of characteristics of sensory memory

TYPE OF SENSORY MEMORY	PROPERTIES		FORM OF ENCODING	FORGETTING	EXAMPLE
	DURATION	CAPACITY			
Iconic memory	0.3 seconds	Unlimited	Visual	Fades rapidly	Waving a sparkler in the dark and briefly experiencing an afterimage
Echoic memory	3–4 seconds	Unlimited	Acoustic	Fades	Retaining the sounds of words for long enough to understand the whole word or phrase that has been spoken

Source: (Sperling, 1960)

SPERLING'S ICONIC MEMORY STUDIES

In his experiment on memory, Sperling was able to demonstrate the existence of iconic memory by using a tachistoscope, a device that flashes visual stimuli onto a blank screen for a specific, very brief period of time.

Sperling asked participants to remember as many symbols (letters or numbers) as they could from a grid of 12 that he displayed for 1⁄20 of a second with the tachistoscope. He found that participants could remember about four of the symbols before the remaining items had faded from their sensory memory. Sperling concluded that iconic memory has a **duration** of approximately one-twentieth of a second. However, participants said that they saw more symbols than they could report before they faded. Therefore, Sperling also tested the **capacity** of the iconic memory.

He presented the twelve-item grid for 1⁄20 of a second, followed by a high-, medium- or low-sounding tone which signalled to the participants which of the three rows of four symbols to attend to and report (partial report condition). He found that the mean number of symbols reported was three out of four symbols from the specified row.

Sperling further tested the duration of the iconic memory by allowing a delay between the sounding of the tone and the presentation of the grid in the tachistoscope. He found that the longer the delay, the more symbols were forgotten, with only 50 per cent of symbols recalled after a 0.3 second delay and 33 per cent after a 1 second delay.

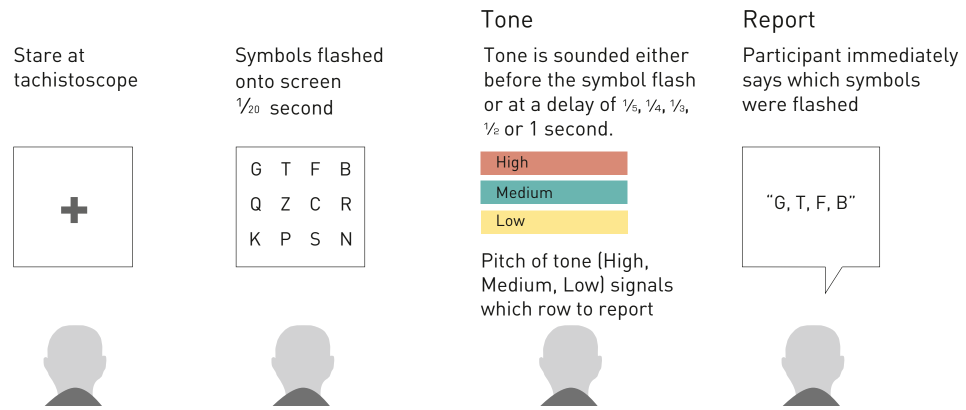


FIGURE 8.6 Sperling asked participants to stare (fixate) at the tachistoscope screen. The symbols were briefly flashed onto the screen. Participants relied on the afterimage of the symbols to report what symbols they could remember.

Step 1 Use the tachistoscope to flash the grid to participant	Step 2 Ring the tone to signal to the participant which row to attend to	Step 3 Participant recalls the symbols from the relevant row in the grid
G T F B Q Z C R K P S N	e.g. High tone for top row Medium tone for middle row Low tone for bottom row	If medium tone is sounded ? ? ? ? Q Z C R ? ? ? ?

FIGURE 8.7 Steps in Sperling's study

SPERLING'S STUDY OF ICONIC MEMORY

8.2 INVESTIGATE

Write a report about Sperling's study of iconic memory.
Answer the following questions.

1 Write the three experimental hypotheses.
2 Name the independent and dependent variables.
3 How was the DV operationalised?
4 What was the experimental design for this study?
5 Identify one limitation and one advantage of using this experimental design.
6 Were there any potential confounding variables?
7 How might the encoding and retrieval for iconic memory be affected if Sperling's participants were shown pictures instead of symbols? To answer this question, consider the amount of time it takes to identify and name a picture compared to a symbol.

8.3 REVIEW

1 Explain the difference between iconic and echoic memory.
2 What is the capacity and duration of iconic and echoic memory?
3 Explain why one has a shorter duration than the other.
4 Consider the following situation. A friend asks you a question. Initially, you say 'I beg your pardon?' By the time you've finished saying that, you become aware of the content of that question and respond appropriately. Explain this phenomenon in terms of sensory memory.

Short-term memory

Short-term memory (STM) is often likened to the RAM (Random Access Memory) in a computer because it is where mental manipulation takes place. It may be using information coming in from sensory memory and information being retrieved from long-term memory (LTM), and often it is combining the two. STM allows us to retain information for enough time to use it; for example, looking up a telephone number and keeping it in your awareness long enough to dial it.

Incoming sensory information that is selected through attention by the sensory memory may pass into the STM. We routinely draw information from LTM to STM to evaluate and understand information that we are working on at a given moment, for example, reading comprehension questions or mental arithmetic. STM is distinguished from sensory memory and LTM because it has only a brief duration of approximately 12–30 seconds and a brief capacity of only 5–9 (7 ± 2) pieces of information. The reason that we write 7 ± 2 is because on average adults retain seven pieces of information, but for some adults it is five and for others it is nine pieces of information. When this capacity is reached, new information can only be put into STM by displacing existing information.

TABLE 8.2 Characteristics of short-term memory

PROPERTIES OF STM		FUNCTION	ENCODING	FORGETTING	EXAMPLE
CAPACITY	DURATION				
7 ± 2 items	12–30 seconds	Holds information in awareness for a short period of time – long enough to use for mental tasks	Mostly acoustic. Attention and rehearsal will help store information in LTM	Displacement and interference Possibility of decay	Remembering an address long enough to look it up in an online street map service

INVESTIGATE 8.3

MEMORY SPAN

1 Complete the following activities about short-term memory capacity.

a Have a partner read aloud each row of the digits below, with you repeating them immediately. Your partner should proceed through this list until you make errors in two successive sets of digits. This will provide you with an indication of your memory span. Consider whether there was any interference in your ability to retain the information.

9, 3
7, 4, 6
5, 0, 3, 7
2, 6, 8, 1, 4
7, 3, 9, 0, 2, 5
8, 5, 3, 0, 1, 6, 2
9, 5, 3, 2, 4, 8, 0, 6
2, 5, 7, 1, 0, 8, 3, 6, 4
9, 2, 5, 7, 3, 1, 0, 8, 4, 6

b Did you begin to chunk any of the digit sets?

c Read each row of letters, then look away and try to repeat them.

L J G V Q

A F T E H O

J O Q R D W Y

M D F T U W C H

A S D T H J Q Y O

As the number of letters in each row increases, you will find it more difficult to retain all of them. Most people can retain the 'magic' seven items in short-term memory, plus or minus two items.

2 One limitation is that STM is influenced by how long it takes to say a word or sound. For example, the letter 'a' is quicker to say than the letter 'w'. Similarly, short-term memory capacity is reduced when people try to remember complex visual patterns because they have to retain so much detail in each pattern. Work with a partner to design your own experiment, using words rather than letters or numbers. You can use the Internet for research. Remember to think about the number of syllables in each word. Include the following:

> an aim for the experiment

> an experimental hypothesis

> the independent and dependent variables

> results presented in a table. You may also include a graph

> a conclusion for your experiment.

You do not need to write a formal report. Present your work as a Word document.

CHUNKING AND CAPACITY

Chunking is the grouping together of items that can be remembered as a chunk. An item can be something simple, such as a digit, or more complex, such as a word. A chunk is group of familiar stimuli stored as a single unit.

What this means is that instead of each *item* occupying a number of locations available in short-term memory, each *chunk* occupies only one location and therefore frees up the other locations for more information to be stored.

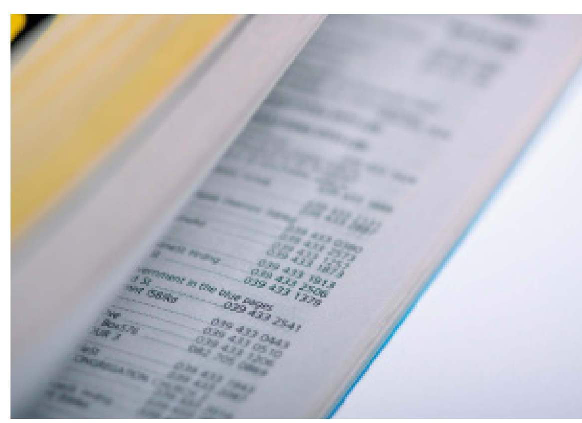


FIGURE 8.8 Chunking greatly increases the amount of information that we can hold in STM.

When remembering a string of numbers, it is often easiest to chunk in twos, threes or fours. Consider when we try to remember mobile phone numbers. With mobile numbers of 10 digits, we need to solve the problem of the limited capacity of STM. To do this, we chunk some of the digits in the mobile number together. We do this automatically as we remember the numbers in the pattern XXXX XXX XXX.

Chunking is even more effective when the chunks themselves have their own meaning in LTM, for example '365' for days in a year or '1966' for St Kilda's only premiership win.

Chunking is a powerful means of assisting our memory; it greatly increases the amount of information that we can hold in STM.

INVESTIGATE 8.4

MILLER'S STUDY AND SHORT-TERM MEMORY

In an empirical study, Miller (1956) demonstrated that short-term memory has a limited capacity of 7 ± 2 locations for items to be stored but this capacity could be increased through 'chunking' items into larger groups – and therefore storing 7 ± 2 groups of items.

Answer the following questions.

1 What are the dependent and independent variables for Miller's study?
2 Write an operational definition of Miller's DV.
3 Write an experimental hypothesis for this study.
4 Which experimental design would be the most effective for this study? Why?
5 What extraneous variables might need to be controlled for in this study? How could these be controlled?
6 What are any potential confounding variables for this study?
7 Write a conclusion for Miller's research findings.
8 Suggest any ethical issues that could have arisen in this study.

Chunking: increasing the capacity of short-term memory

Working in pairs, carry out the following investigation.

1 Ask your partner to tell you a mobile telephone number without pausing between any of the 10 digits.
2 Immediately try to recall the number. Give yourself a score of 1 for each digit remembered to obtain a score out of 10.
3 Now ask your partner to tell you a different mobile phone number, but this time with a pause after four digits, then the next three digits and the last three.
4 Immediately try to recall the number and record your score. Was your score improved due to the chunking?
5 Repeat this task with a new phone number that is chunked, but allow a 30-second pause before you try to recall the number. Record your score out of 10.
6 Record your results in a table.

MAINTENANCE REHEARSAL AND DURATION

The duration of STM is limited compared to that of sensory memory and LTM. It lasts for approximately 12–30 seconds provided there is no **interference**. Interference occurs when new information enters the STM and pushes out information that is already there. To retain information in our STM, we need to solve the problem of its limited duration. To do this, we use **maintenance rehearsal**. If you rehearse the information in the STM, you increase the chances of retaining the information.

Maintenance rehearsal enables us to keep information in STM for a longer period of time. It simply means repeating the information over and over again. As long as we are not interrupted, we can keep information in STM almost indefinitely by this method; however, we can't spend our lives thinking about the same 5–9 pieces of information, so new information fills the spaces and displaces the old items.

Maintenance rehearsal does not add meaning to the information or link it to other material already in LTM. It just holds it in STM for a longer time and, when maintenance rehearsal stops, the information will be lost 12–30 seconds later.

However, if we repeat something often enough – maybe tens or hundreds of times – transfer to LTM can occur.

FIGURE 8.9 We use maintenance rehearsal to retain the map reference for an address in our STM for long enough to find it on the map. For example, E6 on this map has been retained for long enough to look up the street and page number and then locate it on the map.

TABLE 8.3 Methods of maintenance rehearsal

METHOD	EXAMPLE
Verbal (using words)	> vocal – saying words out loud > sub-vocal – thinking words silently to oneself
Non-verbal (using visual or spatial information)	> visualising – keeping a pictorial image in one's mind > muscular – imagining how it feels to perform an action

8.4 REVIEW

1 Outline the duration and capacity of short term memory (STM).
2 How does STM differ from sensory memory?
3 What function does STM play in our ability to remember things?
4 As STM has a limited duration and capacity, what methods can be used to increase its efficiency?
5 Maintenance rehearsal increases the ______________ but not the ______________ of STM.
6 Roger attends a party with a friend and is introduced to three new people. Explain how Roger could memorise these people's names using maintenance rehearsal.
7 Explain how chunking can be used as a method for improving memory. Give a real life example of how we use chunking in day-to-day life.

KEY STUDY

PETERSON AND PETERSON (1959)

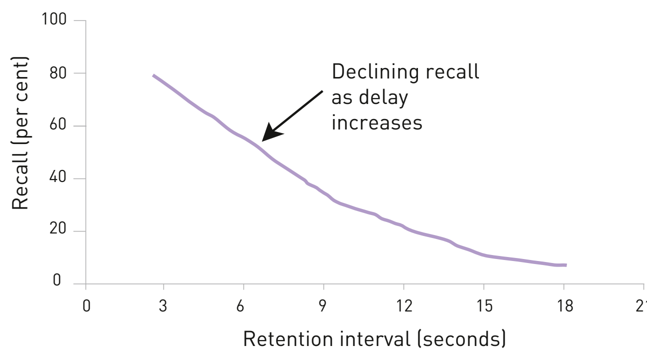


FIGURE 8.10 Results for Peterson and Peterson's study for the percentage of trigrams recalled after a delay.

Peterson and Peterson (1959) demonstrated in an experiment that STM has a duration of approximately 12–30 seconds unless the information is rehearsed.

They asked participants to remember a single nonsense trigram of three consonants, such as 'dkt'. Participants' recall of the trigram was recorded after delays of 3, 6, 9, 12, 15 or 18 seconds. It was found that recall was very good (80 per cent) after 3 seconds but was only 10 per cent after 18 seconds. This study demonstrated the duration of STM and also the role of maintenance rehearsal in STM.

Figure 8.10 indicates the duration of the nonsense trigrams in STM for different periods of time.

In the second experiment, participants were given a task to prevent them from rehearsing the trigram. They were asked to count backwards by threes from the time each trigram was presented to the time a light signalled them to recall it. This is called a 'filled delay'. Results showed that recall after a filled delay was poor, even after 15 seconds. This study demonstrated the role of displacement in STM. The results for this study are shown in Figure 8.10.

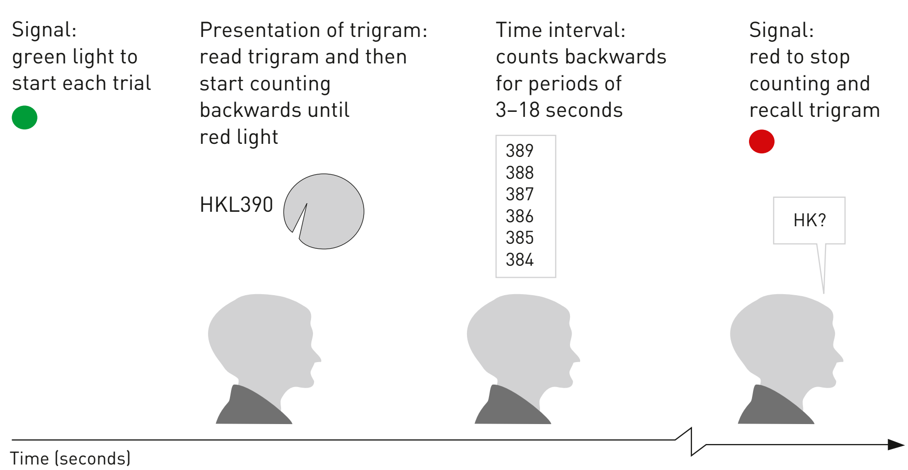


FIGURE 8.11 Peterson and Peterson's experiments on duration of STM

KEY STUDY

CONRAD (1964)

Conrad (1964) demonstrated in an empirical study that short-term memory appears to encode items mostly in an acoustic (sound) code. His experiments suggested that, regardless of whether we see or hear information, we usually repeat the information verbally rather than visually when we want to retain it in our short-term memory.

Conrad showed that when the presented letters rhymed they were significantly harder to recall than non-rhyming letters because there was acoustic confusion.

Conrad also found that when letters were presented visually to participants, errors still tended to be based on acoustic confusability. He concluded that even when information enters the short-term memory in visual format, it is still encoded acoustically.

RHYMING LETTERS	B,T,C,P,D,E
NON-RHYMING LETTERS	Z,R,N,W,Q,A

INVESTIGATE 8.5

DURATION OF SHORT-TERM MEMORY

Read the key study 'Peterson and Peterson (1959)' and complete the following.

1 Identify the dependent and independent variables for each of Peterson and Peterson's experiments.
2 What was the experimental design for each experiment?
3 Name one limitation of this experimental design.
4 What extraneous variables might need to be controlled for in these experiments? How could these be controlled?
5 Write a conclusion for each of Peterson and Peterson's experiments.

INVESTIGATE 8.6

RESEARCH METHODS: ENCODING OF STM

Read the key study 'Conrad (1964)' and complete the following.

1 Name the independent and dependent variables.
2 Write experimental hypotheses for each of Conrad's experiments.
3 What might have been a suitable experimental design for these experiments?
4 Identify any potential for confounding variables.

Long-term memory

Long-term memory (LTM) works very much like the hard drive on your computer (ROM – Read Only Memory) – the information is encoded and stored and, as long as you know enough about the information (like the name of a document or the folder it is in), you can retrieve it. Often we find we can't recall something that we know really well – that just means that there were not enough cues (hints or prompts) to enable us to retrieve it.

In LTM, information is encoded by its meaning (i.e. semantically) and stored in **semantic networks**. LTM is thought to have virtually unlimited capacity and also virtually unlimited duration.

DURATION AND CAPACITY

It is clear that LTM lasts longer than sensory memory and STM and its capacity is greater than STM. It is hard to identify, however, just how long the duration of LTM might be. Sometimes, previously stored memories are thought to be forgotten but, with the appropriate cues, the memories will suddenly come flooding back into conscious awareness. Long-term memories are maintained because of physiological changes to the neurons and their connections with other neurons.

Similarly, it is difficult to determine the capacity of LTM and there is probably no way of finding its limits. We use LTM for conducting our everyday lives and without it we cannot function. It is generally considered that 'forgetting' long-term memories is due to poor retrieval cues rather than capacity limitations. There are also difficulties in measuring the capacity of LTM, where different measures of retention (see Chapter 11) will produce different results.

INVESTIGATE 8.7

MEMORY VIDEO

Evaluation of research: duration of LTM

Researchers tested participants' memory of high school classmates 25 years later. Participants were able to distinguish between former classmates and strangers in a pool of photographs (recognition). Similarly, they could also match names to the photographs (cued recall). Their rate of non-cued recall (free recall) of names, however, was poorer (Bahrick, Bahrick & Wittlinger 1975).

1 What does this study demonstrate about the difficulty in researching the capacity of LTM?

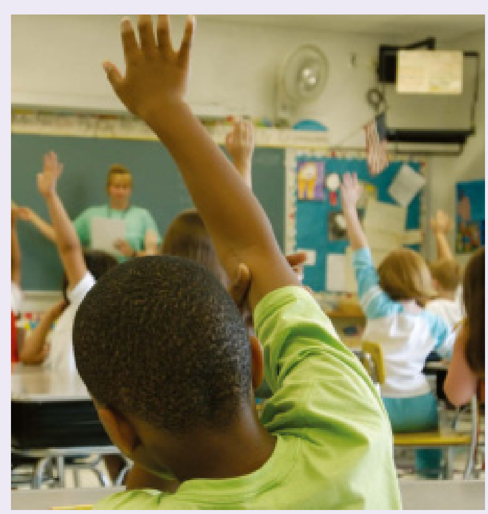


FIGURE 8.12 Can you remember the names of students in your Year 7 English class?

2 Identify the dependent and independent variables for this study.
3 Write a research hypothesis.
4 Identify an appropriate research design that might have been used in this research.

ENCODING AND STORAGE: ELABORATIVE REHEARSAL

For information to be encoded in LTM, it would ideally be transferred in STM in a meaningful form – that is, semantically encoded. However, we can also hold visual, acoustic, and procedural information in LTM.

To have the best chance of encoding information into LTM it is best to use a form of **elaborative rehearsal**. Elaborative rehearsal is a process by which we give meaning to information and link it to other information already in memory. By thinking of examples of concepts as we are learning them, we tend to process the information at a deeper level. Salience, or personal relevance, is another way we can improve encoding of information. This requires mentally involving ourselves in an example connected with the material being learnt.

The advantage of elaboration is that it provides extra links to other material in LTM. To use an analogy, it is like putting a brick in a wall that's being built – if it is attached to six other bricks it will be secure and fixed tight!

In other words, elaborative rehearsal involves using effort to make meaningful associations between new information to be remembered and old or familiar information that is already in LTM. This involves association: making information meaningful by relating new information to that which is already in memory. By making associations between new and old information, we create cues to help us locate and retrieve this information from LTM at a later time.

8.5 REVIEW

1 Outline two key differences between STM and LTM.
2 How is information stored in LTM?
3 What is the most effective method of encoding or storing into LTM?
4 Explain what elaborative rehearsal involves and give an example to illustrate your understanding.

8.8 INVESTIGATE

ELABORATIVE REHEARSAL

Ask a classmate to give you a mobile phone number to remember. You could use maintenance rehearsal or chunking to try to remember it but later you will probably find that you have forgotten it. However, you might be able to link the numbers with the birthdays or ages of family and friends, or you might convert the numbers into a song with a familiar tune. Test your memory for the number at the end of the lesson to measure the effectiveness of your method of elaborative rehearsal.

Another form of elaborative rehearsal is through use of **mnemonic devices** (see Chapter 11). Think about when you are studying for a test and only have a small amount of time to learn the information. How you rehearse information will influence how effectively you retain it. You could try repeating it over and over, or you could elaborate on it so that it becomes meaningful to you by connecting it to knowledge already in LTM. This can be achieved through processing at the semantic level, which might involve using deliberate methods such as mnemonics.

TABLE 8.4 Summary of properties of long-term memory

PROPERTIES OF LTM		FUNCTION	ENCODING	FORGETTING	EXAMPLE
CAPACITY	DURATION				
Virtually unlimited	Virtually unlimited	Holds information in semantic networks making it available for retrieval at a later time	Elaborative rehearsal > structural > phonemic > semantic	Displacement and interference Possibility of decay	Remembering the names of your friends; remembering your 18th birthday party; remembering how to ride a bike

BADDELEY'S STUDY OF ENCODING

Baddeley (1966) demonstrated that LTM stores information in semantic form. He presented participants with four lists to remember. He found variation in the recall of each list.

For trial one, he presented a list of similar-sounding words followed by different-sounding words. Results indicated that immediate recall for similar-sounding words was poorer than for different-sounding words. However, after a 20-minute delay, the percentage of words recalled was similar for both types of word lists. This suggested that it was easier to retain words that sounded different in STM but, for LTM, the way words sounded (acoustic encoding) made no difference to the amount of information that was encoded, stored and retrieved.

TABLE 8.5 Summary of results for encoding in LTM study (Baddeley 1966)

TYPE OF WORD LIST	IMMEDIATE RECALL (% WORDS RECALLED)	RECALL AFTER 20 MINUTES LTM (% WORDS RECALLED)
SOUND OF WORDS		
List A: Acoustic similarity (similar-sounding words) e.g. *man, map, cap, can*	worse than list B	similar to list B
List B: Acoustic difference (different-sounding words) e.g. *hard, tree, ball, chair*	better than list A	similar to list A
MEANING OF WORDS		
List C: Semantic similarity (similar-meaning words) e.g. *small, tiny, little, mini*	similar to list D	worse than list D
List D: Semantic difference (different-meaning words) e.g. *cook, sunny, grass*	similar to list C	better than list C

For the second trial, Baddeley first presented a list of words that were similar in meaning and tested the immediate and delayed recall. He then presented a list of words that were different in meaning. He found that participants' immediate recall was the same for both word lists but, after a 20-minute delay, their recall was worse for words that had similar meaning than for words that had different meaning. This suggested that meaningful encoding (semantic encoding) was more effective for retention in LTM.

CAT	CAR
DOG	DAD
HAT	MAN
ELEPHANT	

FIGURE 8.13 Which word do you remember best from this list?

BADDELEY'S STUDY OF ENCODING IN LTM

INVESTIGATE 8.9

Using the previous information, answer the following questions about Baddeley's research (1966).

1. Name the independent and dependent variables.
2. State the variables in operational terms.
3. What were the two experimental conditions?
4. Write an experimental hypothesis for this research.
5. What was the experimental design?
6. Identify any potential confounding variables. How might these have been controlled?
7. Write a conclusion for this experiment.
8. How have the results of this study contributed to our understanding of memory?

Evidence to support the multi-store model of memory

There are two types of evidence to support Atkinson and Shiffrin's proposal that information moves between the different memory stores:

- **free recall** studies: the **serial position effect**
- studies of patients with brain damage.

THE SERIAL POSITION EFFECT

A number of research studies have identified the serial position effect. This is where the immediate free recall of items at the beginning or at the end of a list are remembered better than those in the middle of the list (Glazner & Cunitz 1966; Postman & Phillips 1965). The serial position effect provided evidence that there might be short-term and long-term memory systems.

The serial position effect was demonstrated where participants were given a list of 20 words to learn and then asked to recall them immediately. When the recall of words was graphed, a pattern referred to as the *serial position curve* emerged, depending on where the words were located on the list (see Figure 8.14).

To observe the serial position effect, the words or items in the list need to be similar in characteristics and in significance to the learner. For example, they might all be three-lettered words such as 'cat', 'pen' and 'try'. A word such as 'elephant' placed in the middle of a list will be remembered because it stands out from the rest of the list (the von Restorff effect).

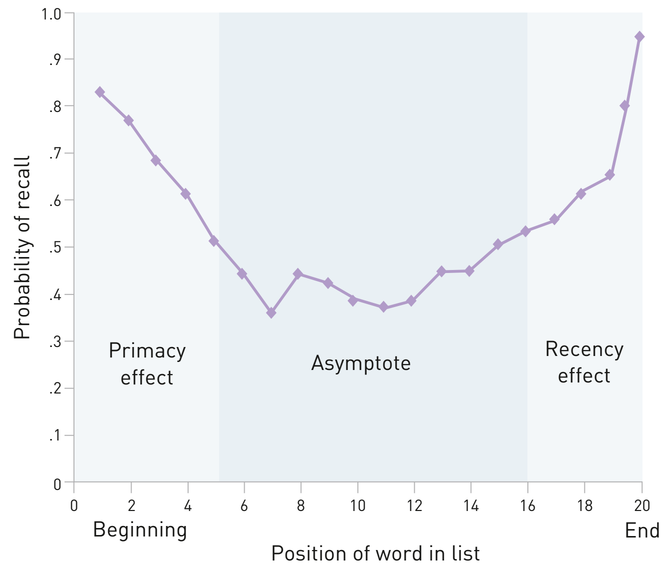


FIGURE 8.14 The serial position curve. The serial position effect provides evidence for the existence of separate long-term and short-term memory stores.

TABLE 8.6 Summary of serial position effect

EFFECT	DESCRIPTION	ENCODING	EXPLANATION
Primacy effect	Superior recall for items at the beginning of a list compared to items in the middle of a list	Items at the beginning of a list are stored in and retrieved from LTM.	Items have probably been rehearsed and transferred into LTM before the capacity of the STM was full. If list lasts longer than approximately 30 seconds (duration of STM), it is likely that items from the start of the list will be forgotten unless they have been stored in LTM. The primacy effect will still occur if there is a delay of more than 12–30 seconds between learning and reporting items.
Recency effect	Superior recall for items at the end of a list compared to those in the middle of the list	Items at the end of a list are retained in STM. There is a tendency to get more of these items correct than items presented earlier on the list.	Items from the end of the list are recalled first. The recency effect will still occur even if the list of items is increased. Maintenance rehearsal has probably been used. The recency effect will not occur where there is a delay of more than 12–30 seconds between learning and reporting the items (delayed free recall).
Asymptote	On a graph, this shows inferior recall for items in the middle of a list compared to those at the start and end of a list.	Items are either not stored in LTM or are displaced from STM.	As STM reaches capacity, items are displaced before they can be adequately rehearsed and stored in LTM.

REVIEW 8.6

1. Copy the graph in Figure 8.14 and annotate/label the principles of the serial position effect.
2. Explain how serial position effect confirms the existence of STM and LTM stores.
3. Outline one criticism of the Atkinson–Shiffrin model.

STUDIES OF PATIENTS WITH BRAIN DAMAGE

Patients with **anterograde amnesia** have provided evidence for a difference between short- and long-term memory. This type of brain damage is after injury to the hippocampus, and often patients can only remember information up to the time of the head injury, although they can still carry out many procedures learnt prior to the brain damage, such as using cutlery. They can also form new **procedural memories** such as learning a simple skill in a ball game.

In contrast, however, these patients were unable to form new **declarative memories** (memory for facts and events, also called **explicit memories**). This was shown in free recall tests where they have good recency effects but very poor primacy effects (Baddeley & Warrington 1970).

CRITICISMS OF THE ATKINSON–SHIFFRIN MODEL

The Atkinson–Shiffrin model does not adequately explain the interaction between the different memory stores. For example, LTM must interact with STM because chunking is most successful when meaning is given to the material that is chunked. Also, we probably rely on information that is already stored in LTM to help determine which information we pay attention to in sensory memory.

The model does not show why the coding of the information changes between the different memory stores.

Other explanations of memory such as levels of processing (Craik & Lockhart 1972) do not draw such a clear distinction between short- and long-term memory, and view memory as a continuum rather than discrete systems.

INVESTIGATE 8.10

In reference to the studies of patients with brain damage, answer the following:

1. What type of research method is used in these studies?
2. What are some limitations of this type of research?
3. What might have been potential ethical issues?
4. How do these studies contribute to our understanding of memory?

Baddeley and Hitch's model of working memory

For many years, the idea was that STM was a location for storage of material as it was processed into LTM. More recently, however, this memory register has been seen as a system for working with the information we are aware of at any given time. Since we are consciously *working* on this information, psychologists now refer to this component as **working memory** (Baddeley *et al.* 2009).

Baddeley and Hitch's model shows that there are four separate but interdependent aspects of working memory:

- the **phonological loop**: auditory working memory; storage of what we hear (also called the articulatory rehearsal loop). This is the store that helps us to understand a sentence of more than a few words; it retains the words from the beginning of the sentence until we have heard the words at the end

- the **visuo-spatial sketchpad**: visual short-term memory; storage of what we see. This is the store you use to help picture what your bedroom would look like if you shifted the furniture around

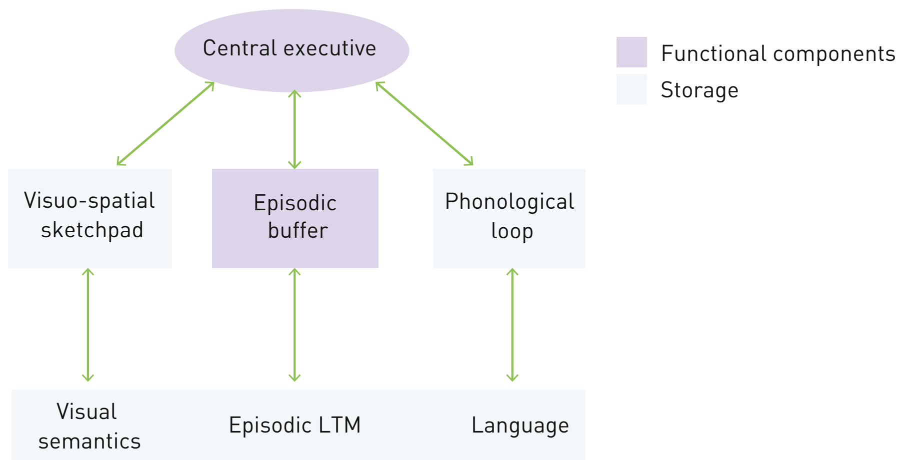


FIGURE 8.15 Baddeley and Hitch's (2000) model of working memory

- the **central executive**: puts together the sounds and vision of working memory; controls our attention and enables us to perform mental manipulation of data. Three main functions of the central executive have been identified as:
  - inhibition: an aspect of attention; screening out irrelevant material
  - switching: changing attention from one item to another
  - updating: modifying items brought in from LTM before re-committing them to memory through the episodic buffer; creating a process of accommodation of the semantic network
- the **episodic buffer**: helps retrieve information from LTM to associate with information that is in working memory, and to select and encode information into LTM.

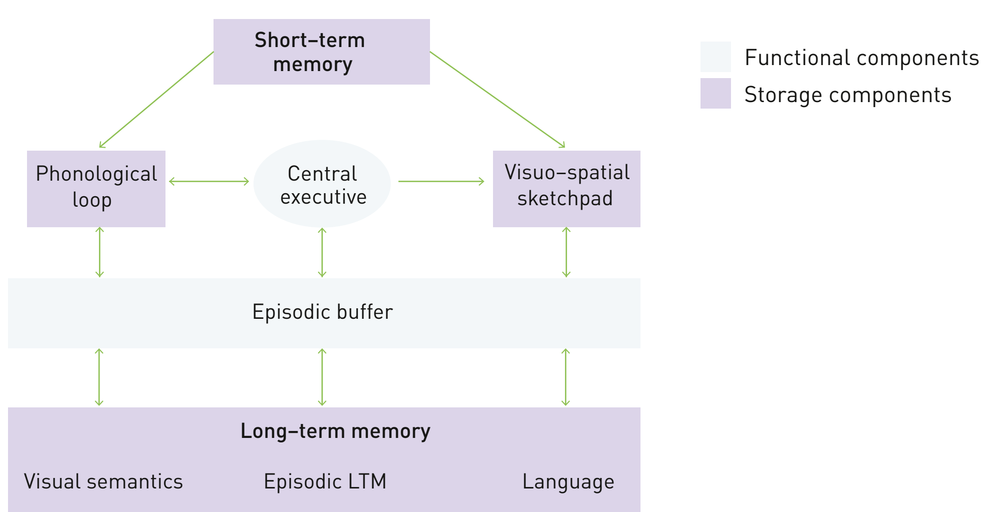


FIGURE 8.16 Working memory – an adaptation for VCE students

How does working memory function in everyday life?

Example 1

Imagine you want to send an SMS to a friend to arrange to meet.

1 Your **central executive** gets the **episodic buffer** to access language from LTM.
2 Your **central executive** forms the message you want to send: *Coffee at Glorious Beans at 12. OK?*
3 Your **central executive** obtains the visual images of your mobile keypad from your **visuo-spatial sketchpad** and coordinates the keystrokes that write the message.
4 Your **central executive** encodes the memory of sending the message through the **episodic buffer** into LTM.

As you can see, the central executive is the controller, manager and decision-maker in working memory.

Example 2

You are going to perform the multiplication problem $7 \times 43 = \_\_\_$

1 The **visuo-spatial sketchpad** enables us to picture the problem.
2 The **phonological loop** enables us to sound the problem in our minds.
3 The **central executive** enables us to realise that we are going to need to retrieve our 7 times table from LTM.
4 The **episodic buffer** retrieves the 7 times table from LTM.
5 The **central executive** works out that $7 \times 3 = 21$ and $7 \times 40 = 280$.
6 The **phonological loop** holds the 'sounds' of 21 and 280.
7 The **central executive** adds these together to come to the answer $280 + 21 = 301$.
8 The **phonological loop** holds the 'sounds' of 301 and enables us to announce the answer.
9 The **central executive** decides if this figure is to be committed to LTM.
10 The **episodic buffer** encodes the information into LTM.

8.7 REVIEW

1 What is the role of the central executive in Baddeley and Hitch's model of working memory?
2 How does the central executive differ from the episodic buffer?
3 Explain how the visuo-spatial sketchpad and phonological loop process different types of information.
4 Create your own example using each of the components of working memory to illustrate your understanding (central executive, phonological loop, visuo-spatial sketchpad and episodic buffer).

Investigating working memory

Researchers have tried various ways of investigating the control of attention, which is a major function of the central executive.

INVESTIGATE 8.11

SWITCHING ATTENTION

Do you know the words to the chorus of 'Waltzing Matilda'?

Waltzing Matilda, waltzing Matilda,

Who'll come a-waltzing Matilda with me?

And he sang as he watched and he waited 'til his billy boiled,

Who'll come a-waltzing Matilda with me?

Now try this:

1. Time yourself as you say the chorus aloud as fast as possible.
2. Time yourself as you say the chorus silently as fast as possible.
3. Time yourself as you say the first word aloud and the second silently and so on as fast as possible.

What were your results? Can you explain why?

In Investigate 8.11, when you said the words aloud or silently, you were performing an automatic process and very little attention was needed. However, when you had to focus on saying the words aloud/silently/aloud/silently, switching (shifting) attention was involved and the task was much more difficult.

Did you know?

A question: if you study and listen to music at the same time, does this interfere with working memory? The answer can be yes or no!

If you sing along or if you tap out a rhythm with your fingers or your feet, then the answer is yes. But if you don't listen to the words (or if there are no words) AND you don't tap out the rhythm, then the answer is no.

WORKING MEMORY AND MULTI-TASKING

Early research showed that the different stores in working memory are reasonably independent (Logie, Zucco & Baddeley 1990); this means that we can fairly easily do two or more things at once, provided the tasks are using different 'stores' in working memory. For example, we can (1) drive a car at the same time as (2) recalling information relevant to a (3) conversation we are having with a passenger. In contrast, if two tasks use the same store, we have much more difficulty doing them simultaneously; think about how frustrating is it when you are talking on the phone to someone and a friend next to you is trying to tell you something at the same time.

WORKING MEMORY AND INTELLIGENCE

People who perform well on working memory tasks also tend to show high levels of ability in such tasks as reading comprehension and even intelligence tests (Engle, Tuhulski, Laughlin & Conway 1999); they are also likely to be better able to understand other people's points of view (Barrett, Tugade & Engle 2004, cited by Kalat 2009).

Levels of processing: Craik and Lockhart

This model of memory storage suggests that memory does not comprise any specific number of separate memory stores but instead is a continuous dimension in which memories are encoded related to the ease with which they can be retrieved: the deeper the processing of information, the greater the chance of it being retrieved. **Levels-of-processing** refers to the number and types of associations made between new knowledge and previous knowledge. Research by Craik and Lockhart (1972) suggested that there are three levels at which we encode material and the deeper the processing, the better the chance of retrieval from memory at a later time.

This model has practical applications. For example, when you are studying, the deeper and more elaborately you encode information, the more likely it is that you will understand it and remember it later on. Actually thinking about and using the information to be remembered is much more productive for encoding than just looking at or repeating the information.

TABLE 8.7 Types of encoding and processing

TYPE OF ENCODING	TYPE OF PROCESSING	EXAMPLE		RECALL
Structural Words are learnt by remembering their physical features, such as whether they were in upper or lower case, started with a vowel or consonant, or were long or short.	Shallow	pOTato brick BOOK Apple	Participants were asked to remember whether the word contained upper case letters.	Only about 20 per cent of words were recalled after structural encoding.
Phonemic Words are learnt by their sounds.	Moderate	bull style amazing radio	Participants were asked to think of a rhyme (bull/full; style/smile) for the word, or perhaps rhyme and rhythm (What a song/I love the phrasing/and the tune/is just amazing!)	Approximately 50 per cent of words were recalled after phonemic encoding.
Semantic Words are encoded by their meaning, which allows them to be placed directly in our semantic networks.	Deep	gate yacht truck apple	Participants were asked to put the words into a sentence where the meaning of the word would be important to the meaning of the sentence, such as 'She opened the gate and entered the garden'.	80 per cent or more of words were retrieved after semantic encoding.

8.8 REVIEW

1. Explain your understanding of Craik and Lockhart's model of levels of processing. Provide an example to illustrate your understanding.
2. Why is deep processing more effective than shallow processing?
3. Imagine you were studying for a difficult Psychology test on 'memory'. Suggest a way of studying that uses a method based on the levels of processing model.

FIGURE 8.17 Deeper encoding gives access to much more content and meaning in memory.

Research

Craik and Lockhart suggested that it is the level of processing that influences how well material is encoded, but other research has shown that the story is not as simple as that. Craik and Tulving (1975) found that the more complex the processing, the stronger the memory, even within the same level. In this way, 'The gale sent the yacht flying through the water' would be more strongly encoded than 'The yacht was sailing in the bay'.

FIGURE 8.18 'The gale sent the yacht flying through the water' is easier to remember.

Rogers and his colleagues (1977) found that personal relevance or salience has a major effect on recall, so using questions like 'Does this describe you?' produces better recall than 'What does this mean?' Later, it was found that memory for participants who related each word to their mothers was just as strong as for those who related the words to themselves (Symons and Johnson, 1997). The conclusion is simple: memory grows stronger the more it is elaborated and linked to things we know well and care about.

Tyler and his colleagues (1979) found that the more effort we have to put into remembering something, the stronger our recall will be once we have encoded it. They gave participants easy anagrams and complex anagrams of words to be remembered and found that the harder the participants had to work to solve the anagrams, the better they remembered the word!

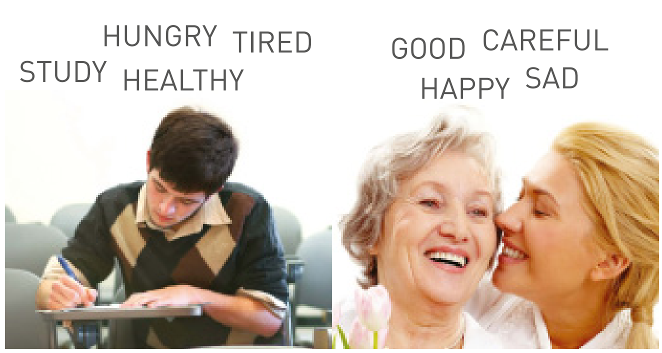


FIGURE 8.19 Memory grows stronger when linked to things we know and care about.

INVESTIGATE 8.12

LEVELS OF PROCESSING

This activity gives you the opportunity to test Tyler and his colleagues' (1977) experiment through a shortened version.

Unscramble the three complex and three simple words in the table below.

COMPLEX	SIMPLE
OCRTDO	MORYME
OOMTTA	UTEMIN
RREEAS	MMERSU

Try to recall these words tomorrow. Which words do you think you will recall best?

Organisation of long-term memory

There are different types of LTM which are identified as two systems: **procedural memory** and **declarative memory**. Procedural memory refers to knowledge of skills, habits, or actions ('how to' knowledge). Declarative memory refers to memory for facts and events. Declarative memory is further divided into **episodic memory** and **semantic memory**. Episodic memory refers to memories of particular events and is often autobiographical, such as birthdays, your first day of school or your first romantic kiss. Semantic memory is memory for facts, worldly knowledge or general knowledge.

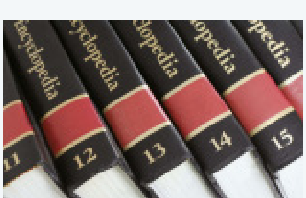
FIGURE 8.20 Organisation of long-term memory

Long-term memory

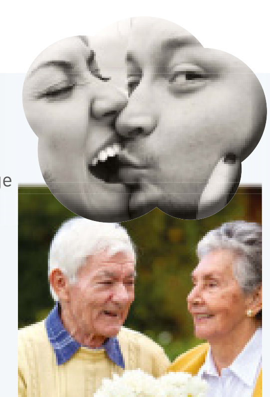
Declarative memory
> Memories of personal experiences (events) and facts

Procedural memory
> 'How to' memories
> Occurs after practice
> Examples
  > *riding a bicycle, once the skill has been learnt*
  > *using cutlery to eat*

Semantic memory
> Memories of facts (or knowledge)
> Examples
  > *knowing that Canberra is the capital city of Australia*
  > *knowing the times tables*
  > *'encyclopaedic' memory*



Episodic memory
> Personalised memories of events
> May be related to knowledge of facts if the memory is also of how and where you learnt them
> 'autobiographical' memory
> Examples
  > *your first day at school*
  > *a first romantic kiss*



Procedural memory

Procedural memory involves knowing how to do things – yet we might still find it hard to describe how to do them.

The procedural memory system houses memory for actions, skills, operations and conditioned responses. It is very resistant to forgetting – people rarely forget how to ride a bicycle, for example.

Some theorists believe that there is a link between implicit memory and the procedural memory system (Squire, Knowlton & Musen 1993) because memory for skills is largely unconscious. People use skills such as keyboard skills or cleaning teeth with little conscious awareness of what they are doing. Furthermore, memory for these skills does not decline much over time. Sometimes people are surprised that they can still perform an activity such as skiing, playing music or driving a car, even after many years of not doing it. This is because procedural memory is a store of routines that can be accessed and retrieved.

SUPPORTING UNDERSTANDING

Implicit and explicit memory

Information from LTM can be retrieved and expressed either explicitly or implicitly. Explicit memory is the conscious retrieval of memory. This includes recall and recognition. Implicit memory includes classical conditioning (see Chapter 13), priming (in which memory of one item influences future perception), and procedural memory.

Implicit and explicit memory are not memory systems. They are observable behaviours that appear to be handled by the declarative and procedural long-term memory systems. The demonstration of the differences between implicit and explicit memory is evidence to suggest that people may have several separate memory systems.

Explicit memory involves intentional remembering (declarative memory) and is shown to be the responsibility of the brain structure known as the hippocampus.

FIGURE 8.21 When learning a new task, a conscious and deliberate effort is often required. However, after practice, the retrieval of this knowledge becomes implicit.

Implicit memory involves unintentional remembering (procedural memory). It is unconscious, that is, it does not require intentional, deliberate recall. Recent research has shown that the amygdala is the key brain structure involved in implicit memory. Emotional aspects of memory is also the role of the amygdala, as we shall see in our study of phobias in Unit 4. See Chapter 9 for more information about the hippocampus and amygdala.

Declarative memory

Declarative memory involves memory for facts, events and general knowledge. It generally refers to information associated with learning for school, reading, mathematics and higher-order thinking, which is associated with intelligence. It includes episodic and semantic memory.

A distinction can be made between two types of episodic memory:

- retrospective memory – remembering past events
- prospective memory – remembering things to do in the future.

FIGURE 8.22 Declarative memory can involve a past event being remembered because of a current event.

8.9 REVIEW

1 Draw a diagram to show how our LTM stores procedural, declarative, episodic and semantic memories.
2 Explain what procedural memories are and provide an example.
3 Outline what declarative memories are and how they differ from procedural memories.
4 What is the difference between episodic and semantic memories? Provide an example for each to illustrate your understanding.
5 Vicki loves to dance. She recently took up Zumba, a Latin American style of dancing that involves many complex steps. Where would Vicki's new dance steps be stored? Explain why.
6 When Karen celebrated her 18th birthday, she had a huge party. Her family also surprised her with a new red car. The years have passed and Karen still recalls her party with happiness. Where would this type of memory be found? Explain why.

INVESTIGATE 8.13

TEST YOUR LONG-TERM MEMORY

Work with a partner and follow the instructions below. You might be quite surprised by the results!

1 Remember these numbers in order: 0963157208.

2 Sit on your hands while you answer the following questions:
   - Do you turn your front-door key clockwise or anticlockwise when entering your house?
   - Do you rotate a tap clockwise or anticlockwise to turn it off?
   - How do you use a knife and fork? (Remember to use words only.)
   - How do you use chopsticks? (Remember to use words only.)

3 What does the image below mean?

4 What was the name of your grade 1 school teacher?

5 What was the name of the horse that came fifth in last year's Melbourne Cup?

6 Describe the front cover of this book without looking at it. How much can you recall?

7 Recite the national anthem out loud without singing the melody.

8 Name the highest mountain in Australia.

9 Cover question 1 above and write the numbers in the exact order as presented.

Which type of long-term memory?

Identify which type of long-term memory would be used for each of the following:

- naming all of the street signs you passed as you travelled to school today
- recognising people at a social function and being able to recall their names
- visiting a particular place from your childhood and finding that it brings back memories of particular events from your early life
- remembering what fire feels like
- hearing a song that brought back memories of a particular event in your life
- recalling everything that you need to be able to answer particular questions in an exam
- carrying out tasks such as cleaning teeth, opening doors and eating with cutlery
- remembering the exact words someone has just spoken to you
- remembering a mobile phone number until you have a chance to write it down.

SUPPORTING UNDERSTANDING

Other forms of long-term memory

Flashbulb memories

Sometimes, the emotional intensity of an experience or event will assist the likelihood that we will recall it later. However, this is no guarantee that the memory will be accurate. One form of vivid memory is the flashbulb memory. This is a memory of an event that is so powerful emotionally that we can remember the event very clearly, as if it is on film. The information is effortlessly encoded and may last for a very long time.

Researchers have suggested that flashbulb memories are so intense because they are emotionally arousing. Personally interesting information activates a particular area of the brain (the amygdala) and causes the secretion of hormones related to emotions. For example, most Americans believe that they can recall exactly where they were when they heard the news that terrorists had flown hijacked planes into the World Trade Centre in New York on 11 September 2001. These people may be absolutely certain of their memory for the events but, in fact, these are often recalled inaccurately.

Photographic memory

This is the ability to form and later recall sharp, detailed visual images of a picture or notes from a page after examining them for only a short period of time. There are very few reports of people who truly have this type of memory. Sometimes people with exceptional memories are described as having photographic (sometimes called eidetic) memories.

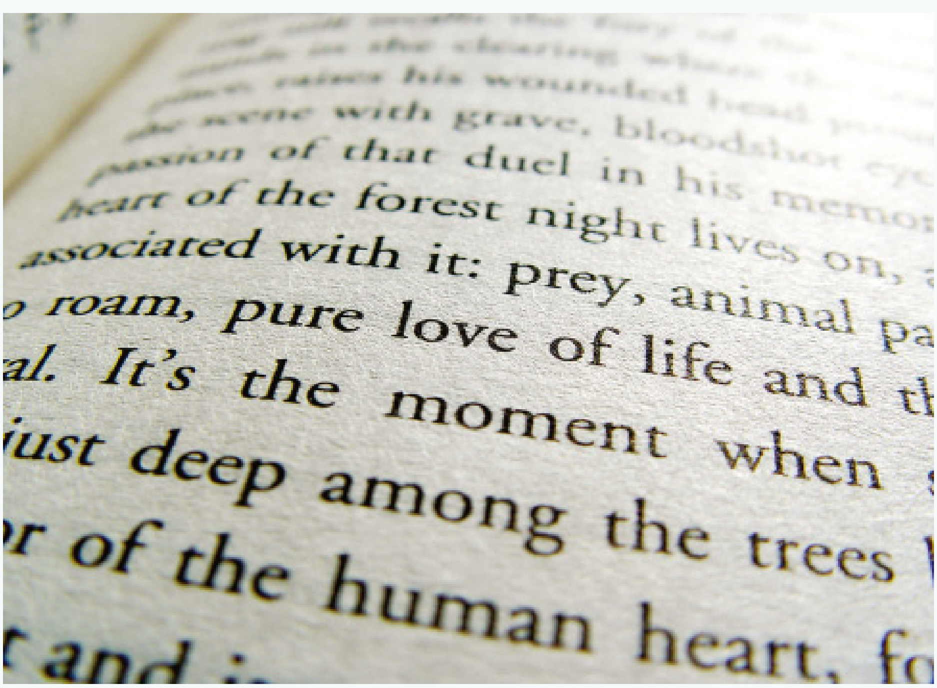


FIGURE 8.23 A photographic memory would allow accurate recall of this text after a quick read.

Eidetic imagery

This refers to the ability of some people to look at a picture for a few seconds and then recall it in detail. It mainly occurs in children.

FIGURE 8.24 It is mainly children who can have eidetic memory.

Semantic network theory

Collins and Quillian (1969) suggested a model to explain how LTM is organised. Their model, the **semantic network theory,** proposes that the nodes of information are stored in a hierarchy according to particular concepts. Figure 8.25 shows the types of memory in a semantic network and the characteristics of our storage systems, including:

- nodes – the named units of information
- links – the lines showing the relationships between nodes (the shorter the link, the closer the relationship)
- hierarchical structure – several nodes on the lowest level form part of one node at the next level up, and so on.

Research by Bower (1970) has also shown that organising information into a conceptual hierarchy will assist recall of information. This suggests that elaborative rehearsal is likely to assist learning of new information that we want to be able to retrieve later on.

While this description has referred to a small number of nodes and networks, in reality there are thousands of interconnected nodes which together form a huge cognitive network that we are constantly using during everyday activities. Also remember that, although nodes have been likened to files, in reality there are multiple neurons that are activated during a thinking process.

REVIEW 8.10

1. Outline the principles of Collins and Qhillian's semantic network theory.
2. Explain the difference between and 'node' and a 'link'.
3. In terms of semantic network theory, why might a person remember one word/concept more quickly than another? Explain this process using Figure 8.25 to assist you.
4. Most people love cakes! Draw a flowchart/diagram like Figure 8.25 using 'cakes' to illustrate semantic network theory.

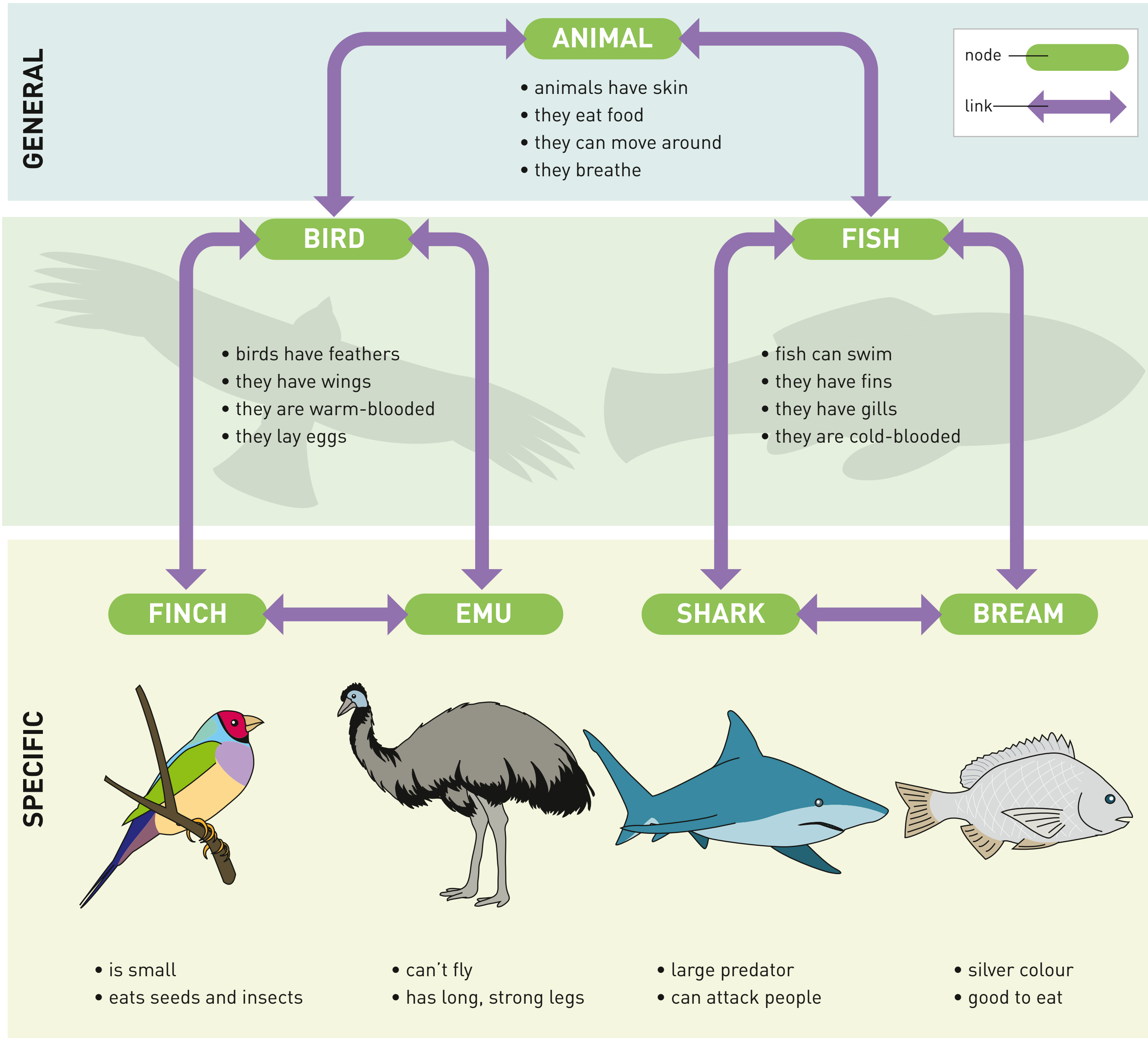


FIGURE 8.25 An example of a semantic network

SEMANTIC NETWORKS IN ACTION

INVESTIGATE 8.14

1 Time yourself (or a friend) as you recite the months of the year in order, as fast as you can. Now time yourself as you recite them in *alphabetical* order. What was the time difference?
Reciting the months in order was retrieving them in the way they are arranged in our semantic network of 'months' – it was easy, quick and efficient. Putting them in alphabetical order did not use the cues we are used to and so was much less efficient. Most people take 3–4 seconds to recite the months in order and 30–40 seconds to put them in alphabetical order – and even then often make mistakes!

continued on next page

2 You and a partner, individually and separately, write down a list of as many different animals as you can think of in two minutes. Next, go through the two lists and work out how you were each using your semantic networks:

Did you group all pets together?

> Did you name one bird (or mammal, amphibian, fish or reptile) and then several more?
> Did you group Australian animals/African animals/farm animals/ animals from the zoo?
> Did you write one breed of dog/cat/horse/etc. and then several more?
All these show how your individual semantic network is organised and how each node is linked to each other node, to act as a cue for retrieval.

3 Design your own semantic network to answer the question: Is a platypus a mammal?
You may use an A4 sheet of paper or poster paper for this activity. Feel free to illustrate your semantic network!

KEY STUDY

COLLINS AND QUILLIAN (1969)

Collins and Quillian's (1969) research led them to suggest that information in LTM is organised in hierarchies that range from general concepts to very specific ones. This was demonstrated in their experiment where they tested the reaction times for participants to agree or disagree with statements such as 'a canary can sing', and 'a canary has skin'. It took longer for participants to verify the second statement (a level two concept in the hierarchy search) than it did to verify the first statement (a level one concept in the hierarchy). Generally, it was found that reaction times were longer for statements that needed information from nodes that were higher up the hierarchy.

INVESTIGATE 8.15

EVALUATING RESEARCH: SEMANTIC NETWORK THEORY

Read the key study 'Collins and Quillian (1969)' and complete the following with reference to their study.

1 Identify the dependent and independent variables.
2 Write an experimental hypothesis.
3 Which experimental design would be the most effective for this study?
4 Identify any potential confounding variables.
5 Write a conclusion.

Organisation of information in the LTM: other theories

Network theory is not an adequate model for how information is organised and stored in LTM. Researchers are developing more sophisticated models.

TABLE 8.8 Comparison of multi-store model of memory to alternative models

MODEL	DESCRIPTION	RELATIONSHIP BETWEEN STORES	TRANSFER OF INFORMATION	KEY POINT
MULTI-STORE MODEL	Working memory is seen as another name for STM.	Sensory, STM and LTM stores are distinct from each other.	Information moves from sensory to STM, from STM to LTM, and from LTM to STM.	Distinction between each memory store
ALTERNATIVE MODELS	Baddeley and Hitch's model sees working memory as part of LTM, which includes the knowledge of facts and procedures that become activated in memory at any given time when brought into conscious awareness.	Craik and Lockhart's levels-of-processing model does not see memory stores as separate entities. Instead, the stores are all seen as being on a continuum where working memory contains only the very recently activated information from LTM, and STM contains only a very small, fleeting part of working memory.	Baddeley and Hitch's model suggests that information is stored in LTM and, when activated, it moves the relevant information into the specialised working memory which then operates on the information, associates it with new information and restores the modified material to LTM.	Working memory is most important in moving information between STM and LTM. For this to happen, the working memory must be activated. Working memory contains the central executive which is not part of the multi-store model.

→ CHAPTER SUMMARY

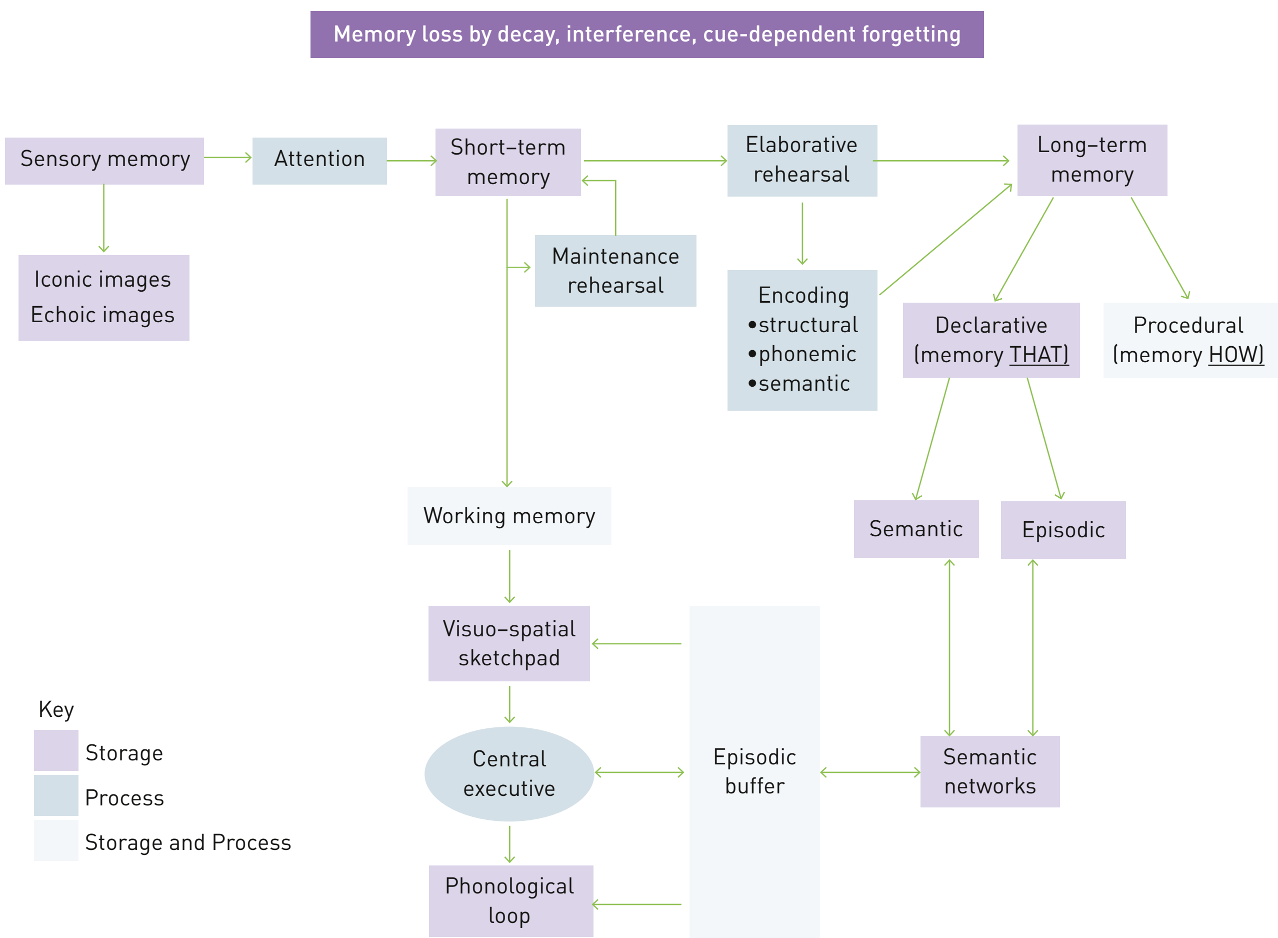
08:

- Information in memory must be encoded and stored, and retrieved for use at a later time.
- The Atkinson–Shiffrin model of memory suggests that there are three types of memory: sensory, short-term, and long-term. Information is first received by the sensory memory and information that is attended to is passed into short-term memory (STM). If it is adequately processed, it will be encoded and stored in long-term memory (LTM).
- The sensory, short-term and long-term memory stores are distinguished by duration and capacity.
- Sensory memory has a brief duration and an unlimited capacity. It relates to the senses: iconic memory for sight and echoic memory for sound.
- STM has a limited capacity and duration.
- Chunking and maintenance rehearsal are techniques for increasing capacity and duration of STM.

- LTM is thought to have an unlimited capacity and an unlimited duration.
- Elaborative rehearsal is a technique for encoding information through association in LTM.
- The serial position effect provides evidence to suggest that there is both short-term and long-term memory, with distinct duration periods.
- Baddeley and Hitch's working memory model suggests that working memory is not separate from LTM but is responsible for integrating activity between long and short-term memory at any given time.
- Craik and Lockhart's levels-of-processing model suggests that there are not discrete memory stores; rather, different types of memory exist on a continuum and are activated at given moments.
- LTM is further organised into procedural memory and declarative memory. Declarative memory has two subsystems: episodic memory and semantic memory.
- The semantic network theory is a model of organising long-term semantic memory. It suggests that semantic memory is organised in a hierarchy of concepts. Each piece of information within the network is called a node. The nodes are linked, and the closer the nodes are to each other, the stronger the link and the quicker the information in that node can be retrieved.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

central executive
chunking
declarative memory
echoic memory
elaborative rehearsal
episodic buffer
episodic memory
iconic memory
levels of processing model
long-term memory
maintenance rehearsal
multi-store model of memory
phonemic encoding
phonological loop
procedural memory
semantic encoding
semantic memory
semantic network theory
sensory memory
serial position effect
short-term memory
structural encoding
working memory
visuo-spatial sketchpad

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of:

- Atkinson and Shiffrin's multi-store model of memory, including maintenance and elaborative rehearsal, serial position effect and chunking
- Baddeley and Hitch's model of working memory:
  - central executive
  - phonological loop
  - visuo-spatial sketchpad
  - episodic buffer
- levels of processing as informed by Craik and Lockhart
- organisation of long-term memory
  - declarative (including semantic and episodic memory)
  - procedural memory
  - semantic network theory.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study related to the models of human memory
- apply your knowledge and understanding from this chapter to a related research study
- understand and identify any ethical considerations in relation to researching human memory and establishing a model of human memory.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 In the information processing model of memory, what are the three divisions considered to be, in order of initial processing?
   a sensory memory; short-term memory; working memory
   b episodic memory; semantic memory; procedural memory
   c short-term memory; declarative memory; procedural memory
   d sensory memory; short-term memory; long-term memory

2 Transfer of material from short-term to long-term memory requires which of the following processes?
   a encryption
   b encoding
   c transmission
   d transduction

3 Iconic images are considered to be those that register in which type of memory?
   a visual sensory memory
   b visual short-term memory
   c auditory sensory memory
   d auditory short-term memory

4 What is the duration of (unrehearsed) short-term memory for the average adult considered to be?
- a 7 ± 2 seconds (5–9 seconds)
- b 30 minutes
- c 12–30 seconds
- d 5 minutes

5 Loss of information from short-term memory is considered to be due to which of the following processes?
- a proactive or retroactive interference
- b anterograde or retrograde amnesia
- c decay
- d displacement

6 Duration of short-term memory may be increased by:
- a maintenance rehearsal.
- b elaborative rehearsal.
- c mnemonics.
- d chunking.

7 Items are lost from long-term memory through:
- a interference.
- b amnesia.
- c cue-dependent forgetting.
- d all of the above.

8 Which of the following are storage components of working memory?
- a visuospatial sketchpad and episodic buffer
- b phonological loop and visuospatial sketchpad
- c central executive and episodic buffer
- d phonological loop and central executive

9 According to Baddeley and Hitch's model, what is the role of the episodic buffer?
- a to form a storage component for visual and auditory information
- b to organise information in working memory
- c to retrieve information from long-term memory and transfer information into long-term memory
- d to act as a bridge between short-term memory and the central executive

10 What does the process of encoding refer to?
- a rehearsing material over and over
- b formatting information so that it can be retained in long-term memory
- c transferring material into working memory
- d paying attention to what we wish to remember

11 The roles of the hippocampus and amygdala in memory formation can be summarised as:
- a hippocampus: implicit, declarative memories; amygdala: explicit, declarative memories.
- b hippocampus: implicit, procedural memories; amygdala: explicit, declarative memories.
- c hippocampus: explicit, procedural memories; amygdala: implicit, declarative memories.
- d hippocampus: explicit, declarative memories; amygdala: implicit, procedural memories.

12 According to Craik and Lockhart, the levels-of-processing model depends on:
- a the amount of effort required to transfer material to long-term memory.
- b the type of formatting of information to be retained in long-term memory.
- c the number and types of associations made between the new knowledge and previous knowledge.
- d the amount of attention paid to what we wish to remember.

13 What does semantic encoding refer to?
- a processing in terms of the meaning of a word
- b processing in terms of the shape or form of a word
- c processing in terms of the sound of a word
- d remembering a word according to its place in our memory network

14 What does phonemic encoding refer to?
- a processing in terms of the meaning of a word
- b processing in terms of the shape or form of a word
- c processing in terms of the sound of a word
- d remembering a word according to its place in our memory network

15 What does structural encoding refer to?
- a processing in terms of the meaning of a word
- b processing in terms of the shape or form of a word
- c processing in terms of the sound of a word
- d remembering a word according to its place in our memory network

SHORT ANSWER

16 Jan is going grocery shopping. Give an example of how she could use semantic encoding to improve her memory for the items she has to buy.

2 marks

17 Deeper processing means that ability to recall words is improved. How is this explained by Craik and Lockhart?

2 marks

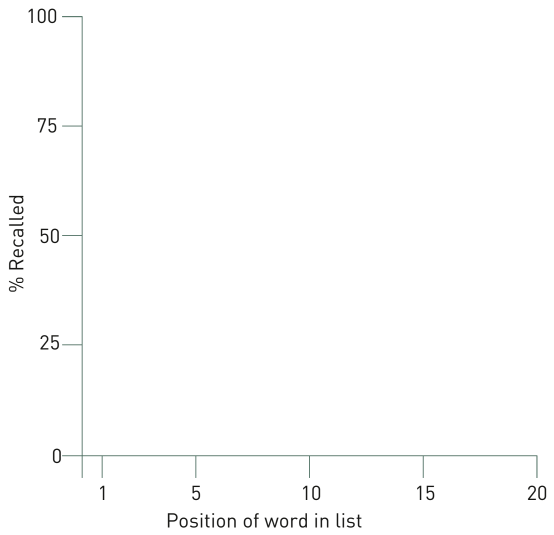
18 Declarative memories are considered to be stored in semantic networks. Construct a possible semantic network including the node 'car'. Your network must include at least three other nodes in order to show the characteristic features of a semantic network; links should be shown as lines joining nodes.

3 marks

19 What does the serial position effect suggest about the organisation of long-term memory?

1 mark

20 On the axes below, indicate the most likely shape of a curve showing average immediate recall in random order for a list of 24 words by 100 subjects.



21 a Draw a diagram to represent Baddeley's model of working memory.

3 marks

b How does the concept of working memory differ from the concept of short-term memory?

2 marks

→CHAPTER 09:

MECHANISM OF MEMORY FORMATION

Why are people who have head injuries often unable to remember what happened at the time of the accident? To understand memory as a physiological process, it is important to understand what happens in neurons and synapses in the brain when new memories are formed or old memories are altered. It is also necessary to know which particular brain structures have roles in the formation and storage of memory. Patients with brain damage or neurodegenerative diseases provide researchers with insight into the mechanism of memory formation.

KEY KNOWLEDGE

Mechanism of memory formation:

- → the neuron in memory formation including the role of axons, dendrites, synapses and neurotransmitters
- → the role of the temporal lobe including the hippocampus and the amygdala
- → consolidation theory
- → memory decline over the lifespan
- → amnesia resulting from brain trauma and neurodegenerative diseases including dementia and Alzheimer's disease.

(VCE Study Design 2013)

The formation of memory in the brain

CHAPTER OVERVIEW

Neurons and neurotransmitters in memory and learning	Neurons > The structure of neurons > Communication between neurons Neurotransmitters
Brain structures involved in memory	The roles of the hippocampus and the temporal lobe in memory formation > The location of key structures of the temporal lobe > Function of the hippocampus in memory formation > Factors affecting the functioning of the hippocampus > The amygdala in memory formation > The hippocampus versus the amygdala in memory
Consolidation theory	
Memory decline over the lifespan	Brain functioning and age-related memory decline Different types of memory decline
Researching human memory formation and amnesia	Types of amnesia > Retrograde amnesia > Anterograde amnesia Brain trauma Neurodegenerative diseases > Dementia > Alzheimer's disease

The role of neurons in memory formation

Research shows that memory is formed due to biochemical changes in the synapses in response to different **neurotransmitters** (chemicals), and that memory-making is a form of neural **plasticity** where neural connections are removed and re-made on a continual basis. Although researchers have yet to identify all locations of the brain that are responsible for memory, they have been able to learn about the specific structures of the brain that are involved in memory such as the role of certain neurotransmitters and hormones.

Some neurotransmitters help memory storage while others can disrupt it. It is known that memory is helped by the serotonin and acetylcholine neurotransmitters, as well as the hormone noradrenaline. For example, the hippocampus in the brain of a person with normal memory has high levels of acetylcholine, whereas the hippocampus of patients with **Alzheimer's disease** (which progressively destroys neurons in the brain, causing memory loss) has low levels of acetylcholine. Similarly, alcohol consumption disrupts the level of the serotonin neurotransmitter and can impair the formation of memories in a condition known as Korsakoff's syndrome.

Neurons and neurotransmitters in memory and learning

Researchers have long believed that, in order to understand how memories are formed as a physiological process, they would first need to discover what happens at the level of the neuron, especially at the synapse.

Neurons

Neurons receive information from other neurons, process this information, and then communicate it to other neurons. In other words, neurons receive, process and transmit information.

THE STRUCTURE OF NEURONS

Neurons are generally comprised of three elements: **dendrites**, the **soma** and the **axon**.

Dendrites

Dendrites look tree-like (the word dendron is Greek for 'tree'). The function of dendrites is to receive information from other neurons.

Soma

The soma is the cell body. It is the largest part of the neuron and controls the metabolism and maintenance of the cell.

Axon

The axon is a nerve fibre that carries information away from the soma toward cells that communicate with the neuron. This information is referred to as action potential, which consists of brief changes in the electrical charge of the axon. The end of each axon has terminal buttons that secrete a chemical called a **neurotransmitter** whenever information is sent down the axon in the form of electrical impulses (see Figure 9.1).

COMMUNICATION BETWEEN NEURONS

Between neurons is a **synapse**. This is the junction between two neurons where the end of the axon (terminal buttons) of the presynaptic (before the synapse) neuron comes into close proximity with the receptor sites on the dendrites of a postsynaptic (after the synapse) neuron. The process of neurons communicating with other neurons is known as **synaptic transmission**. The neurotransmitter that is secreted from the presynaptic neuron affects the activity of the postsynaptic neuron with which it communicates. In other words, neurons communicate via a chemical process.

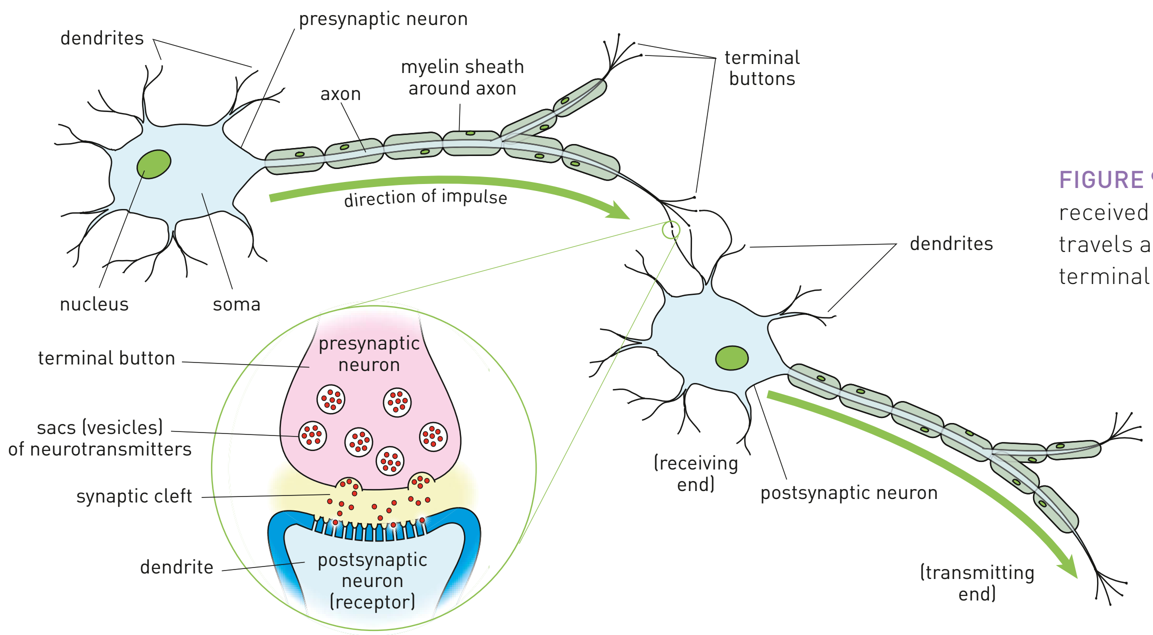


FIGURE 9.1 Information received by dendrites travels along the axon to terminal buttons.

TABLE 9.1 The effects of neurotransmitters and hormones

NEUROTRANSMITTER	EFFECTS
Acetylcholine	Memory and memory loss, learning Muscle movement Activates cerebral cortex REM sleep Hippocampus
Dopamine	Facilitates movement, attention, learning, reinforcement
Serotonin	Regulates mood Eating, sleep, arousal, pain
Glutamate	Necessary for the changes in synapses that occur with memory formation
HORMONE	**EFFECTS**
Adrenalin	Triggers physiological arousal
Cortisol	Repairs the body

It is important to remember that the neural structure of the brain is very complex and that, in reality, synapses can be located at several points along a neuron (that is, at dendrites, the axon or the soma) and many terminal buttons can form synapses with a single neuron. However, for simplicity, it is easier to think of communication as starting with the dendrites receiving information (neurotransmitter) from the synapse, the information being passed in the form of electrical impulses through the soma along the axon, and a neurotransmitter being secreted from the terminal buttons to a synapse shared with the dendrites of another neuron.

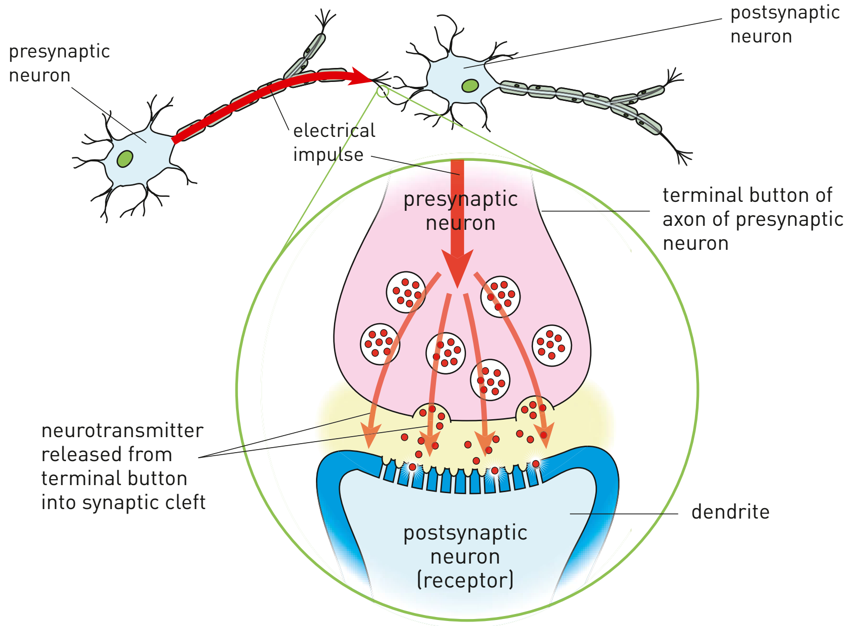


FIGURE 9.2 A synapse is the junction between two neurons. The presynaptic neuron releases molecules of neurotransmitters, which then fit into receptor sites on the postsynaptic neuron. The charge builds up until a signal, the 'action potential', is sent down the postsynaptic axon.

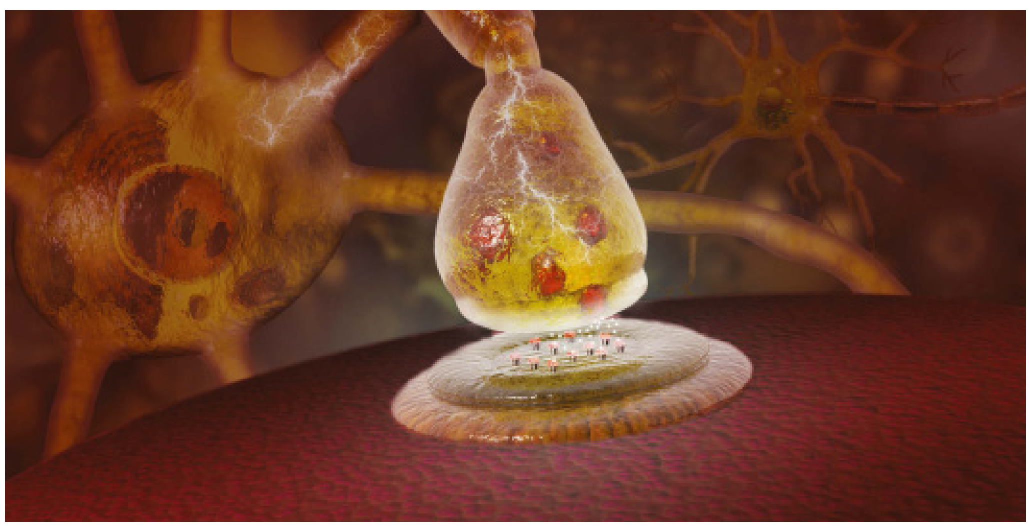


FIGURE 9.3 Axon of a neuron sending an electrical impulse to stimulate the release of neurotransmitters, which cross the synapse and attach to receptors on the next cell, passing the message along.

Neurotransmitters

Within the terminal buttons of each neuron are small sacs known as synaptic vesicles that contain neurotransmitters. When a neuron fires, its terminal buttons' sacs release their neurotransmitter into the synaptic cleft for the dendrites of other neurons. A neuron can release more than one neurotransmitter. Research has identified more than 100 neurotransmitters. Table 9.1 outlines some examples of neurotransmitters and hormones.

REVIEW 9.1

1 Neurotransmitters can either help or disrupt the formation of new memories. Which neurotransmitters are linked with memory?

2 What other factors can result in memory loss or the disruption of memory formation?

CHILDHOOD MEMORIES

9.1 INVESTIGATE

Work in pairs for this activity.

1 Each person is to ask their partner the following three questions and try to remember the answer in as much detail as possible.
   a What is your earliest childhood memory? Describe it in detail and identify, if possible, how old you were at the time.
   b What was the most memorable birthday or other celebration that you attended? Explain why.
   c Describe in detail what you had for dinner last night.
2 Once each member of the pair has both asked and answered the questions, go around the class and ask each person to recall (in as much detail as possible) their partner's responses to the three questions.
3 As a class, discuss how memories are formed.

SUPPORTING UNDERSTANDING

The work of Eric Kandel

To try to understand the role of neurons in memory formation, psychiatrist, physician and researcher Eric Kandel and his colleagues studied forms of memory of the giant sea hare (or sea slug) known as Aplysia. Aplysia are ideal to study because their nervous system has only approximately 20 000 very large neurons compared to more than one billion neurons in humans. The experiments by Kandel and his colleagues showed that the changes in the neurons of the Aplysia lasted for several weeks. This was evidence of primitive long-term memory.

THE HIPPOCAMPUS AND MEMORY FORMATION

KEY STUDY

Maguire and colleagues hypothesised that, just as with other animals, there also might be an increase in the size of human brain areas, such as the hippocampus where memories are formed.

Their research found that this was the case for 16 London taxi drivers who were expected to memorise the streets of London before they could obtain a licence to drive a taxi cab (known in London as 'Doing the Knowledge'). The researchers found that the drivers had more activation in the hippocampus (in the brain) for a navigation memory task than for other types of memory tasks (Maguire, Frackowiak & Frith 1997).

Further research using MRI scans of the drivers found that the posterior part of the hippocampus, an area of the brain that is involved in spatial navigation, was larger than in males of similar age who were not taxi drivers. It was also found that this area of the brain was largest in the most experienced drivers. However, the overall size of the hippocampus was not different to non-taxi-driving males (Maguire, Mummery & Beuchel 2000).

This research was helpful in understanding the role of the hippocampus in memory but it is important to remember that it is *correlational* – it is impossible to know if the taxi drivers' hippocampal changes were *caused* by memorising the maps or by some other variable such as walking the streets of London frequently. (The role of the hippocampus in memory formation is covered in a later chapter.)

FIGURE 9.4 London taxi drivers are expected to memorise the streets of London before they can obtain a licence.

INVESTIGATE 9.2

KEY STUDY: THE HIPPOCAMPUS AND MEMORY FORMATION

1 What was the aim of the researchers in the case study 'The hippocampus and memory formation'?
2 Write a simple hypothesis for this study.
3 Were there any physiological changes to the hippocampus? Explain.
4 Can the researchers conclude that changes in the taxi drivers' hippocampus are caused by the memorisation of maps?
5 What were the researchers able to conclude about this particular experiment?
6 Name two ethical principles that the researchers took into consideration.

SUPPORTING UNDERSTANDING

The experience of H. M.

'H. M.' was a patient who suffered severe temporal lobe epilepsy. His experience has provided a wealth of information for researchers of the human brain, and we are indebted to him for the contribution that he has made by allowing himself to be studied. This has been particularly important in assisting researchers to understand human memory.

In 1957, at the age of 27, patient H. M.'s epilepsy had reached the point where he was unable to conduct a normal life and he consented to experimental surgical treatment to remove portions of both his temporal lobes (Scoville & Milne 1957). After he recovered from the surgery, he was tested to assess the effects of the procedure on his brain functioning. His short-term memory and intellectual ability remained intact and normal, except for his score on the memory aspect of the intelligence test which was now way below average and much lower than it had been prior to the operation. Furthermore, after taking the memory test, he could not remember that he had taken it; he could be given the test repeatedly as though for the first time. He did not recognise the doctors who were treating him, he could read the newspaper repeatedly as if it was new, he could not recall what he did the day before, and he would return to his previous family home because he was unable to remember that his family now lived at a new address.

As a result of the surgery, H. M. was now suffering a severe form of **anterograde amnesia**, where he had great difficulty remembering events

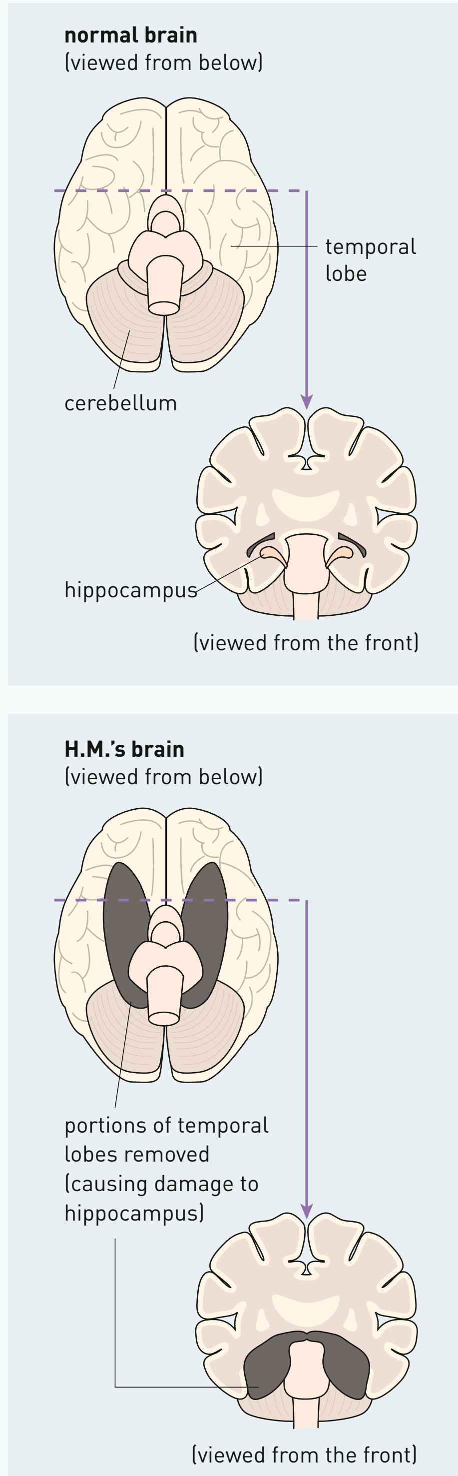


FIGURE 9.5 The changes to H.M.'s brain after his temporal lobes were removed

that occurred from the time of his surgery onward. However, he had full recollection of his life before the operation. It is now understood that the surgery damaged each hippocampus (located in the medial temporal lobe). The hippocampus plays a role in the process of forming new memories, and this is why H. M. suffered anterograde amnesia after the surgery.

Despite H. M. being unable to store new explicit memories, he *was* able to learn new procedural skills (implicit memory) such as writing upside down. Each time he was asked to perform this task he was better at doing it, but he could never remember having been taught how to do it. In other words, his ability to encode and store new implicit memory, such as procedural memory, had not been damaged by the surgery. This helped researchers to realise that explicit memory and implicit memory are processed and stored in different parts of the brain (Garrett 2009).

Today, such crude surgery is not carried out on patients; techniques have become much more sophisticated so that surgery for epilepsy ensures that there is minimal damage to parts of the brain other than those that are the source of the epilepsy. However, H.M. provided researchers with a rich store of material and much understanding about human memory. (An Internet search of 'H.M.' will provide you with further information about this case.)

REVIEW 9.2

1 What was the purpose of H.M.'s surgery in 1957?
2 What structures of the brain were removed?
3 The operation caused H.M. to suffer from 'anterograde amnesia'. Explain the symptoms and the difficulties H.M. experienced after the operation.
4 What type of memories could H.M. form after the operation?
5 Discuss two ethical issues that may have been neglected in this case.
6 Discuss one advantage and one limitation of case studies.

Brain structures involved in memory formation

Despite advances in the research and understanding of memory, the physiological make-up of memory is such that it is not possible to find the specific locations of specific memory, thoughts, ideas or events. However, it is clear that some structures play a pivotal role in the mechanism of memory formation.

Neuroscientists have located key brain structures involved in memory, such as the hippocampus for declarative memory; the cerebral cortex for short-term memory and aspects of declarative memory; the cerebellum for classically conditioned responses; the amygdala for emotional aspects of memory (a form of implicit memory); and the basal ganglia for procedural memory.

Table 9.2 is an overview of what researchers hypothesise to be the key brain structures that are involved in memory. Memories are located in different areas of the brain according to the type of memory and whether it is being encoded or stored. Figure 9.6 shows different parts of the brain where different forms of memories are processed and stored. For example, memories for pictures tend to be stored in the occipital lobe region and memories for sound in the left temporal lobe.

TABLE 9.2 Structures of the brain that are responsible for memory

TYPE OF MEMORY	GENERAL LOCATION IN THE BRAIN
Short-term memory	Cerebral cortex
Working memory Procedural memory Episodic memory	Frontal lobes of cerebral cortex
Declarative memories for some forms of sounds, pictures and words/language	Lobes of the cerebral cortex
Processes of consolidation and retrieval of long-term declarative (explicit) memories	Hippocampus
Forms of long-term non-declarative (implicit) memory including emotional memories such as recognising emotions in faces, procedural or skill learning and stimulus-response conditioning (e.g. learnt fears)	Amygdala
Long-term procedural (implicit) memory – movement	Basal ganglia
Classically conditioned responses (implicit memory)	Cerebellum

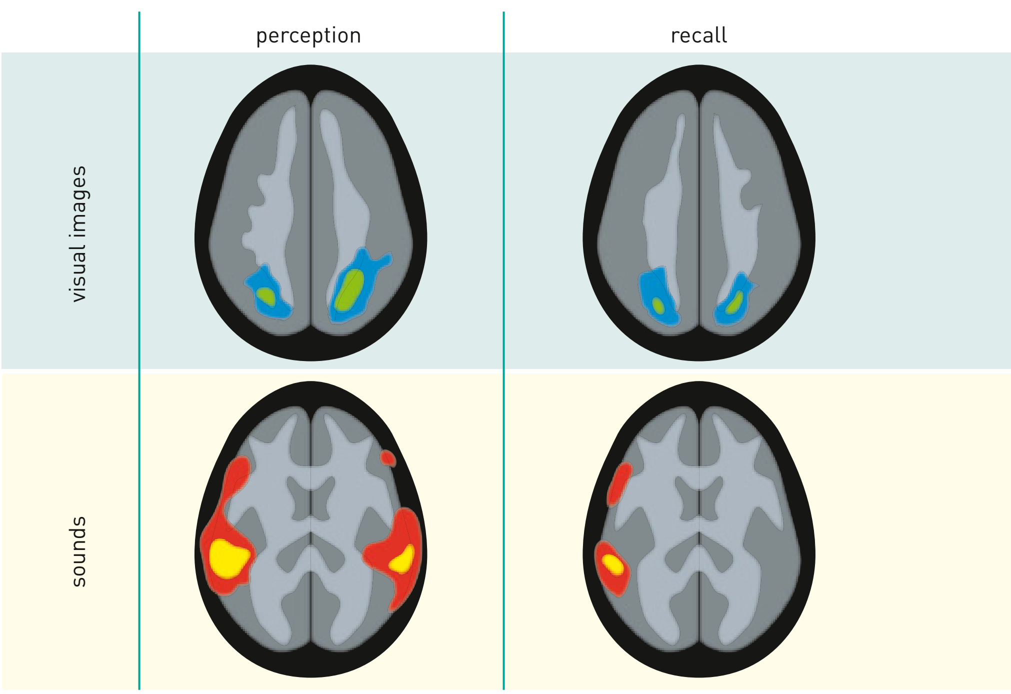


FIGURE 9.6 The original stimuli for visual images and sounds activated specific parts of the brain. Later, when the participant was asked to recall the same visual images and sounds, the same parts of the brain became active. This suggests that these memories were stored in these parts of the brain.

The mechanism of memory is complex and involves several different regions of the brain at any given time. In very simple terms, the cerebral cortex stores short-term memories and declarative (long-term) memories, the hippocampus consolidates declarative long-term memories and transfers them to the relevant area of the cerebral cortex for storage, and the amygdala adds emotional content to memories. Figure 9.6 indicates the structures of the brain that have key roles in the mechanism of memory formation.

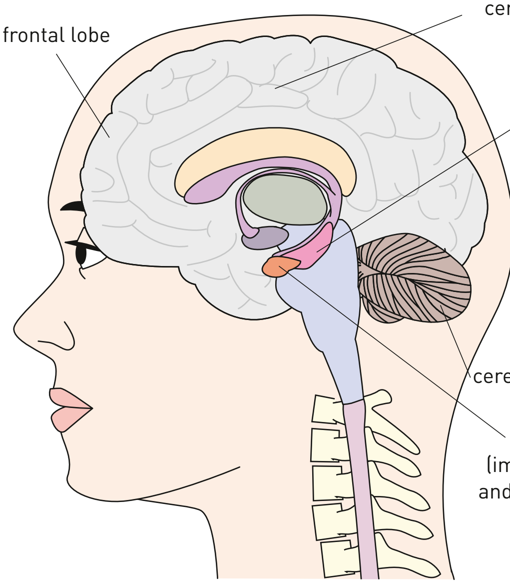


FIGURE 9.7 Cross-section of the human brain indicating the location of key structures of the brain responsible for memory

Where memory is stored

Declarative memories are not permanently stored in the hippocampus. We know this from H.M. being able to remember things that happened in his life prior to his surgery. Researchers hypothesise that the hippocampus stores information for a period and then a more permanent memory is formed elsewhere in the brain, such as the lobes of the cerebral cortex. A study found that, in mice, the neural activity in the hippocampus gradually diminished 25 days after learning, but increased in areas in their cerebral cortices (Bontempi *et al.* 1999).

In another study, the researchers lesioned (damaged) the pathway between the hippocampus and cortex in the brains of rats. For the first 24 hours, this did not affect the rats' ability to learn the location of the platform for them to stand on in a water maze. However, after four weeks, the rats had lost their memory of its location. The results of this study suggest that short-term memory formation is dependent on the hippocampus but long-term memory formation requires both the hippocampus and cerebral cortex over time. To explore this further, the researchers lesioned another group of rats 24 hours after learning the water maze. They found that the rats' performance on the maze was poor four weeks later, whereas another group that was lesioned three weeks after training performed just as well as a control group of rats with intact brains (Remondes & Schuman 2004).

INVESTIGATE 9.3

POSTER

You will require an A3 sheet of paper for this activity.

- Photocopy, draw or trace a cross-sectional picture of the brain that shows the structures in Table 9.2.
- In separate text boxes, describe the type of memory for the following structures: cerebral cortex, frontal lobes, occipital lobes, parietal lobes and temporal lobes, hippocampus, amygdala, basal ganglia and cerebellum.
- Ensure that your poster is well-presented and colourful!

Role of the temporal lobe including the hippocampus and the amygdala

Research suggests that regions within the temporal lobes such as the **hippocampus** play a key role in the consolidation of declarative memory and the **amygdala** for emotion-related memory. For declarative memories, there is a point in the encoding and storage process that happens in the hippocampus, followed by a transfer to a more permanent storage in the cerebral cortex (Garrett 2009).

THE LOCATION OF KEY STRUCTURES OF THE TEMPORAL LOBE

Chapter 6 identified the location of the temporal lobes in the cerebral cortex. The key parts of the temporal lobes for memory are located in the medial temporal lobe. They include the hippocampus and the amygdala. Figure 9.8 indicates the location and features of the temporal lobes that are responsible for memory.

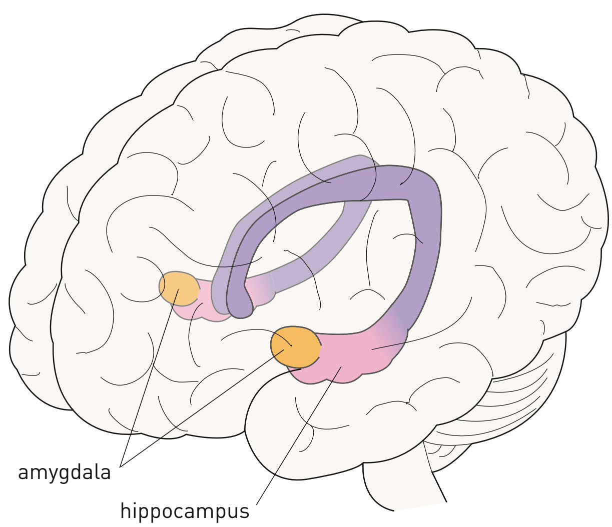


FIGURE 9.8 The medial temporal region is located inside the middle of the temporal lobe. The hippocampus is important for consolidation of explicit declarative memory and the amygdala adds emotional content to memories and is essential for the formation of implicit memories including classical conditioning.

TEMPORAL LOBES IN MEMORY FORMATION

As a result of H.M.'s temporal lobectomy (removal of the temporal lobes), his brain was no longer able to consolidate new declarative memories and these memories could never be transferred to the cerebral cortex for storage as permanent long-term memory. Other cases of patients suffering anterograde amnesia have also shown that the temporal lobe, and the hippocampus in particular, are important in the consolidation and storage of declarative memories (Parkin & Leng 1993).

For many years, drug-resistant, temporal lobe epilepsy has been treated with unilateral temporal lobectomy (removal of one temporal lobe). Sometimes the hippocampus and/or the amygdala are removed. It has been found that these patients suffer much less memory impairment after a unilateral removal of temporal lobe areas than do patients such as H.M. who have had a bilateral temporal lobectomy (removal of both temporal lobes) (Andrewes 2001).

There is also evidence that patients are likely to experience more verbal memory loss after removal of their left temporal lobe (language side) whereas patients with loss of their right temporal lobe are likely to have loss of non-verbal memory such as maze-learning.

REVIEW 9.3

1. What structures of the human brain are involved in the formation of memories?
2. What is the role of the temporal lobe in the formation of memory?
3. Where are the key parts of the temporal lobes for memory located? What do they include?
4. Some patients can have either a bilateral or a unilateral lobectomy to help treat epilepsy. What is likely to happen to memory for patients who have had each of these procedures?

THE HIPPOCAMPUS

The hippocampus is a finger-sized curved structure that lies in the interior of each of the temporal lobes and is located close to the amygdala. It is named because its appearance is considered to be similar to a seahorse (in the genus Hippocampus). It is usually larger in women than in men. The hippocampus in each lobe is connected directly to the frontal lobe, thalamus and amygdala.

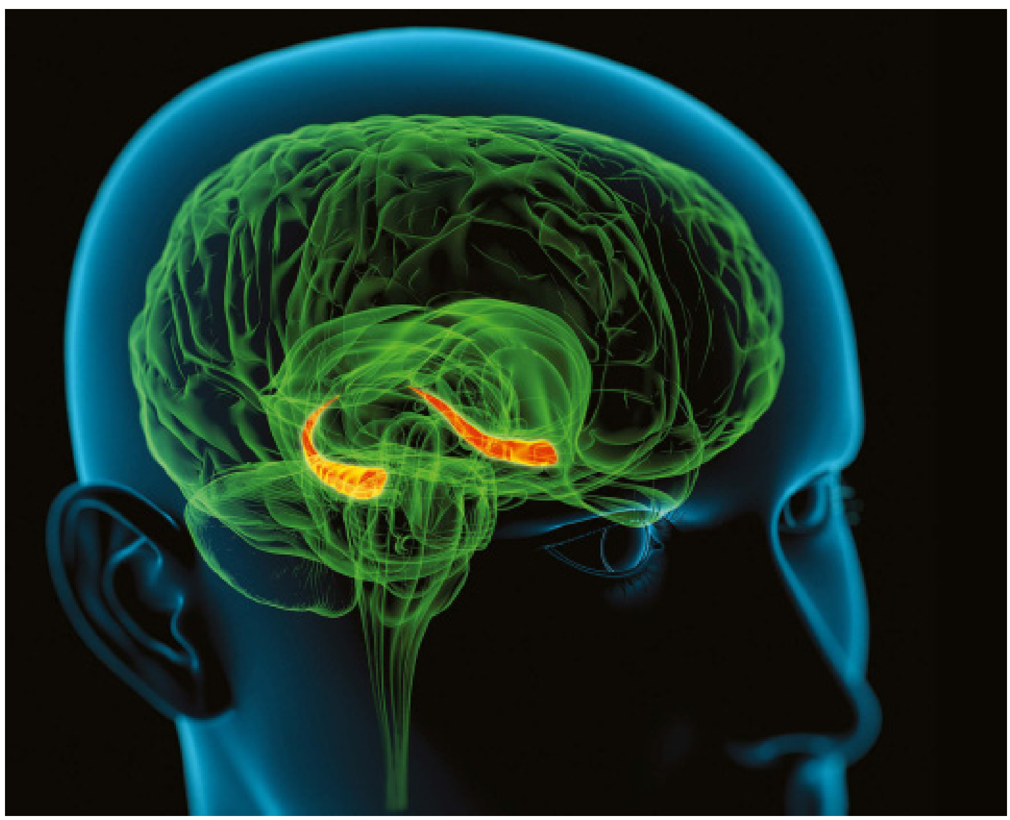


FIGURE 9.9
Hippocampus in the brain. Computer artwork of a person's head showing the brain inside. The highlighted area shows the hippocampus, part of the brain's limbic system – a primitive part of the brain involved in emotions, learning and the formation of memories. The hippocampus is located inside the medial temporal lobe and plays an important role in long-term memory, and spatial memory and navigation.

FUNCTIONS OF THE HIPPOCAMPUS IN MEMORY FORMATION

Formation of explicit memories

Unlike the cells of other parts of the brain, hippocampus cells are special because they are able to reproduce and therefore enable new learning to take place and new memories to form. The hippocampus is important for forming explicit memory and for difficult tasks that draw upon declarative memory, for example, a child learning to spell unfamiliar words (Reed & Squire 1999). Another example is in the research of

Maguire and colleagues (1997) who found the hippocampi of London taxi drivers to be larger than those in people who worked in other professions.

The hippocampus is also involved in establishing the background or context for each new memory, such as the location, situation and memory for places. Refer to the key study on page 275.

Consolidation of explicit memories

The process of **consolidation** (the permanent storage of a memory) of declarative memory takes place mostly in the hippocampus. Neuroscanning techniques have enabled researchers to observe the hippocampus in the process of consolidation. For example, in one study participants were asked to learn words or pictures that were shown to them. How well the words were remembered later on could be predicted from how much activation occurred in the hippocampus during the presentation (Alkire *et al.* 1998; Brewer *et al.* 1998).

KEY STUDY

THE ROLE OF THE HIPPOCAMPUS IN THE CONSOLIDATION PROCESS

A study using rats indicated that the hippocampus has a vital role in the consolidation process. The rats were trained in a water maze, which is a tank of muddy water from which they could escape once they had quickly learnt the location of a hidden, submerged platform on which they could stand.

Immediately after they had learnt to swim to the platform, the rats were given a drug that temporarily disabled their hippocampus and prevented consolidation. When they were re-tested in the maze 16 days later, these rats performed poorly. This indicated that the hippocampus has a role in consolidation.

In a different trial, rats were *not* given the drug at the time they were in the maze: consolidation of learning the water maze was allowed to take place. However, these rats were given the drug at the time of testing 16 days later. It was found that these rats also performed poorly because they were unable to *retrieve* the information about the platform that they had learnt. This demonstrated that the hippocampus also has a role in retrieval of declarative memory (Riede *et al.* 1999).

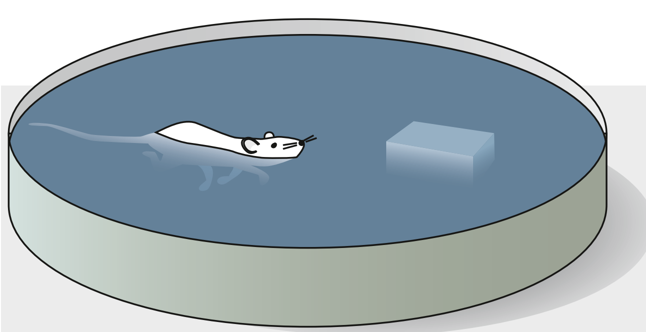


FIGURE 9.10 The rat learns to escape the water by standing on the submerged platform.

INVESTIGATE 9.4

KEY STUDY: THE ROLE OF THE HIPPOCAMPUS IN THE CONSOLIDATION PROCESS

1 What was the aim of this experiment?
2 Identify the research design used in this experiment.
3 Name one advantage and one disadvantage of using this study design.
4 Write an experimental hypothesis for this study.
5 How were the independent variable and dependent variable operationalised?
6 What did the researchers conclude from the results of this study about the role of the hippocampus in memory?
7 Discuss two ethical issues related to this experiment.

Did you know?

Because the hippocampus is involved in the formation of new memories, researchers are currently exploring the possibility that drugs that assist the growth of neurons might provide treatment for sufferers of Alzheimer's disease and other diseases that reduce memory (Frielingsdorf et al. 2007). The recent research in neuropsychology and **neural plasticity** (the ability of the brain to be modified) is also providing hope for sufferers of memory loss.

Transfer new memory for storage

The hippocampus transfers declarative information to other relevant parts of the brain for permanent storage as long-term memory. Research suggests that this occurs at times when it is less busy, such as during sleep (Lisman & Morris 2001). The hippocampus is active during slow-wave sleep, when it is considered that memories are being processed. Researchers have found that human performance on a visual discrimination task continued to improve 2–4 days after the initial training and even with no additional practice, but only if the participants had slept within the first 30 hours after training (Stickgold, James & Hobson 2000).

Linking emotion to memory

Through its close relationship with the amygdala, the hippocampus plays an important role in the relationship between emotion and memory, including both the emotions that are generated by particular memories and memories that are triggered by emotions.

FACTORS AFFECTING THE FUNCTIONING OF THE HIPPOCAMPUS

The functioning of the hippocampus can be disrupted by psychological factors such as stress, anxiety, depression and post-traumatic stress disorder (PSTD). It can also be damaged through brain trauma such as head injury. Health-related conditions such as Alzheimer's disease, viruses such as herpes, encephalitis and various other conditions can also cause dementia. Prolonged stress may cause the hippocampus to shrink and thereby disrupt its role in memory formation.

THE AMYGDALA

In each hemisphere, the amygdala is located almost directly behind the temple and beneath the cortex of the temporal lobe. It regulates emotions such as fear and aggression, and plays a more general role in the formation of emotional memory.

The amygdala has been found to have a special role in the memory for emotions shown on faces (Markoswitsch *et al.* 1994). The amygdala also has an important role because the emotions it regulates enhance the memorability of an event that is stated as declarative memory. Research suggests that for declarative memory with emotional content, such as winning an important sports competition, the amygdala has a role in activating the hippocampus and therefore enhancing the consolidation of the declarative memory (Garrett 2009). Cahill's research on flashbulb memories and PTSD provide insight into the effect of stress hormones released during the fight–flight response on memory formation.

9.4 REVIEW

1 Explain how sleep has been found to improve memory.
2 Which structure in the brain is linked to fear and aggression?
3 How does the amygdala assist in the formation of declarative memory?
4 Summarise the role of the hippocampus in memory formation.
5 What can disrupt the function of the hippocampus in memory formation?

SUPPORTING UNDERSTANDING

Emotional arousal and flashbulb memories

In researching 'flashbulb' memories, Cahill and colleagues (Cahill, Prins, Weber & McGaugh 1994) investigated the adrenalin hormone that is released in the flight–flight response (see Chapter 5). They found that participants who were shown the image of an emotionally arousing event of a boy in an accident had an enhanced memory of the event, compared to participants in other groups who were shown images that were not emotionally arousing. The results supported the notion that flashbulb memories for emotionally arousing events are affected by the fight–flight hormone, adrenalin.

9.5 INVESTIGATE

THE EFFECT OF FEAR AND AGGRESSION ON MEMORY FORMATION

Search the Internet and find your own experiment on 'fear and aggression' using the key words: amygdala, fear, aggression and memory. Once you have found an interesting study, print it out and complete the following questions:

1 When was the experiment conducted?
2 Who were the researchers?
3 Was the experiment on humans or animals?
4 What was the aim of the experiment?
5 Write a possible experimental hypothesis for the experiment.
6 What did the study conclude?
7 Were there any potential ethical issues associated with this study? If yes, explain them.
8 How do experiments on fear and aggression relate to the formation of memories?

INVESTIGATE 9.6

'FLASHBULB' MEMORIES

1 Research and explain what 'flashbulb' memories are.
2 What was the aim of the experiment that Cahill and colleagues performed when researching 'flashbulb' memories?
3 What hormone is linked with 'fight–flight'?
4 Identify the independent and dependent variables in the experiment.
5 Write an experimental hypothesis for this experiment.
6 What did researchers conclude about the role of emotions in memory formation?
7 Discuss two ethical considerations that the researchers needed to address in this experiment.

KEY STUDY

THE ROLE OF ADRENALIN AND EPISODIC MEMORIES

The role of adrenalin has been investigated in relation to encoding of episodic memories. If these hormones are present in the bloodstream during a highly emotional event, then they might enhance the encoding of the event. In some instances this can be helpful, such as learning to avoid a dangerous situation in future. However, in other circumstances it can be a problem, such as in the case of post-traumatic stress disorder (PTSD), which is a condition where victims suffer symptoms such as sleep disturbances and flashbacks due to a traumatic event.

Recent studies (Maheu *et al.* 2004) *have* investigated the possibility that medication that is able to block particular hormones in the body might assist in the treatment of PTSD. Research suggests that if a patient is given the medication within hours of the trauma, then their memory of the event may be less intense than it otherwise would have been. This medication also achieved some success in the treatment of patients with longstanding PTSD (Brunet *et al.* 2008).

INVESTIGATE 9.7

KEY STUDY: THE ROLE OF ADRENALIN AND EPISODIC MEMORIES

1 What is the aim of the study in the key study?
2 Write an experimental hypothesis for this study.
3 What did the researchers conclude?
4 Discuss two potential ethical issues that could arise in conducting this experiment.

THE HIPPOCAMPUS VERSUS THE AMYGDALA IN MEMORY

Patients with damage to their hippocampus (see the case of H. M. on page 277) have enabled researchers to realise that there were two types of long-term memory: long-term declarative memory (a form of explicit memory) and long-term procedural memory (a form of implicit memory). To further understand the brain structures that are involved in implicit memory processing, researchers studied PET scans of participants while they undertook activities that required use of explicit, and implicit memory. They found that the hippocampus was active for explicit memory tasks but other parts of the brain were active for procedural memory tasks – for example, the cerebellum was, in part, responsible for remembering motor skill tasks (Sanes, Dimitrov & Hallett 1990; Schachter *et al.* 1996).

People with hippocampal damage are still able to learn and remember non-declarative (i.e. procedural) information such as motor skills or habits (bike riding, playing table tennis). If asked, however, these people cannot remember actually performing the skill because their memory of it is declarative (episodic) memory (Zola & Squire 2000).

Bechara and colleagues (1995) demonstrated the important role of the amygdala for non-declarative emotional memory. This research included one participant with damage to both amygdala and another participant whose hippocampus was damaged on both sides of the brain.

The researchers tried to link responses in the participants by making a loud unpleasant noise when a blue slide was shown to them, but no noise when a slide of a different colour was shown.

The participant with the damaged amygdala reacted emotionally to the loud noise and was able to tell the researchers which slide was followed by the unpleasant noise; however, when the same blue slide was presented without the loud noise, he did not react emotionally. In other words, he had no emotional memory (reflex response) associated with the blue slide and so did not react to it when it was not accompanied by the unpleasant noise.

In contrast, the participant with damaged hippocampi showed an emotional response to the noise and also to the blue slide (the conditioned stimulus) but, when asked later, could not remember which colour slide was associated with the loud noise. In other words, his brain had not consolidated declarative memory for the colour that was associated with the noise (Bechara *et al.* 1995).

This study indicated that people with a damaged amygdala are incapable of fear conditioning, indicating that this part of the brain is important for the formation of this type of memory.

Consolidation theory

Consolidation theory proposes that memory is permanently stored through a process where there are physical changes to neurons (Andrewes 2001). It refers to the strengthening of memories over time (from brief periods to several years). It is thought that any memory that is permanently stored will involve the process of consolidation. The hippocampus is one particularly important structure that is involved in this process (Andrewes 2001; Garrett 2009).

When new information such as a telephone number or a mathematical formula is learnt for the first time, it is temporarily held in the short-term memory. It does not always become a permanent memory – and if it does, the process takes time. This is the period in the transfer of information into long-term memory when the 'setting' of the information is necessary for a permanent memory to be established. The case of H.M. (page 277) demonstrated the period of extended consolidation in which human memories are vulnerable to disruption and disturbance because he had retrograde amnesia for some events that happened up to three years prior to his surgery.

According to consolidation theory, three conditions – physical change, no disruption and time – are required for memory to be permanently stored.

FIGURE 9.11 Consolidation theory explains why people often don't recall events when they have suffered a head injury (concussion) because the lost information had not yet been consolidated and so the long-term memory had never formed.

INVESTIGATE 9.8

1 Create a flow chart diagram to illustrate which structure(s) of the brain are responsible for emotional memories and which are responsible for procedural memories. In this flow chart, show what happens to information when these structures are damaged.
2 What is a 'case study'? Explain.
3 Why are case studies useful in experimental research?
4 Can results from a case study be generalised?
5 In terms of experimental research, explain what is meant by generalising results.

TABLE 9.3 Consolidation theory: conditions necessary for permanent storage of memory

CONDITION	DESCRIPTION
Physical change (a physical change must occur in the synapses)	> Consolidation mostly happens through the hippocampus, which converts information from the short-term memory into permanent memory codes that are gradually stored in the long-term memory. > The short-term memory changes the strength of the existing synapses in the brain, whereas long-term memory involves the growth of new connections between neurons (Kandel 2001). > Long-term memories are probably stored in the same areas of the cerebral cortex that were originally involved in processing the sensory input of the information (e.g. visual information in the occipital lobe).
No disruption (if the process is disrupted, long-term memory is unlikely to form)	> There is a period where memories are less consolidated or 'set'. These memories are susceptible to alteration by new relevant information. > The process may be disrupted by a head injury, the amount of attention that is paid to the information, or the arousal level due to anxiety and alertness. > Information can be altered or completely lost during this process.
Time (consolidation takes time)	> Neural connections that have had more time to strengthen are less likely to be disrupted. This explains why head injury patients can still remember their names, family members and address but not remember the events that led to the head injury happening. > Researchers are still identifying the period of time it takes for consolidation to take place to the point where it is no longer vulnerable to disruption or change. Some research suggests that it is a process that can occur over a 30-minute period. Yet there is also evidence to suggest that it can take several years before some memories are permanently stored and no longer vulnerable to disruption or change.

To date, most research on the consolidation process has focused on declarative memory. No clear evidence has emerged to indicate that a process of consolidation happens for non-declarative memory.

Consolidation is an ongoing process Each time we learn something new that is associated with some previously stored information, we retrieve the old information from our long-term memory and therefore further strengthen the neural connections. Research also suggests that any time a memory is retrieved it must be reconsolidated (reset) and at this time it is again vulnerable to disruption (Garrett 2009). It is thought that this happens so that existing memories can be refined, corrected or modified (Dudai 2004).

Memory decline over the lifespan

As humans age, they find it more difficult to recall names, dates or even where they put their mobile phone. This does not necessarily mean the onset of dementia – it's more likely that our ability to recall has slowed down because our brain, much like the rest of our body, is no longer in the same shape that it was in when we were younger.

In the absence of any causes for **organic** (biological) **amnesia**, such as disease or stroke, memory abilities vary across the lifespan of humans. In the normal ageing brain there is usually some decline in learning and memory but the loss of neurons and synapses is limited to a few areas only.

Brain functioning and age-related memory decline

The brain of an older person is not quite as efficient or fast as when that person was younger. The central nervous system begins to slow down and this may affect memory.

Several neuroimaging studies have found that age-related deficits in working memory and episodic memory are related to changes in the functioning of the prefrontal cortex after the age of 60 (Rajah & D'Esposito 2005). There is also a decline in the bundles of axons (white matter) that connect different regions of the brain. This decline disrupts communication between the different regions of the brain (Andrews-Hanna *et al.* 2007).

Research on ageing animals also shows loss of synapses in the hippocampus (Gazzaley *et al.* 1996). It is hypothesised that if this loss also occurs in humans, then long-term potentiation is diminished, resulting in a slower rate of learning and more rapid rate of forgetting in elderly people. It has also been suggested that the neurons in elderly brains have myelin loss, which results in slower neuron conduct.

REVIEW 9.5

1 Explain the statement 'consolidation is an ongoing process'.
2 Explain what occurs during the consolidation of memories.
3 Why must memories be reconsolidated?
4 What happens when memory formation is disrupted?
5 Research has found that it takes minutes for new memories to be established/consolidated. However, other research has found that it takes days for memories to become more permanent and it might take many years for the consolidation process to be completed. Find out how many minutes and hours are involved in the statement in question 1.

IS AGE-RELATED MEMORY DECLINE INEVITABLE?

Not all forms of memory decline with age. Determining whether a person really does have age-related memory decline requires consideration of:

- the type of memory
- how the memory decline is measured
- the motivation of the individuals being tested
- the level of confidence an older person has in his or her memory.

FIGURE 9.12 Just like the body, some aspects of our memory slow down as we age.

There tends to be an age-related memory decline for episodic memory. Working memory also becomes less efficient with age. Studies have shown, however, that semantic memory, short-term memory and procedural memory perform at a relatively constant level across the adult lifespan, although some specific tasks used to assess short-term memory and procedural memory have revealed an age deficit (Nilsson 2003).

LONG-TERM MEMORY

Declarative memory: semantic memory

Elderly people perform just as well as younger people on semantic memory tasks but may take a little more time to encode and retrieve information. It may take older people more time to learn new material but, if they are given adequate time to encode, they can learn as well as younger people (Perlmutter *et al.* 1990). Knowledge that has become implicit memory (well-learnt semantic memory), such as reading and spelling familiar words, is readily retrieved and used.

Declarative memory: episodic memory

Older people tend to have episodic (autobiographical) memory decline and, within episodic memory, **prospective memory** (remembering to do things in the future) is particularly affected (Einstein *et al.* 1998). Longitudinal studies suggest that episodic memory is relatively stable up to middle age, then there is a sharp decline (Nilsson 2003). This is possibly the reason that older people tend to talk more readily about their lives when they were younger rather than more recent personal events. Episodic memory is also unique because it is the only memory system showing gender differences in performance throughout the adult lifespan, with a significantly higher performance for women (Nilsson 2003).

Procedural memory

Procedural memories tend to last for a long time, despite ageing. Learning that has become implicit memory or skills (procedural memories), such as riding a bike, opening a can or cleaning our teeth, does not disappear with age. For long-term memory, the difficulty older people tend to have is in retrieving explicit memories, rather than learning, using or demonstrating forms of implicit memory.

FIGURE 9.13 Some older people use lists to help them remember things they have to do. Which form of memory is assisted by a list of things to do?.

SHORT-TERM MEMORY AND WORKING MEMORY

Short-term memory

For simple tasks, short-term memory generally does not deteriorate with age (Nilsson 2003) and older people can perform well on simple short-term memory tasks such as remembering a list of numbers (Baudouin *et al.* 2006). Verbal recency memory (memory for recently learnt verbal information) is an aspect of memory that is most affected by ageing. Visual recency memory (recency memory for visual information) is, in contrast, less likely to be affected by age (Sekular *et al.* 2006).

Working memory

Elderly people are also more likely to perform more poorly than younger people on complex working memory tasks. For example, elderly people find it difficult to perform complex tasks such as saying a string of digits backwards (Kirasic *et al.* 1996), doing several tasks at once or dividing their attention without interference (Einstein *et al.* 1997; Van Gerven, Meijer & Jolles 2007). Studies that used neuroimaging found that the prefrontal cortex – responsible for working memory – was less active and less efficient for people aged 60 and over (Reuter-Lorenz & Stanczak 2000).

HOW MEMORY DECLINE IS MEASURED (MEASURES OF RETENTION)

Older people tend to experience more difficulty than young people in retrieving new information rather than encoding it. Although the ability to recall information declines with age, the ability to recognise the same information does not. Therefore, the measure of retention that is used to assess the memory of older people is important. In a study testing people ranging from young adults to those over 70 years old on their memory for school classmates, older people performed worse if asked to recall the names of classmates but were able to recognise the names and faces of their classmates just as well as younger adults (Bahrick, Bahrick & Wittlinger 1975). In a study of declarative memory, elderly people performed much better on recognition tests than on recall tests. It is likely that, while the memories in storage in the brains of elderly people may not actually decline, the ability to retrieve them does (Searlemann & Herrmann, 1994).

MOTIVATION

Some elderly people lose interest in trying to learn and later remember information that is of no consequence or interest to them. People who continue to use their memory for thinking and problem solving well into old age tend to suffer less memory loss than those who occupy their old age with pursuits that are less mentally challenging.

CONFIDENCE IN MEMORY

Some elderly people worry about their capacity to learn and remember new material and therefore do not make as much effort in this as younger adults. Research has demonstrated that professors aged in their 60s performed as well as those half their age on learning and memory tests (Shimamura *et al.* 1995).

STUDY SHOWS BUSY MINDS GOOD FOR THE WHAT'S-ITS-NAME

By Kate Benson

That part of the brain responsible for memory shrinks twice as much in elderly people who had little education, limited social life or have not kept mentally active since their teens, a study found.

Researchers at the University of NSW followed a group of 60-year-olds over three years.

It found that those who had been mentally and physically active continually since the age of 13 had a larger hippocampus, the part of the brain governing short-term memory and navigation skills.

A small atrophied hippocampus is a major factor in developing Alzheimer's disease, and mental activity has been found to delay the onset of some other degenerative diseases such as Huntington's and Parkinson's. The author of the report, Michael Valenzuela of the school of psychiatry, said researchers had for the first time compared brains, using magnetic resonance imaging, over many years in relation to mental activity patterns.

This added weight to the previous work that showed that complex mental activity helped block dementia.

"It also helps throw some light on why there has been this consistent link between mental activity and lower dementia risk," Dr Valenzuela said.

But he said the study, published in the *Public Library of Science One* journal, indicated that the size of the hippocampus was not directly related to intelligence.

"Among people who had the bigger hippocampi, it came down to them having a real diversity of interests," he said.

Some had gone back to university in their 60s and 70s, and others had a variety of interests and socialised "quite a lot."

He said that while many drug companies were searching for ways to stop the hippocampus shrinking, people could help themselves.

"Our prior research shows the risk for dementia is quite malleable, even late in life," he said. "It is vital that everyone is involved in cognitive, social and physical activities late in life such as tai chi, sailing, travelling and learning a new language for example.

The Age 15 July 2008

INVESTIGATE 9.9

MEMORY DECLINE OVER A LIFETIME

Create a PowerPoint presentation to explain what happens to memory as people age. Include the following information:

- brain functioning and age-related memory decline
- types of memory affected (declarative/semantic/procedural)
- the effects of ageing on short-term memory and long-term memory
- role of motivation and confidence
- is memory decline inevitable as people age? Explain.

KEY STUDY

AGEING AND WORKING MEMORY

Research using *f*MRI has shown that memory decline for normal, ageing adults might be caused by an inability to ignore surrounding distractions (also see interference theory in Chapter 10). It was suggested that if older people are unable to block out distracting information, it prevents them from paying attention to relevant information and therefore the relevant information is not encoded. The study compared the *f*MRI scans and the performances for a simple memory task for younger adults (19–30 years) and older adults (60–77 years). The older adults were unable to ignore irrelevant information, yet both groups were equally able to use the appropriate parts of their brain for dealing with the information to be remembered (Gazzaley et al. 2005).

When asked to remember faces, the *f*MRI scans of young adults' brains showed enhanced activity in the part of the brain dealing with faces and less in the part of the brain dealing with scenes. Similarly, when asked to notice scenery, the part of the brain dealing with scenes was more active than the part of the brain dealing with faces.

When older adults were asked to notice faces, their brain activity in the part of the brain dealing with faces was similar to that of young adults, but, unlike young adults, their brains were also active in the area for scenes (and vice versa). In other words, older adults were unable to ignore or filter out the information (scenery) when asked to focus only on faces. This resulted in poorer memory test performance. This finding led the researchers to suggest that problems of ageing have to do with a decline in the functioning of the frontal lobe.

9.6 REVIEW

1 Some people think that age-related memory decline is inevitable and applies to all forms of memory. Are these people correct? Provide reasons for your answer.
2 Which lobe of the brain is thought to decline in functioning with age?

Researching human memory formation and amnesia

Studies of memory usually fall into two groups:

1 studies of patients with neurodegenerative diseases
2 studies of patients with specific memory loss due to brain trauma.

The first group includes studies of patients with diseases such as Alzheimer's disease. This type of memory deficit is rarely 'pure', however, and it is common for Alzheimer's disease to be accompanied by other cognitive deficiencies besides simple memory loss. This makes it difficult to identify exactly which aspect of the patient's problems is based on memory. This also means that although case studies of diseased patients are valuable, it is difficult for researchers to develop and test theories about the mechanism of memory formation.

This second group, studies of patients with specific memory loss due to brain trauma, makes a more powerful contribution to research because the location of lesions in specific parts of the brain will often provide a pure memory deficit. Nevertheless, this does not automatically mean that a patient with a pure deficit will have specific brain damage. This is because the human brain is complex; often, the memory functions of different parts of the brain are interrelated or another part of the brain has compensated for the damaged part. Nevertheless, study of brain-damaged patients such as H.M. (earlier in this chapter) enables researchers to establish better generalities about memory and to develop and test theories about which areas of the brain play important roles in particular types of memory (Baddeley, Eysenck & Anderson 2009).

Researchers are able to use brain-imaging technology in both normal and brain-damaged patients to obtain information about the function of specific brain-structures in memory tasks. For example, the key study 'Ageing and working memory' (page 285) shows an example of an *f*MRI neuroimaging technique being used by researchers to investigate which areas of the brain are active when specific memories are in use. The study of London taxi drivers (earlier in this chapter) is another example of research that used neuroimaging to study normal brains.

Types of amnesia

Amnesia refers to the inability to remember. There are two forms of amnesia: **retrograde amnesia** and **anterograde amnesia**. People with forms of amnesia have a range of types of memory loss and cognitive deficits.

RETROGRADE AMNESIA

Retrograde amnesia is difficulty in recalling previously stored memories. Usually, retrograde amnesia involves the loss of memories from a period before the time when the person's brain was damaged. Patients usually have no memory of the period just prior to the injury, but sometimes the amnesia can go back several years. Generally, older memories are less affected. Strokes, brain tumours, surgery and electroconvulsive therapy (ECT) are all common causes of this type of amnesia. When this amnesia is caused by head injury, such as trauma or stroke, some memories might eventually return, with the older memories generally returning first. Memory of the events that occurred just prior to the injury, however, are unlikely to be recovered because the consolidation of these would have been disrupted. Sadly, when retrograde amnesia has been caused by degenerative diseases such as Alzheimer's disease, the memory loss may be more fragmented and it is unlikely that memories will ever be recovered.

Did you know?

Post-traumatic amnesia is a form of amnesia that people may have when they are emerging from a coma. It may last for minutes or years, depending on the nature of the head injury that caused the coma. Its symptoms include disorientation, confusion, fatigue, agitation and the inability to form new memories.

ANTEROGRADE AMNESIA

Anterograde amnesia is the inability to encode and store new memories. Typically, people can retrieve memories they had prior to the trauma but cannot learn anything new. This amnesia is commonly associated with Alzheimer's disease. Case studies and modern brain-scanning techniques show that damage to the temporal lobe and hippocampus is often related to anterograde amnesia. These structures are involved in the consolidation process, especially for encoding and storage of long-term declarative memories. In particular, damage to the part of the hippocampus called CA1, which is linked to the cortex, is likely to cause anterograde amnesia but not much retrograde amnesia.

ANTEROGRADE AND RETROGRADE AMNESIA TOGETHER

Damage to the whole of both hippocampi will cause severe anterograde amnesia and also some retrograde amnesia. H.M. (see earlier in this chapter) had both of his temporal lobes and hippocampi removed and this caused his severe anterograde amnesia. He had difficulty encoding and storing new long-term declarative memories, but was able to form short-term, procedural and implicit memories.

H.M. also suffered a degree of retrograde amnesia; he had very little memory for events that occurred prior to the operation. His retrograde amnesia extended back to the age of 16, so he was able to remember events and information learnt up until then, but after that his memory loss was severe. He could not remember the end of World War II, when he finished school or his high school classmates when he attended a school reunion.

Anterograde amnesia is often accompanied by retrograde amnesia – for example, in Alzheimer's patients – but it is less common to find the reverse. When it does occur, a clinician may be suspicious that the patient is trying to feign amnesia in order to cover for some criminal or unacceptable behaviour. Andrewes (2001) reported a case of a patient who claimed he could not recall stealing a car or assaulting his father-in-law. Subsequent assessments showed that he was faking amnesia.

Did you know?

Infantile amnesia refers to the minimal declarative memories from our early childhood, usually prior to the age of three or four. Recent research suggests that the hippocampus is slow to develop in young children and so declarative memories are poorly stored or not stored at all. Infants also have immature neural circuits, which are involved in the retention and retrieval of memory (Burton, Westen & Kowalski, 2009).

Effect of brain trauma and neurodegenerative diseases on memory

Brain trauma (damage to the brain) refers to 'organic' or physiologically-based amnesia. It is typically partial and selective amnesia. It can be caused by traumatic head injury, disease, seizure, malnutrition, stroke or chemical damage due to drugs (including alcohol). Total amnesia (no memory of anything at all) is extremely rare.

FIGURE 9.14 Types of amnesia

BRAIN TRAUMA

SUPPORTING UNDERSTANDING

Head injuries

Head injuries are common forms of brain damage that may cause amnesia. Severe head injuries are likely to cause greater memory loss. Stroke, anoxia (damage due to lack of oxygen) and severe injuries that damage the brain directly are clear in the nature of the damage. H.M. (see page 277) is an example of a person whose brain was unintentionally damaged by surgery.

Concussion, where a person experiences loss of consciousness for a period of time, may lead to temporary or permanent memory loss or permanent brain damage. Mild concussion will disrupt the consolidation process and cause anterograde amnesia for the events that took place just prior to the head injury. This is common among sports players in contact sports such as Australian Rules Football and Rugby. Sports medicine doctors in attendance will ask the player if he is able to remember particular details of the game during the minutes preceding the injury. For boxers, the ongoing effect of severe hits to the head can, in some individuals, lead to brain damage and result in a range of impairments such as poor memory, permanently slurred speech and other cognitive deficits. This condition is often referred to as an athlete being 'punch-drunk'.

TEST TO GUIDE RECOVERY PLAN AS POLAK SHRUGS OFF AMNESIA

By Julia Medew
Health Reporter

Doctors caring for tram crash victim Graham Polak have been given their first opportunity to assess the football player's brain injury and prospects for rehabilitation after he emerged from a condition known as post-traumatic amnesia this week.

In an exclusive interview with *The Age*, Polak's doctor, John Olver, said he would assess damage to the patient's brain only when the patient was cleared of the amnesia – a dream-like state that people move into after waking from a coma.

The condition can last between minutes and several months depending on the severity of a head injury and is characterised by disorientation, confusion, agitation, fatigue and an inability to store new memories.

"Some people say it's a bit like when you wake up and you're half asleep," Associate Professor Olver, head of the Epworth hospital's rehabilitation unit, said.

"During PTA, the brain is working at a fairly low level so people generally don't like a lot of stimulation. For that reason we keep them in a very low stimulation environment with lots of nursing care but little therapy."

He said after a patient passed tests, including recognising memory cards and remembering the date over three consecutive days, they were deemed past the condition and their injury could be assessed.

"At that time, neuropsychologists start testing thinking, speed of thinking, memory, concentration, and whether someone can plan and solve problems... When we know what's working well and what isn't working well, that's when we can start designing rehabilitation."

While Associate Professor Olver would not comment on the specifics of the Polak case, a spokeswoman for Richmond Football Club confirmed the footballer was cleared of amnesia yesterday.

Polak was hit by a tram near his Armadale home on June 29. He was put into an induced coma at The Alfred Hospital before being transferred to the Epworth Hospital rehabilitation unit on July 4.

Associate Professor Olver said that after a patient is assessed, it could be weeks and possibly months before the speed of recovery and the chances of a full recovery were known.

Because the brain is shaken against the side of the skull during head trauma, most people will experience damage to their frontal lobe, he said.

"This is the sort of executive part of the brain that controls emotion, mood, sexuality, and planning... In the long term that can change your personality because it can make you more disinhibited, say inappropriate things and behave in a way that you wouldn't have previously," he said.

Associate Professor Olver said it was impossible to tell at this stage if Polak would regain the skills to return to football.

"Recovery is very individual, I've never seen the same patient twice in 25 years of treating traumatic brain injury," he said.

"In general terms, sportsmen are fairly motivated though, so it works in favour in terms of personality.

"But you really can't make any predictions soon after an injury, because you just don't know."

The Age 17 July 2008

FIGURE 9.15 Australian Football League player Graham Polak was hit by a tram and sustained serous head injuries.

SUPPORTING UNDERSTANDING

Long-term procedural memory

Procedural memory is not stored in long-term memory the same way as declarative memory. Procedural memory (a form of implicit memory) does not require conscious recollection. Patients with Parkinson's disease or Huntington's disease, who have damaged basal ganglia, are more likely to display amnesia for procedural memory.

A patient with Korsakoff's syndrome (a degenerative neurological syndrome) learned to play a new piano piece but could not remember actually learning to do so and told others that he could not play the song. When seated at the piano, however, he automatically played it – to his own surprise!

Neurodegenerative diseases and memory loss

DEMENTIA

Dementia is a disorder affecting higher mental functions (Morris & Baddeley 1988). It can have various forms and may be caused by disease or brain damage. Dementia can be caused by a variety of factors, such as reduced blood supply to the brain or toxins such as alcohol. There are many different types of dementia. A common dementia is Alzheimer's disease, for which dementia is a symptom.

ALZHEIMER'S DISEASE

This neurodegenerative disease, which is most common in old age, involves gradual, severe memory loss, confusion, impaired attention, disordered thinking and depression (Kalat 2008). It involves both anterograde and retrograde amnesia because the disease affects both the hippocampus and the prefrontal cortex. The earliest symptom is usually impaired declarative memory, where the patient has difficulty remembering events from the day before, forgets names and has difficulty finding the right word when speaking. Next, the patient might repeat stories or questions, and eventually will fail to recognise familiar people and family members.

Amyloid plaques (proteins that form among axon terminals and interfere with communication between neurons) typify Alzheimer's disease. In addition, patients' brains have *neurofibrillary tangles* (an abnormal build-up of protein inside neurons) and these are associated with the death of brain cells. Alzheimer's patients also have lower levels of important memory neurotransmitters, especially acetylcholine.

One of the first brain structures to be affected by this disease is the hippocampus. When the cells are lost here, it causes the brain to atrophy (shrink) and the damage to the temporal lobes means that the hippocampus becomes isolated. This is probably why there is early memory loss (Hyman *et al.* 1984). Plaques and tangles in the frontal lobes cause more memory problems and difficulty in attention and motor coordination. In the occipital lobes, the disrupted link between the primary visual cortex and the visual association areas in the parietal and temporal lobes can cause reading and other visual problems for the patient. Altogether, the nature of the brain damage caused by Alzheimer's disease means that declarative memory in particular is impaired.

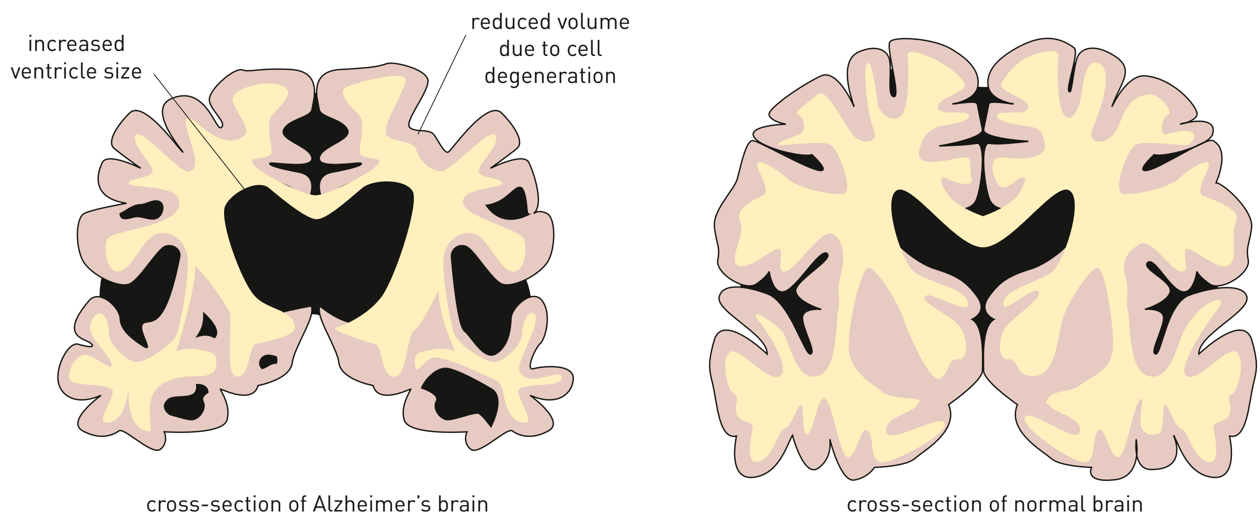


FIGURE 9.16 The brain on the left indicates the cell loss by the decreased size of the cortex compared with the normal brain on the right.

SUPPORTING UNDERSTANDING

Korsakoff's syndrome

This form of brain deterioration is a syndrome that is almost always caused by chronic alcoholism. The hippocampus and temporal lobes are unaffected but the frontal lobes deteriorate. This deterioration comes from a deficiency in the vitamin thiamine (B1), which is caused by two factors:

1. the alcoholic consumes most of his/her calories in alcohol and therefore suffers malnutrition
2. the alcohol reduces the amount of absorption of thiamine in the stomach.

Thiamine therapy can reverse the symptoms if the disorder is not too advanced but the actual brain damage is not reversible (Garrett 2009). Some Korsakoff's patients demonstrate confabulation, where they fabricate stories to make up for those missing from their memories. While these patients might confidently provide incorrect answers or information in response to questions, they are not intentionally lying. For example, an elderly patient may talk about his friend Peter as though he is a current acquaintance but in reality Peter was a childhood playmate.

9.7 REVIEW

Complete the following table.

MEMORY DECLINE	DESCRIPTION/CAUSE	STRUCTURE AFFECTED
Retrograde amnesia		
Anterograde amnesia		
Alzheimer's disease		
Dementia		

→ CHAPTER SUMMARY

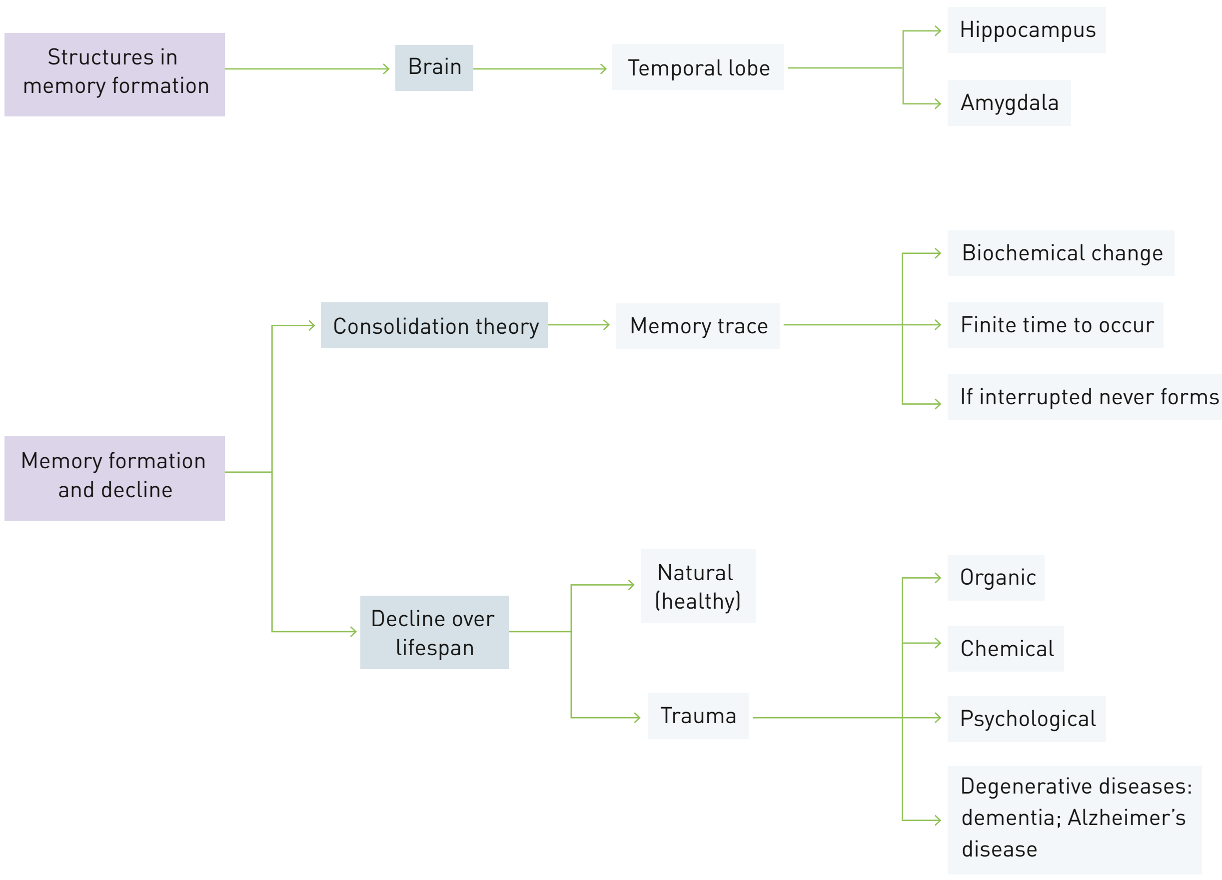
09:

- The process of memory formation involves neurons receiving, processing and transmitting information between each other through the release of neurotransmitters into the synapses. A synapse is the space between the end of one neuron and the beginning of a neighbouring neuron. Memory is formed when the synapses change in response to the release of the neurotransmitters.
- Neurons are generally comprised of three elements: axons, dendrites and the soma.
  - The soma is the cell body.
  - The axon carries information away from the soma. The end of each axon has terminal buttons that release a neurotransmitter whenever information is sent down the axon in the form of electrical impulses.
  - Dendrites receive neurotransmitters from the synapse where they have been released from other neurons.
- Some neurotransmitters can disrupt memory formation. Alcohol, stress and disease can interfere with memory formation or cause memory loss.

- Brain structures involved in memory formation include the temporal lobes, especially the medial temporal lobe (which includes the hippocampus and amygdala).
  - The hippocampus appears to play a role in the consolidation of explicit (declarative) memory.
  - The cerebral cortex is also involved in storage of explicit memory.
  - The amygdala has a role in the emotional content of memories.
- Consolidation theory describes the neuropsychological process that enables memory to be processed and stored. This mostly occurs in the hippocampus. This process can be disrupted by head injury, damage to the hippocampus, prolonged stress (adrenalin hormone) and diseases such as Alzheimer's disease.
- The study of memory usually involves case studies of people with brain damage caused by neurodegenerative diseases or head injury, or people with intact brains. Techniques include neuroimaging devices.
- Ageing usually involves some degree of memory decline but not all forms of memory are affected. Compared with the other forms of long-term memory, episodic memory is unique in showing an age-related decline. Semantic memory remains strong into old age. Working memory is affected more than simple tasks for short-term memory.
- Age-related memory decline is not inevitable. Sometimes it may appear as though an older person has memory decline but this may not be the case. It will depend on:
  - the type of memory being measured
  - how the memory decline is measured
  - the motivation of the individuals being tested
  - the level of confidence an older person has in his or her memory.
- The hippocampus has been shown to have a role in the consolidation process. Studies indicate that where amnesiac patients have trauma to the hippocampus, memories that are most recently formed are less consolidated and more fragile than well-rehearsed memories formed long before the trauma.
- Anterograde amnesia is often caused by permanent damage to the temporal lobe region of the brain. It is common in patients with Alzheimer's disease.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

Alzheimer's disease
amnesia
amygdala
anterograde amnesia
axon
consolidation
dementia
dendrite
hippocampus
neuron
neurotransmitter
retrograde amnesia
soma
synapse

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of:

- the role of the temporal lobe (including the hippocampus and amygdala) in memory formation
- consolidation theory as an explanation for memory formation
- the effect of ageing on different types of memory
- types of amnesia and their causes, including the effects of neurodegenerative diseases and types of brain trauma.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- understand why it is difficult to research the mechanism of memory formation
- be aware of ethical considerations in relation to researching the mechanism of memory formation.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Memory formation involves changes in the __________ of the brain in response to certain __________ being released.

a structures; neurotransmitters
b neurotransmitters; structures
c synapses; neurotransmitters
d structures; synapses

2 Excessive alcohol consumption may cause memory dysfunction by disrupting the __________ neurotransmitter and preventing memory formation.

a acetylcholine
b serotonin
c dopamine
d noradrenaline

3 Where would you expect to find the greatest amount of brain activity for a person learning French verbs for the first time?

a cerebellum
b hypothalamus
c right frontal lobe
d hippocampus

4 The hippocampus is particularly active during __________. This is also a time when __________ is likely to be taking place.

a concentration; attention
b sleep; consolidation
c concentration; consolidation
d sleep; ageing

5 Tony is an elderly retired plumber. He can easily remember how to attach a new tap to a water pipe but he cannot recall the names of his new neighbours. Tony's __________ memory is better than his __________ memory.
- a implicit; explicit
- b explicit; implicit
- c prospective; retrospective
- d episodic; prospective

6 Spiro was in an accident which damaged his amygdala. Which of the following would he have most difficulty with since the accident?
- a reading books
- b riding his bike
- c having emotional content in his memories
- d the consolidation process

7 Annette suffered concussion after she was hit in the head by a baseball. After the injury happened, she could no longer recall the events of the week leading up to the accident. Annette is likely to be suffering from __________.
- a retrograde amnesia
- b anterograde amnesia
- c damage to the frontal lobes
- d damage the amygdala

8 People suffering amnesia typically have loss of __________ memory but not __________ memory.
- a declarative; procedural
- b procedural; declarative
- c implicit; explicit
- d explicit; implicit

9 Which of the following would be the most difficult for a patient with anterograde amnesia?
- a learning to skip
- b recalling her 8th birthday
- c learning to spell new words
- d learning to play a computer game

10 People suffering from anterograde amnesia typically have damage to their
- a amygdala
- b hippocampus
- c parietal lobe
- d Broca's area

11 Memory loss that is most common in sportspeople after they have been knocked unconscious provides evidence of:
- a the importance of nutrition in memory formation.
- b the consolidation of new memories.
- c the role of the frontal lobes in memory formation
- d the role of the temporal lobes in memory retrieval.

12 Underlying Alzheimer's disease is a deterioration in neurons that produce:
- a epinephrine.
- b serotonin.
- c norepinephrine.
- d acetylcholine.

13 What is Korsakoff's syndrome caused by?
- a serotonin deficiency and alcoholism
- b thiamine deficiency and alcoholism
- c genes
- d traumatic head injury through the sport of boxing

SHORT ANSWER

14 Name and describe two structures of the brain that are associated with memory formation.

2 marks

15 Researchers hypothesise that memory formation involves a strengthening of certain neural connections, which occurs at the __________

1 mark

16 During memory formation, a presynaptic neuron needs ___________ (more/less) excitement to fire, and the number of receptor sites that it stimulates may increase. This is known as ___________ and it is thought to be the neural basis for learning and memory.

2 marks

17 Drugs that boost the neurotransmitter ___________ might enhance memory formation. Two neurotransmitters that seem to enhance neural transmissions associated with memory are ___________ and ___________.

2 marks

18 Hormones released when we are stressed or excited are likely to ___________ (assist/prevent) memory formation, whereas drugs that block the effects of stress hormones are likely to ___________ (assist/prevent) memory formation. However, stress that is prolonged might cause shrinkage of the ___________, an area of the brain which is important for consolidation of memories.

3 marks

19 The hippocampus functions as a part of the brain which ___________ (temporarily/permanently) stores new memory. However, memories are transferred to other parts of the brain for ___________ in ___________ (long-term/short-term) memory.

3 marks

20 People with damage to the ___________ are likely to be incapable of fear or other emotional forms of conditioning, indicating that this part of the brain is important for the formation of implicit memories.

1 mark

21 The irreversible disease which causes progressive brain deterioration is ___________ disease. This disease has been linked to a deterioration of ___________.

2 marks

22 Amnesia patients who have lost their capacity for learning suffer from ___________ amnesia. Patients who have lost the ability to retrieve memory prior to a head injury suffer from ___________ amnesia.

3 marks

23 Amnesia patients typically suffer damage to their ___________, a structure within the medial temporal lobe. This structure is important for the consolidation and storage of ___________ memory. Damage to this structure in the left hemisphere is likely to impair ___________ memory.

3 marks

24 We do not have explicit memories of our first three years of life because the ___________ is one of the last brain structures to mature. This type of amnesia is known as ___________ amnesia.

2 marks

→ CHAPTER 10:

STRENGTHS AND LIMITATIONS OF THEORIES OF FORGETTING

At any given time, you might be able recall what has happened in your life for the previous 24 hours. Most of these memories will be to do with aspects of your personal life, such as talking and interacting with friends and family, and things that have happened to you. However, if you try to remember the detail of a new topic that you have studied in a class at school, you might find it more difficult to recall every piece of information.

The first studies of forgettting, by Hermann Ebbinghaus in the late 1800s, showed that most forgetting happens immediately after learning – after a few hours we dont forget anymore.

KEY KNOWLEDGE

Strengths and limitations of theories of forgetting:

→ forgetting curve as informed by the work of Hermann Ebbinghaus

→ 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.

(VCE Study Design 2013)

Forgetting or memory loss?

CHAPTER OVERVIEW

The forgetting curve	The work of Hermann Ebbinghaus Accessibility and availability of memory > How declarative memory is measured > Availability versus accessibility > Accuracy of long-term memory Unavailable memories: ineffective encoding
Theories of forgetting	Retrieval failure theory > The tip-of-the-tongue phenomenon Interference theory > Proactive interference > Retroactive interference > Effect of similarity on retrieval > Strengths and limitations of interference theory Motivated forgetting > Criticisms of Freud's theory of repression Decay theory > Criticisms of decay theory

Why is it that we can effortlessly remember words to be able to conduct conversation, yet find ourselves unable to recall all of the quotes we need to use in an English examination? Why do we automatically remember how to turn on the shower taps to the exact temperature each morning, yet need to concentrate when using chopsticks for the first few times? Why can we remember some details of our childhood when other memories appear to have been forgotten, only to come back to us unexpectedly? Can you remember what birthday presents you received from various friends and relatives for every birthday that you have had? Why do we remember useless pieces of information or experiences which we would prefer to forget?

Did you know?

A prominent researcher of memory, Daniel Schachter, described the 'seven sins' or deficiencies of human memory:

- transience – weakening of memory over time
- absent-mindedness – failure to pay attention to material that must be remembered
- misattribution – confusing sources of information
- suggestibility – thinking we remember something when that information was 'planted' by another person
- bias – remembering incorrectly due to our own beliefs or preferences
- persistence – memories that return despite trying to erase them
- forgetting – the inability to retrieve information we know we have in our memory.

These deficiencies of human memory have major importance in criminal investigations. Eyewitness testimony will be explored in Chapter 11.

FIGURE 10.1 You may remember where you had a good meal rather than where you eat at other times. Why does this happen?

Forgetting is the inability to remember. This includes the inability to retrieve, recall or recognise information that was previously stored as memory. Therefore, forgetting refers to an inability to *access* information rather than true loss (as in total disappearance) of the information. In other words, forgetting refers to material that cannot be accessed *at that time*. This is in contrast to an organic form of forgetting, such as amnesia, which has been caused by brain damage.

Remembering is generally a process that requires no special effort. The retrieval of information from memory in response to a stimulus happens automatically. Yet there are times when hard work is required to remember – for example, making an effort to remember material for an examination – but in fact the effort made here is first to store it in a logical way and second to have thoughts or cues that will prompt the information to be retrieved.

Different types of memory can be more or less susceptible to forgetting. The retrieval of implicit memories is an *automatic process*, which requires very little effort or awareness. For example, you are unlikely to have to stop and remember how to clean your teeth each time. Most explicit memories are also retrieved automatically, for example you can automatically say the names of your family members when asked. Reading is a clear example of the way that memory is an automatic process. Experienced readers can automatically recognise words, say them aloud, and know their meanings (read the following case study). For most people, the process of remembering is usually smooth and requires very little effort, and is done unconsciously. Yet we all have experiences where we feel our memory is letting us down – even though we know that the information is somewhere in our memory.

This chapter focuses on forms of explicit (declarative) memory and compares several theories of why people forget, as well as why memory is not always as reliable as we would like it to be.

FIGURE 10.2 Sometimes you can read a page and not remember what you read. Why does this happen? Sometimes you forget that you cleaned your teeth and clean them again. Why?

KEY STUDY

THE STROOP EFFECT

When experienced readers look at a commonly used word, they automatically remember how to pronounce it and its meaning. For experienced readers, this process has become so automatic that it is hard for them to look at a word and not think of its name. This is demonstrated in a well-known study that identified a phenomenon known as the Stroop effect (Stroop 1935). Look at Figure 10.3. As quickly as you can, name the colour in which each word is printed. It is likely that you will find it hard to ignore what the words say because it is difficult to stop the automatic tendency to pronounce the word. The Stroop effect demonstrates just how hard it can be to suppress an implicit memory when an appropriate stimulus cue is presented.

blue blue blue green
green yellow red
yellow yellow blue
red green yellow
yellow green yellow
yellow red yellow
green blue yellow
red blue green green
blue blue green red

FIGURE 10.3 As fast as you can, say out loud the colour in which each word is printed.

Forgetting curve as informed by the work of Hermann Ebbinghaus

Hermann Ebbinghaus was the first person to perform systematic research into remembering (or forgetting), publishing his findings in 1885.

Ebbinghaus experimented using only one participant – himself. He did not want previous knowledge to interfere with his results, so he learnt lists of nonsense syllables – pronounceable, three-letter combinations such as *bup*, *tov*, *ruj* and *lev*. Having tested himself until he had perfect scores for remembering the 'words' on each list, he waited for various periods of time – ranging from 20 minutes to 31 days – and then tested himself again to see what percentage of the learnt material he had retained. His results (see Figure 10.4) show that forgetting occurred most rapidly in the first 20 minutes, at a moderate rate until one hour had passed and then very gradually for the next 31 days.

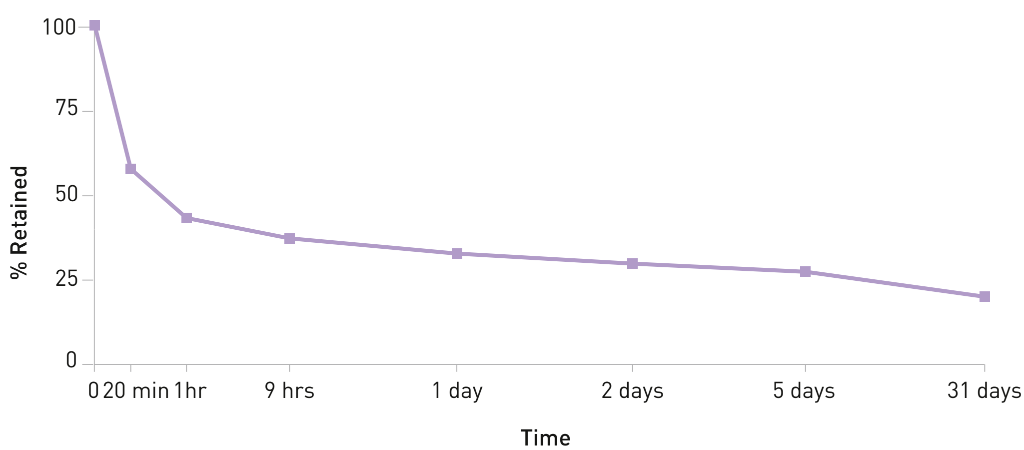


FIGURE 10.4
Ebbinghaus' results

Although Ebbinghaus created the first forgetting curve, the same features have been shown in other research since then, no matter what form of memory is tested:

- most forgetting occurs immediately after the information has been learnt, so the beginning of a forgetting curve has the steepest slope
- more than 50 per cent of the material is forgotten within the first hour
- if the learning that took place originally was *overlearned* (i.e. learnt over and over, even when already well-known), then the material is likely to be retained for longer and with greater accuracy
- factors such as the complexity of the material learnt and even the intelligence of the learner do not seem to affect the rate of forgetting.

REVIEW 10.1

1. Explain how Ebbinghaus developed the forgetting curve.
2. What type of 'words' did Ebbinghaus use in his experiments? Explain why.
3. When does most forgetting occur (according to the forgetting curve)?

INVESTIGATE 10.1

CREATE YOUR OWN FORGETTING CURVE

This activity partially replicates Ebbinghaus' experiment. It will require one full lesson to set up, then two lessons to complete.

Work in groups of 4–5 for this activity. One student will act as the experimenter and the others will act as participants.

Materials

- typed list of nonsense syllables
- pen
- five sheets of paper marked 'Trial 1' to 'Trial 5' (for each participant) to record nonsense syllables for each trial
- watch with second hand or stopwatch

Procedure

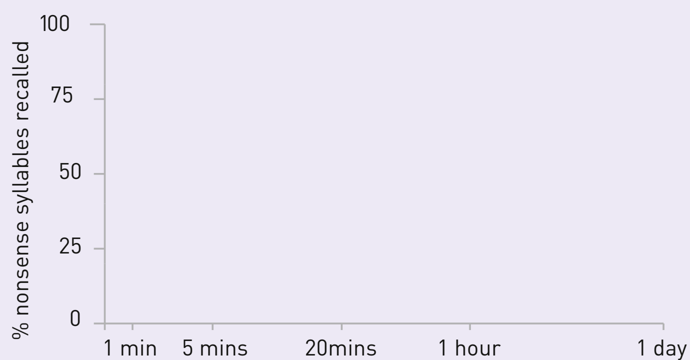
- Type up the following nonsense syllables into a list for each participant (for each class group).
  - FUB, GOF, DAS, VUT, LAR,
  - ZOT, SIG, POG, LOS, JOL,
  - WUJ, KIX, WUC, TOK, DAF
- There will be **five** trials for this experiment (over two lessons).
- Find a quiet place to conduct the experiment.
- The experimenter is to place before each participant a list of nonsense syllables (face down), five sheets of blank paper (marked Trial 1 to Trial 5) and a pen/pencil to record the syllables recalled.

Trial 1:

- Instruct the participants to turn over the list of nonsense syllables and memorise them. Allow one minute for this.
  - At the end of the minute, collect the lists of nonsense syllables and ask the participants to write down as many of the nonsense syllables they can recall on the sheet marked Trial 1.
  - Collect the sheets marked Trial 1.
  - NB: do not give participants the list of nonsense syllables for the remainder of the trials. This way, you can demonstrate the forgetting curve!
- Retest students after five minutes (Trial 2), 20 minutes (Trial 3), one hour (Trial 4) and during the next lesson (Trial 5). The number of days between classes may vary and this needs to be included when plotting the data on the graph. Make sure that participants use the appropriately marked sheets to record the nonsense syllables recalled.
- The experimenter is to make sure that all sheets are collected at the end of each trial.
- At the end of Trial 5, collate the data as a group in the following table (copy the table into your workbook).
- Enter the number of correct nonsense syllables for each trial for each participant.

- Plot the mean scores on the graph.
- Collate the data as a class and display in a table such as the one below.

PARTICIPANT	TRIAL 1 (1 MIN)	TRIAL 2 (5 MIN)	TRIAL 3 (20 MIN)	TRIAL 4 (1 HR)	TRIAL 5 (1 DAY)
1					
2					
3					
4					
Total					
Calculate mean scores for each trial					



Analysis

- Does your graph resemble Ebbinghaus' forgetting curve?
- Collate the data for the entire class and see whether it reflects the forgetting curve as well.
- As a class, discuss the results.

Accessibility and availability of memory

Memory has been likened to an artist's painting rather than a photograph or video (Burton, Westen & Kowalski 2009). For this reason, it is useful to consider some points about memory before examining the theories of forgetting.

HOW DECLARATIVE MEMORY IS MEASURED

The quantity of information retrieved from memory can vary, depending upon the way in which memory is tested. For example, it is often easier to show how much you can remember when you sit a multiple-choice test than a short-answer test. This is because a multiple-choice test requires you to recognise the information you have learnt, whereas a short-answer or essay test requires you to recall the information you

FIGURE 10.5 Memory is more like a painting than a photograph.

have learnt. It is likely that you have not forgotten any material, but the multiple-choice test makes it easier for you to remember than the recall test does. (The different ways of measuring memory will be covered in detail in Chapter 11.)

AVAILABILITY VERSUS ACCESSIBILITY

There is a distinction between the *availability* of the memory trace and the *accessibility* of the memory trace. If material is no longer stored in the long-term memory, then it is no longer available. If it is simply difficult to retrieve but the memory trace still exists, then it is not accessible but might be retrieved at some other time. For example, we might be able to remember details of our seventh birthday but forget most of the day-to-day details about our lives when we were that age, only to have those details suddenly come flooding back when triggered by a cue such as visiting our grade two classroom or seeing old photographs. In other words, the memory had not been lost; rather, it had not been accessible until the moment when a cue (revisiting the classroom/seeing photographs) had activated this old memory into conscious awareness. Memory may be available but inaccessible in many situations. The theories that have attempted to explain this are covered in this chapter.

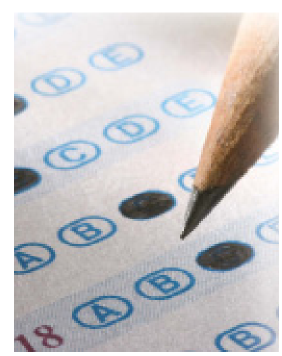


FIGURE 10.6 Multiple-choice tests measure recognition of stored memories.

ACCURACY OF LONG-TERM MEMORY

Accessibility and availability are concerned with how long memory lasts. While a particular memory might appear to have been retained over time, it may be prone to errors and bias due to factors such as emotion and arousal.

1 Outline what is meant by 'forgetting'.
2 How is declarative memory measured?
3 Explain the difference between the 'availability' and 'accessibility' of a memory trace.
4 How accurate is long-term memory?

10.2 REVIEW

INVESTIGATE 10.2

CLASS ACTIVITY

Materials

- Butcher's paper or large sheets of paper for each group (one piece per group)
- Coloured felt-tipped pens

1 Go to the following website to watch a 28-minute video about forgetting.

2 Divide the class into groups of four and allow them to document the contents of the video as they watch it. Each group is to then write their findings on the butcher's paper and to take turns in presenting their observations to the rest of the class.

3 Compile the common themes from each group and discuss the differences in each group's interpretation and memory of what they saw.

Unavailable memories: ineffective encoding

Ineffective encoding can help explain occasions where we think we have forgotten information but in reality the information was never encoded properly at the time of learning. Two examples of ineffective encoding are *pseudoforgetting*, and disruption to the consolidation process.

Pseudoforgetting is where memory is thought to be forgotten but it was never encoded and stored in the first place. It is often caused by lack of attention. The research on levels of processing (see Chapter 8) suggests that the most effective form of encoding is semantic encoding, where information is learnt at a deeper level than phonemic encoding, where information is learnt at a shallow or superficial level and is less likely to be associated with other existing information that is stored in the long-term memory.

Another reason for ineffective encoding is when the consolidation process has been disrupted or prevented (see Chapter 8).

Theories of forgetting

There is no single explanation of why people forget. Different theories have been proposed to explain why we forget but scientists are yet to agree on what the cause of forgetting is. Some theories of forgetting include:

- **retrieval failure theory** – the correct cues to retrieve information are not used or are not available
- **interference theory** – one memory is interfered with by another memory
- **motivated forgetting** – there is an underlying motivation not to remember (especially for episodic memories)
- **decay theory** – the memory has faded, or decayed, through lack of use.

It is likely that no single reason alone will account for forgetting. It is more likely that a combination of them at any given time or circumstance will explain why a particularly memory cannot be retrieved.

Retrieval failure theory

Also known as **cue dependent forgetting**, **retrieval failure theory** explains forgetting as an inability to retrieve material due to an absence of the right cues or a failure to use them. This theory was proposed by Endel Tulving (Tulving & Thomson 1973). It suggests that the amount of information we are able to retrieve from long-term memory depends on the type of cue or prompt we use. If the memory cue or prompt we use is not the right one, then we are likely to experience forgetting. In other words, the memory trace is *available* but it is not *accessible* without the relevant cue or prompt to assist in retrieving it from long-term memory.

FIGURE 10.7 What could you do to remember to cut the lawn? Write a note, send text to yourself, leave the lawnmower on a back path, take a photo and put it on your phone…

This theory tries to explain why we are sometimes unable to remember material that we are certain is in our memory, such as when you cannot remember what you intended to pack in your school bag for the day. If you walk into the kitchen and laundry, you might suddenly remember you need sports clothes and a snack for afternoon tea. The laundry and kitchen provide retrieval cues. Similarly, the smell of freshly cut grass might trigger memories you thought you had forgotten, or the options in a multiple-choice test might provide cues that assist you in remembering the correct information to answer the relevant question.

Retrieval cues are mental reminders or prompts that we create to assist our recollection later on. We may create these cues either deliberately or implicitly or both. Retrieval cues can come in a range of formats, including the **context-dependent cues** or environment in which the memory was encoded, as well as the emotional **state-dependent cues** that we were in or the smell, taste and sounds associated with the memory. Retrieval cues can also include physical objects, suggestions and verbal stimuli. The usefulness of retrieval cues also depends on the *encoding specificity*, which refers to the principle that how we encode information will determine our ability to retrieve that information later on. (The encoding specificity principle and state- and context-dependent cues are explained in further detail in Chapter 11.)

According to Tulving, a good retrieval cue is similar to the original encoding of the information. For example, if the *sound* of the word was emphasised during encoding, then the retrieval cue should be to do with the sound of the word (phonemic cue). Alternatively, if the meaning of a word was emphasised during encoding, then the retrieval cue should be concerned with meaning (semantic cue) (Tulving & Thomson, 1973).

To be sure that we will remember new information, we need to make a conscious and deliberate effort to create effective retrieval cues. This can be done in many ways – some methods include creating bizarre images in our mind, making associations between information already in our memory and the new incoming information, or using **mnemonics** (see Chapter 11).

One particular demonstration of retrieval failure is the **tip-of-the-tongue phenomenon**.

THE TIP-OF-THE-TONGUE PHENOMENON (TOT)

The tip-of-the-tongue phenomenon (TOT) is knowing that your memory does have the name, item or material you are trying to remember but you just cannot retrieve it at that moment. Often, the memory is retrieved a few minutes later. For example, you might be trying to remember the name of an acquaintance. 'What is his name? I can

FIGURE 10.8 It's on the tip of my tongue, I just can't retrieve it right now.

see his face, the colour of his hair, his eyes – and his name starts with R. Ron? Rob? Rod? Roger? … Now I remember; it's Ryan.'

Even though we may not be able to recall the exact name of a person, we will often be able to recall certain features of the name:

- whether it was a long or short name
- the letter or sound it started with.

Usually these features will be recalled accurately. This is interesting because it shows that memories are stored in a complex fashion, at a variety of locations in the brain. TOT is an example of how we intentionally search for cues that will prompt the retrieval of a specific memory. TOT occurs in all languages, at least once a week for people on average, but this occurrence increases as we get older. It typically involves proper nouns and knowing the first letter of the name, and is usually remembered about 50 per cent of the time when a person experiences it.

Two different explanations for TOT are:

- retrieval failure theory – the information was available but not accessible due to inadequate retrieval cues
- interference theory – the information is available but is blocked by interference from similar sounding material (see next section).

REVIEW 10.3

1 Retrieval failure theory is also known as: ___________
2 Explain the difference between 'state-dependent' and 'context-dependent' cues. Provide your own example of each to demonstrate your understanding.
3 Describe the tip-of-the-tongue phenomenon and explain why it occurs.

FIGURE 10.9 If you open a new bank account, remembering your new PIN may interfere with your ability to recall other (older) PINS.

Interference theory

Have you ever found yourself becoming confused or forgetting information you have studied hard when you sit several examinations on the same day? It might be that you have not forgotten the information but that interference is making the information in your memory inaccessible. This often happens when we learn two mobile telephone numbers or personal identification numbers (PINs) for bank accounts. You might also have experienced this if it took you a long time to learn all of the times tables correctly (Burton *et al.* 2009).

Interference theory is an explanation of why a memory trace that is available has become temporarily inaccessible. Interference refers to difficulties in retrieving information from memory, caused by other material learnt either previously, proactive interference, or subsequently, retroactive interference. This theory proposes that one set of information in the memory competes with another set of information.

PROACTIVE INTERFERENCE

Proactive interference is when previously learnt material inhibits our ability to retrieve new material. The prefix 'pro' means 'forward', so proactive interference is where older information moves forward to interfere with our retrieval of more recently learnt similar information. For example, you might have studied Italian in Year 7 and then learnt Spanish in Year 8. In a Spanish verbs test, your older knowledge of Italian verbs might interfere with your ability to retrieve the correct Spanish verbs. It is likely that proactive interference actually makes it more difficult for us to encode and store new information.

RETROACTIVE INTERFERENCE

Retroactive interference is when newly learnt material inhibits our ability to retrieve previously learnt material. 'Retro' means 'backwards' so retroactive interference is where new information acts to interfere with the retrieval of older information stored in memory. For example, in an Italian verbs test your more recent knowledge of Spanish verbs might interfere with your ability to retrieve the correct Italian verbs for the test.

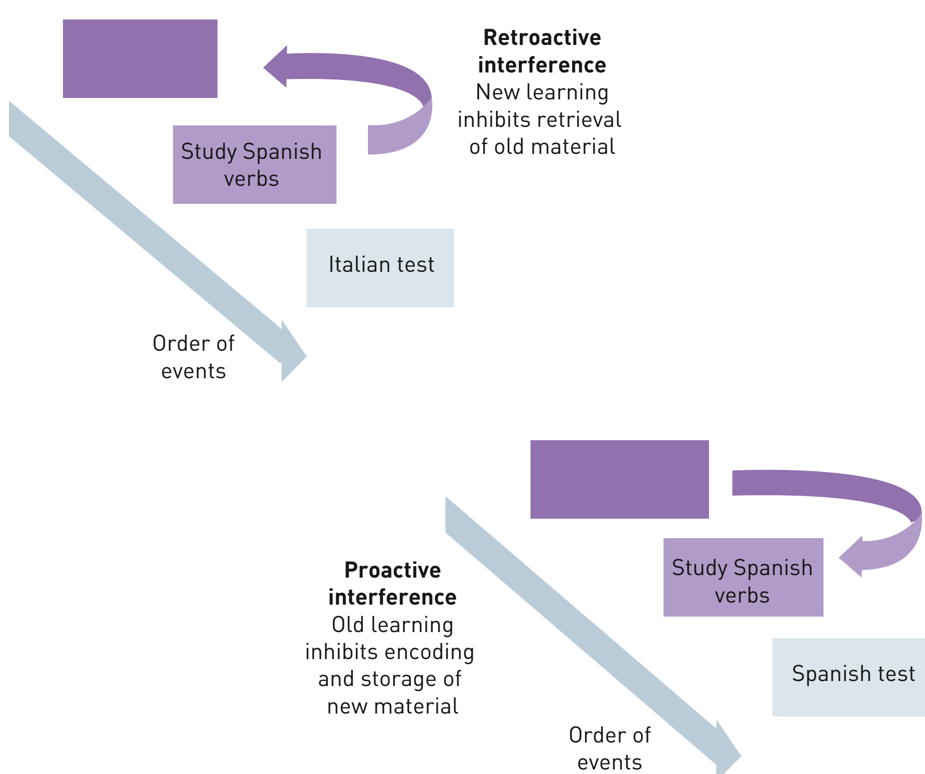


FIGURE 10.10 Retroactive interference occurs when learning new Spanish verbs interferes with the retrieval of previously learnt Italian verbs. Proactive interference occurs when previously learnt Italian verbs interfere with the encoding of recently learnt Spanish verbs.

EFFECT OF SIMILARITY ON RETRIEVAL

Interference is likely to be most pronounced when the two sets of material are very similar. This was shown in a study by McGeoch and McDonald (1931) and many studies since then.

In this well-known study, the researchers had participants memorise a list of two-syllable adjectives where they varied the amount of similarity between the original information to be learnt and the information studied during the interval between the time of learning the original information and the later time of testing recall of the original information. It was found that the amount of original information forgotten increased as the level of similarity between the original information and the interval information also increased (McGeoch & MacDonald 1931).

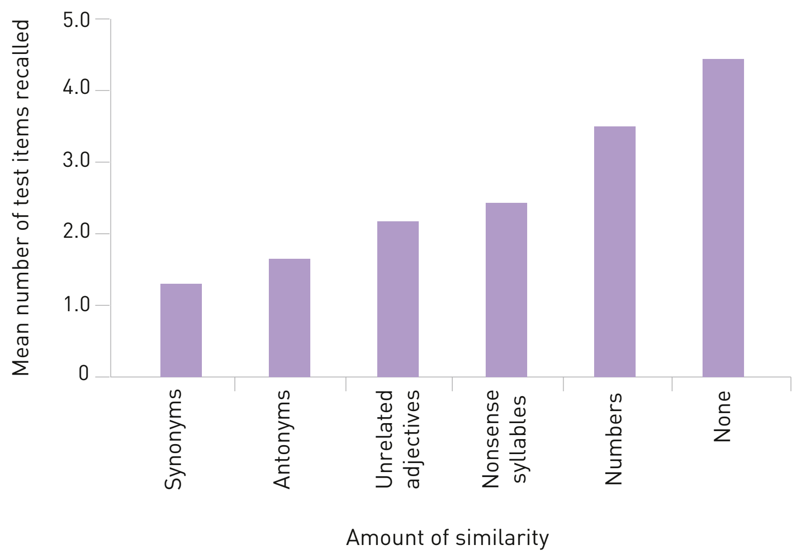


FIGURE 10.11 McGeoch and McDonald (1931) found that the amount of interference is greatest when the material is similar.

INVESTIGATE 10.3

LABORATORY RESEARCH ON INTERFERENCE

Researchers can test for retroactive and proactive interference by using an independent groups experimental design.

Testing for retroactive interference

Experimental group

1 learns a list of words (List A)
2 learns a second list of words (list B)
3 tested for free recall of words from List A

Control group

1 learns List A (only)
2 tested for free recall of words from List A

If the experimental group recalls fewer List A words than the control group, then retroactive interference has occurred.

Testing for proactive interference

Experimental group

1 learns List A
2 learns List B
3 tested for free recall of words from List B

Control group

1 learns List B (only)
2 tested for free recall of words from List B

If the experimental group recalls fewer List B words than the control group, then proactive interference has occurred.

STRENGTHS AND LIMITATIONS OF INTERFERENCE THEORY

Although this theory seems plausible, has been readily replicated in laboratory settings and has face validity in terms of our own personal experiences, it is not without its critics. While researchers agree that interference does occur, they also point out that the laboratory experiments have tended to use tests of recall, which are particularly prone to interference – for example, recall of word lists and nonsense syllables. They also point out that in real life interference might not occur so readily. For example, reading and remembering passages of meaningful information utilises semantic memory, which is less prone to interference (Carlson *et al.* 2007).

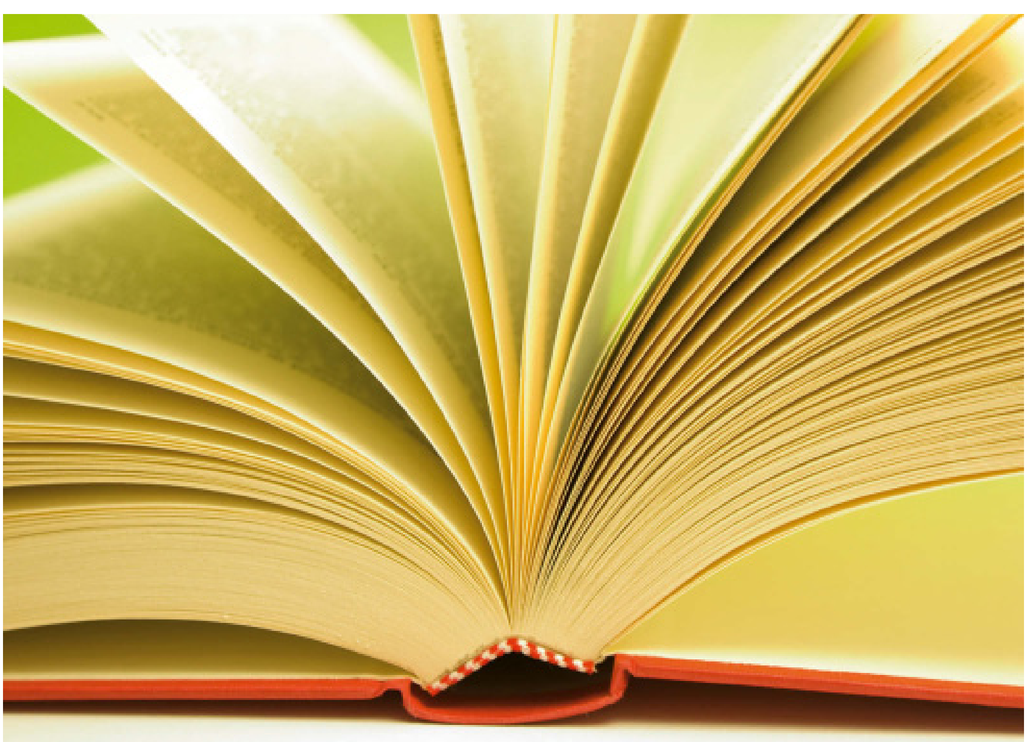


FIGURE 10.12
A criticism of interference theory is that interesting material is semantically encoded and interference is limited, if it occurs at all.

Motivated forgetting

Motivated forgetting occurs when a person has a reason to forget memories that are stored in long-term memory. Motivated forgetting may result from:

- **suppression**, which is a conscious refusal to access memories that are available (e.g. ignoring the memory of an unpleasant activity such as a visit to the dentist)
- **repression**, where painful or distressing memories are unconsciously pushed to an inaccessible part of the mind and the person is unaware that these memories exist.

Memories subject to motivated forgetting are not really forgotten but they become difficult to retrieve. Both suppression and repression are psychological processes. However, unlike suppression where the memories are readily and consciously accessible, repression is an unconscious psychological process that blocks access to memories available in long-term memory.

Repression is a theory of forgetting that was proposed by psychologist Sigmund Freud. Freud suggested that repression is a psychological process that automatically and unconsciously prevents emotionally distressing memories from coming into our conscious awareness. Examples of these unpleasant memories might be of sexual abuse, bullying, torture or any traumatic experience. According to Freud, repressed memories cannot be deliberately brought back into conscious awareness but they may be triggered by an event or experience in the present that brings the repressed memory back into awareness, for example, watching a video, hypnosis or hearing particular music.

FIGURE 10.13 Sigmund Freud

CRITICISMS OF FREUD'S THEORY OF REPRESSION

Memory researchers have questioned the validity of the theory of motivated forgetting. They point out that it is possible that such memories may have been suggested or implanted in the mind of the individual and unless the memories can be corroborated by another person who was present at the time of the traumatic event, there is no way of being sure that such memories are real.

Repression is a controversial theory because of its application in child sexual abuse cases. Some adults have reported they have suddenly remembered abuse that took place when they were children, even though many years may have elapsed since the abuse happened. In other words, their memory of the abuse has been repressed until the point at which something has happened to enable the painful memories to return to conscious awareness.

This issue is complicated when evidence or witnesses are unavailable to corroborate allegations of abuse. Some researchers suggest that these memories may be incorrect. They point out that the retrieval memories come back into awareness where hypnosis or other techniques have been used to try to 'recover' a person's painful childhood memories. There is also debate regarding whether these 'recovered memories' are real, or have been implanted in the patient's mind through suggestion by the therapist – in other words, these 'recovered' memories are, in fact, false memories. The experimental research by Elizabeth Loftus (Loftus and Palmer, 1974) has suggested that memory recall can be influenced and changed by misinformation presented to a person (see Chapter 11).

The repressed memory controversy continues because there is a lack of experimental research to support or challenge Freud's theory. There are ethical issues that prevent experimental research because it would require researchers to traumatise participants and then wait to see if the participants repressed the traumatic memories (Pastorini & Doyle-Portillo 2010).

1 Who proposed the theory of repressed memory? What was this theory based on?
2 Explain the difference between suppression and repression of memories.

10.4 REVIEW

Decay theory

Decay theory suggests that memory traces in the brain will fade over time through lack of use and eventually become unavailable. This theory suggests that forgetting is a physiological process and is based on the idea that when a memory is laid down there is a physical or chemical trace of the experience in the brain. This trace is believed to 'fade' as time passes, unless it is strengthened through repeated use. For example, a person who has not seen a friend for many years might not recall the name of that friend.

CRITICISMS OF DECAY THEORY

Researchers have not successfully shown that decay causes forgetting of something that was stored in long-term memory. Decay theory has been unable to account for the sudden recollection of events or information when the correct cues are available. Also, elderly people can often recollect memories of their younger years, despite these memories not being retrieved regularly over the years. Older people might still retrieve procedural memories such as how to ride a bike after many years of not doing so. One study found that, after 50 years, participants' ability to recognise names and faces from childhood had changed very little (Bahrick, Bahrick & Wittlinger 1975).

Although decay theory is difficult to research empirically, some studies of the hippocampus (where consolidation primarily occurs) have shown a pattern of rapid and then gradual decline of neural pathways (Anderson 1995). It is also true that memories are lost from sensory memory and short-term memory by decay.

KEY STUDY

COMPARING INTERFERENCE AND DECAY THEORIES OVER A SHORT PERIOD

Psychologists at the University of Georgia and the Georgia Institute of Technology investigated interference and decay theories of forgetting.

Participants were given a string of three-letter words to learn for a test.

After learning these words and just prior to the test, the participants were asked to count backwards for different amounts of time, e.g. 4, 8, 12, or 16 seconds.

Results showed that the participants who had to count backwards for the longest period of time had a better recall of the letter strings than the participants who counted backwards for a shorter period.

It was concluded that interference, and not decay, was responsible for the forgetting. If decay had caused the forgetting, then the participants who counted backwards for a longer period would have performed worse. This study suggests that it is possible to help to prevent forgetfulness by making the information distinct so that it is not confused with other, similar information.

(Unsworth, Heitz & Parks 2008)

REVIEW 10.5

1 Complete the following table to explain the main characteristics of the theories of forgetting:

THEORY OF FORGETTING	DEFINITION	KEY ELEMENTS	CRITICISMS
Retrieval failure theory			
Interference theory			
Motivated forgetting			
Decay theory			

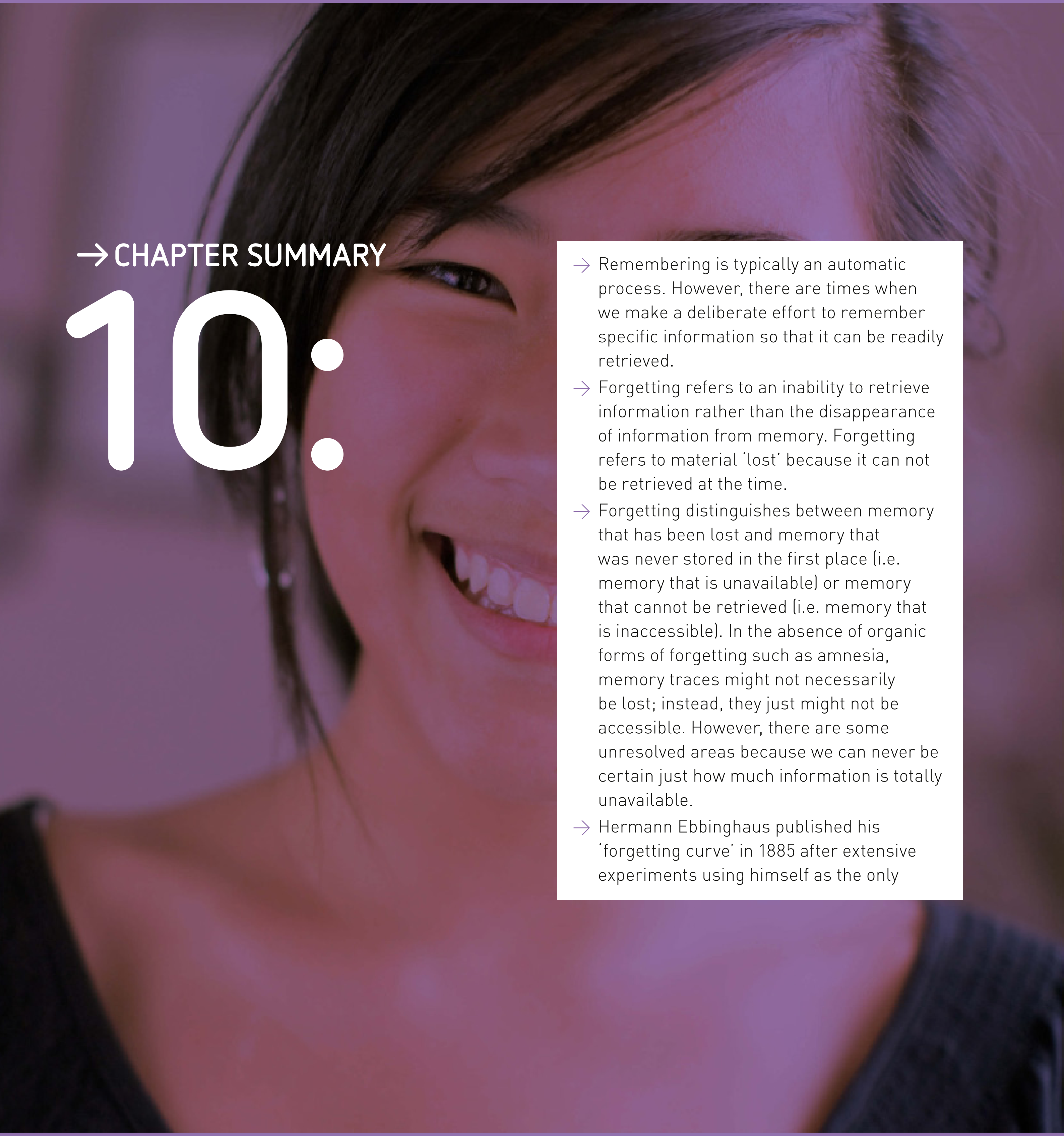
10.4 INVESTIGATE

REMEMBERING AN EVENT

Recall a significant moment in your life. Try to remember the circumstances and the events leading up to it.

1 What is the significant event that springs to mind?
   a Is this a happy, sad or funny event?
   b Where did it take place?
   c Who was present at this event?
   d What was your role in this event?
   e What were other people's roles in this event?
2 Create a directional flow chart to show your memory of the event.
3 How much of the detail you recall is likely to be accurate? Write a 500-word essay to explain your position on how accurate or inaccurate your memory of this event is likely to be. Consider explaining this in terms of the four theories of forgetting.
4 How would you be able to find out whether your memory is reliable? Using a directional flow chart, outline the steps you would take to verify your version of the event.

FIGURE 10.14 Can you remember past birthday parties? Do any specific ones stand out? Why?



→ CHAPTER SUMMARY 10:

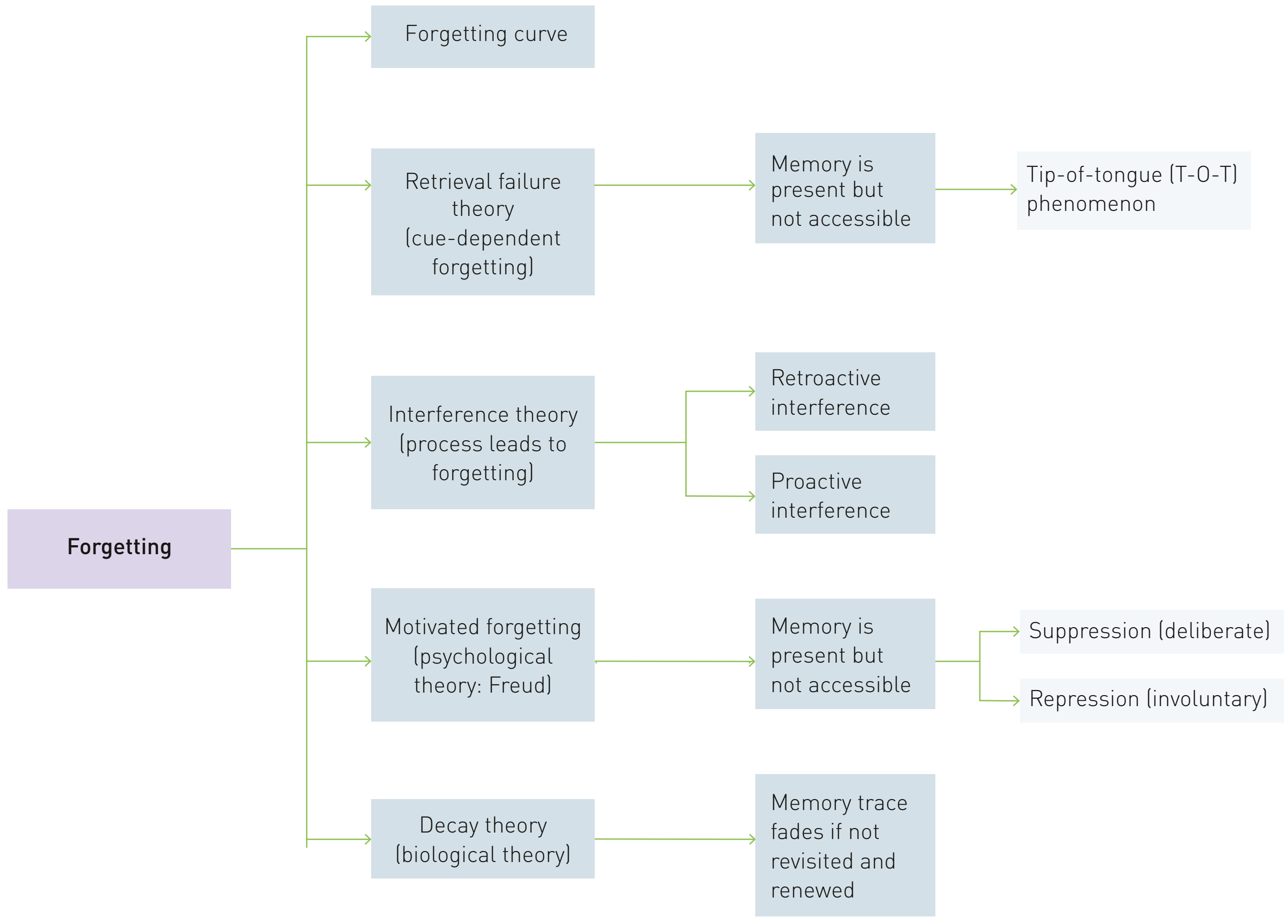
- Remembering is typically an automatic process. However, there are times when we make a deliberate effort to remember specific information so that it can be readily retrieved.
- Forgetting refers to an inability to retrieve information rather than the disappearance of information from memory. Forgetting refers to material 'lost' because it can not be retrieved at the time.
- Forgetting distinguishes between memory that has been lost and memory that was never stored in the first place (i.e. memory that is unavailable) or memory that cannot be retrieved (i.e. memory that is inaccessible). In the absence of organic forms of forgetting such as amnesia, memory traces might not necessarily be lost; instead, they just might not be accessible. However, there are some unresolved areas because we can never be certain just how much information is totally unavailable.
- Hermann Ebbinghaus published his 'forgetting curve' in 1885 after extensive experiments using himself as the only

participant. He learnt lists of nonsense syllables and tested his memory of them until he had perfect scores on each list, then waited for various periods of time and tested himself again to see what percentage he had retained.

- In subsequent research, the same features have been shown, for all forms of memory:
  - most forgetting occurs immediately after the information has been learnt, so the beginning of a forgetting curve has the steepest slope
  - more than 50 per cent of the material is forgotten within the first hour
  - if the learning that took place originally was overlearnt (i.e. learnt over and over even when already well known), then the material is likely to be retained for longer and with greater accuracy
  - factors such as the complexity of the material learnt and even the intelligence of the learner do not seem to affect the rate of forgetting.
- Forgetting may be due to retrieval failure (cue-dependent forgetting). The effectiveness of a retrieval cue will influence how well a memory can be accessed and retrieved. Some memories cannot be retrieved because they were never effectively encoded in the first instance.
- Interference theory refers to forgetting when the retrieval of one memory is made difficult because of interference from other memories. Although interference has been replicated in laboratory studies, it might not operate to the same degree in real life.
- Motivated forgetting includes suppression and repression. Suppression is intentional forgetting, while repression refers to Freud's theory that access to painful memories is unconsciously blocked and therefore unable to be retrieved.
- There is controversy over repressed memory. This has come from cases where hypnosis or other techniques have been used to try to 'recover' a patient's painful childhood memories that might have been repressed. There is debate regarding whether these memories are real or have been implanted through the suggestion by the patient's therapist. The experimental research by Elizabeth Loftus suggested that memory recall can be influenced and changed by misinformation presented to a patient.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

decay theory
forgetting
forgetting curve
interference
interference theory
motivated forgetting
proactive interference
repression
retrieval failure theory
retroactive interference
suppression
tip-of-the-tongue phenomenon

KEY KNOWLEDGE

For the exam, you must be able to:

- show your understanding and apply your knowledge of the psychological theories of forgetting including:
  - Ebbinghaus' forgetting curve

- retrieval failure theory, including tip-of-the-tongue phenomenon
- interference theory, including retroactive and proactive interference
- motivated forgetting, including suppression and repression
- decay theory

→ show an understanding of:
- why it is difficult to research forgetting
- the strengths and limitations of each theory of forgetting.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- understand ethical considerations in relation to researching forgetting.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Ebbinghaus' forgetting curve is basically the same shape as curves shown by later researchers, but he appears to have forgotten more material and at a faster rate than other research showed. What is a likely reason?

a Ebbinghaus tried to learn large numbers of lists of nonsense syllables at the same time, so there was much proactive interference.

b Ebbinghaus tried to learn large numbers of lists of nonsense syllables at the same time, so there was much retroactive interference.

c Nonsense syllables cannot be encoded according to their meaning, so only shallow processing was possible.

d Ebbinghaus was experimenting on himself and his involvement was unethical.

2 Proactive interference refers to:

a difficulty learning material at a later stage due to earlier learnt material causing problems with the encoding process.

b difficulty recalling material learnt at an earlier stage due to later learnt material causing problems with the retrieval process.

c difficulty recalling memories from before a traumatic event.

d difficulty forming new memories after a traumatic event.

3 According to decay theory, which of the following is *not* true?

a If a memory is revisited over time, it is strengthened.

b If a memory is not revisited, it will weaken over time.

c A memory may weaken over time whether it is revisited or not.

d A memory will weaken over time only if the brain decays.

4 Retrieval failure, where we know something perfectly well but just can't recall it at the moment, is indicative of:
   a retrograde amnesia
   b cue-dependent forgetting
   c short-term forgetting
   d anterograde amnesia

5 Retroactive interference refers to:
   a difficulty learning material at a later stage due to earlier learnt material causing problems with the encoding process.
   b difficulty recalling material learnt at an earlier stage due to later learnt material causing problems with the retrieval process.
   c difficulty recalling memories from before a traumatic event.
   d difficulty forming new memories after a traumatic event.

6 Richard has just changed mobile phone providers and he has a new mobile number. When his friends ask him for his new number he keeps giving his old number by mistake and finds he has to write the new number on the back of his hand. The likely reason for his difficulty in learning the new mobile number is that:
   a he experienced proactive interference from the old number he had learnt earlier.
   b he experienced anterograde amnesia from the old number he had learnt earlier.
   c he experienced retroactive interference from the old number he had learnt earlier.
   d he experienced retrograde amnesia from the old number he had learnt earlier.

7 Xiau is preparing a study timetable for his examinations. He is studying Legal Studies and Economics, which he feels are similar to each other in processes and content. His study program will be most effective if he:
   a studies Economics before Legal Studies on odd dates and Legal Studies before Economics on even dates.
   b always studies these two subjects in the same order.
   c only studies one of these subjects on any one day.
   d makes sure that he studies a different subject such as Physics in between studying Economics and Legal Studies.

8 Sachin is studying for his Psychology exam next week, but he finds that he keeps confusing the terms with the Biology material he studied this morning. It is likely that he is experiencing:
   a proactive interference from the material he had studied earlier.
   b anterograde amnesia from the material he had studied earlier.
   c retro-active interference from the material he had studied earlier.
   d retrograde amnesia from the material he had studied earlier.

9 Repression is an example of:
   a encoding failure.
   b memory decay.
   c motivated forgetting.
   d interference.

10 Tom cannot remember the details of the torture he experienced as a prisoner of war. A likely explanation for Tom's forgetting is:
   a repression.
   b retrieval failure.
   c state-dependent forgetting.
   d flashbulb memory.

11 Decay theory suggests that forgetting is due to a lack of ___________, whereas interference theory suggests that forgetting is due to a lack of ___________.
   a encoding; accessibility
   b encoding; availability
   c accessibility; availability
   d availability; accessibility

12 The tip-of-the-tongue phenomenon:
   a is a temporary inability to remember something which we know.
   b an example of unavailable memory.
   c is an example of suppression.
   d is an example of interference.

SHORT ANSWER

13 Describe two major features of Ebbinghaus' forgetting curve.

2 marks

14 Roberta is planning a Saturday study timetable for her VCE examinations. She is taking Further Maths, Psychology, English, Biology and Australian History. She feels that English and Australian History are similar to each other and Psychology and Biology are similar to each other, but Further Maths is different altogether; she needs to study each subject on that day.
Using your knowledge of interference theory, complete Roberta's program in the table below by putting subjects in appropriate time slots to make her study most effective.

TIME	SUBJECT
9.00–10.30	Psychology
10.45–12.15	
12.45–2.15	Further Maths
2.30–4.00	English
4.15–5.45	

2 marks

15 Memories may not be accessible because of __________, which is what can happen if we learn new, similar material.

1 mark

16 The disruptive effect of learning new material on efforts to recall material previously learnt is called __________. The disruptive effect of learning new material on efforts to recall material previously learnt is called __________.

2 marks

17 One type of forgetting is caused by __________ failure. This type of forgetting happens because some of the information was never actually __________.

2 marks

18 Freud proposed the theory of motivated forgetting, also referred to as __________, which protects a person from painful memories.

1 mark

19 Max is unable to remember the key points of a chapter in his English text. He was daydreaming in class when these points were discussed. Max's forgetting is probably due to __________.

1 mark

20 Eugene's new employee is Robert Moore, but Eugene keeps calling him Roger, mixing him up with the actor, Roger Moore. This is an example of __________.

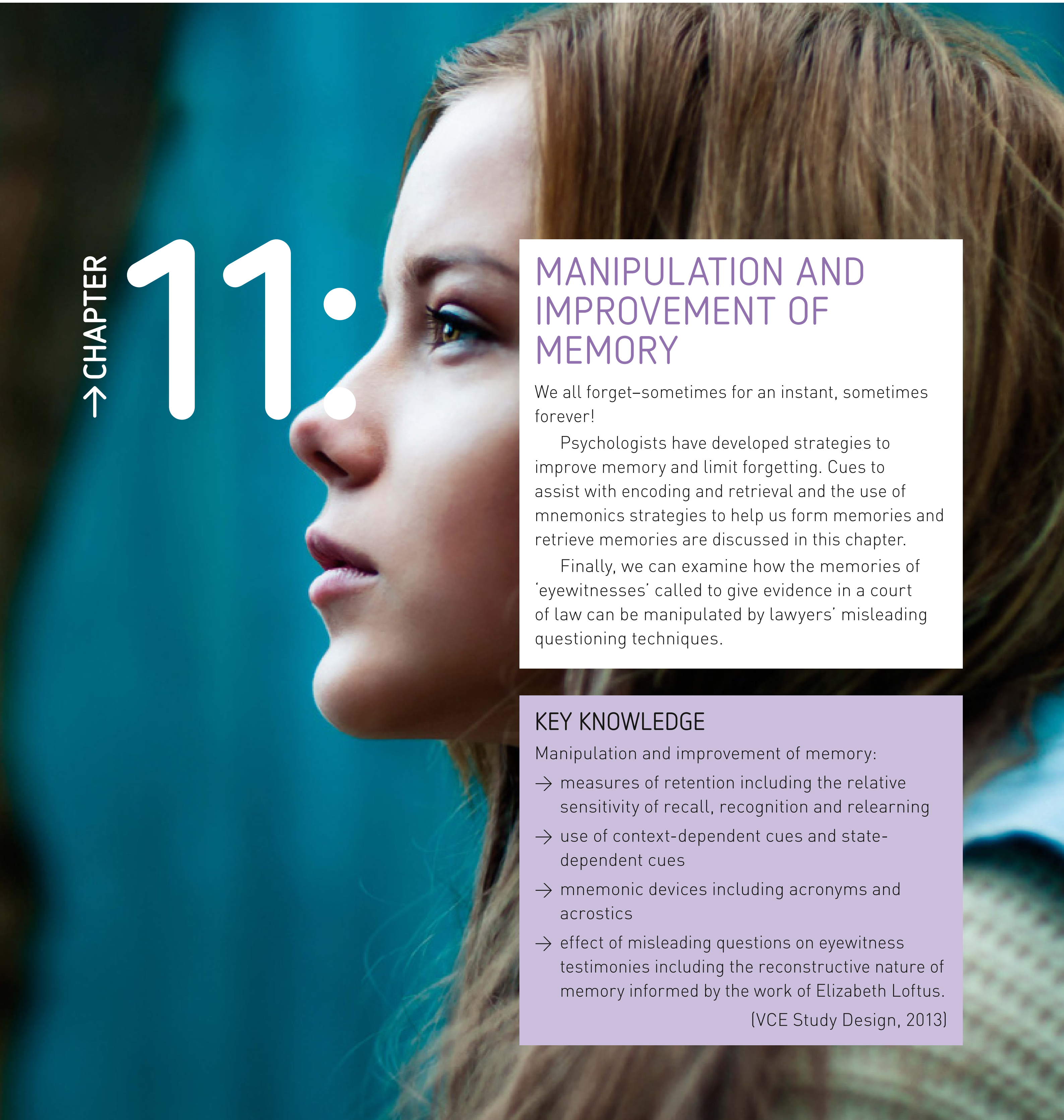
1 mark

21 In the morning, the CEO studied the details of one business plan and a second business plan in the afternoon. That night in a meeting, she found herself mixing them up when she was trying to remember them. This is an example of __________.

1 mark

22 Mac cannot remember the details of issues at his workplace where he knows that he has made silly mistakes. This is an example of __________.

1 mark



→ CHAPTER 11:

MANIPULATION AND IMPROVEMENT OF MEMORY

We all forget–sometimes for an instant, sometimes forever!

Psychologists have developed strategies to improve memory and limit forgetting. Cues to assist with encoding and retrieval and the use of mnemonics strategies to help us form memories and retrieve memories are discussed in this chapter.

Finally, we can examine how the memories of 'eyewitnesses' called to give evidence in a court of law can be manipulated by lawyers' misleading questioning techniques.

KEY KNOWLEDGE

Manipulation and improvement of memory:

- → measures of retention including the relative sensitivity of recall, recognition and relearning
- → use of context-dependent cues and state-dependent cues
- → mnemonic devices including acronyms and acrostics
- → effect of misleading questions on eyewitness testimonies including the reconstructive nature of memory informed by the work of Elizabeth Loftus.

(VCE Study Design, 2013)

FIGURE 11.1 'Method is the mother of memory': Thomas Fuller (1608–1661)

Measures of retention

CHAPTER OVERVIEW

Measures of retention	Recall Recognition Relearning
Encoding specificity: context- and state-dependent cues	Context-dependent cues State-dependent cues
Improving memory: mnemonics	Verbal mnemonics > Acronyms > Acrostics > Narrative chaining
Eyewitness testimony	Why does eyewitness testimony fail? The reconstructive nature of memory Misleading questions and the misinformation effect

Psychologists investigating memory consider that there are three different measures of retention. The three measures of retention used are:

- recall
- recognition
- relearning.

Recall

Recall requires the person to retrieve stored information using a minimal amount of cues to assist retrieval. There are three main types:

- **free recall** is involved in a task in which the participants are required to retrieve as much information as they can in any order (for example, a list of items to purchase from the supermarket)
- **serial recall** involves recalling information in the order in which it was presented (for example, the names of cities visited on an overseas journey). This is discussed in detail in Chapter 10

- **cued recall** uses various prompts (cues) to assist the retrieval process (for example, ‘The surname is short and begins with a D’).

Recognition

Recognition refers to identification of the correct information among a list of incorrect pieces of information; for example, being able to pick the correct answer to a multiple-choice question from a list of four alternatives.

Recognition is generally more accurate than recall because recognition provides more cues to assist retrieval. For example, if you were asked to name the students in your English class in Year 7, what percentage of the class do you think you could recall? If, on the other hand, you were given a list of 50 names and asked to identify (i.e. recognise) those who were in your English class in Year 7, the number of names that you remember would certainly be much higher.

FIGURE 11.2 A photo makes it easier to recall names of all the people in your class, especially if it is a class from a previous year.

Did you know?

Recognition and cued recall are sometimes confused and it is important to distinguish between the two.

Think of the example of remembering the students in your Year 7 English class.

Recognition would involve you being given a list of names that included those who were in the class with many other names.

Cued recall would involve you being given clues to the information(such as a class photograph or the initials of class-members) but not the items to be remembered.

Relearning

Relearning, which refers to learning again something that has previously been committed to memory, is easier than learning something for the first time. This is the case with all aspects of memory but is especially true of procedural memory. Have you ever returned to a previously learnt skill, like a sport or playing a musical instrument, after a period of time and picked it up really quickly? This is the savings effect of relearning. Many people find the same with speaking a foreign language.

If the time taken to learn the material originally can be measured and compared with the time taken to relearn the same material, then a *savings score* can be calculated:

$$\text{Savings score} = \frac{(\text{Time for original learning}) - (\text{Time for relearning})}{\text{Time for original learning}} \times 100\%$$

As an alternative, ‘Trials’ can be substituted for ‘Time’:

$$\text{Savings score} = \frac{(\text{Trials needed for original learning}) - (\text{Trials needed for relearning})}{\text{Trials needed for original learning}} \times 100\%$$

In either case, it is best to remember:

$$\frac{T1 - T2}{T1} \times 100\%$$

is the savings score (always expressed as a percentage).

It is worth noting that relearning is the most sensitive measure of retention, while recall is the least sensitive measure of retention.

A MORE sensitive measure will register that a memory is present even if only a small amount of the memory remains. A LESS sensitive measure will only register that a memory is present when a large proportion of it remains.

Most sensitive

Relearning

Recognition

Cued recall

Free recall

Least sensitive

FIGURE 11.3 If you stop playing guitar for a year, you may need to relearn the chords but it will be quicker than the first time.

11.1 REVIEW

1. Why is recall considered to be the 'least sensitive measure of retrieval'? Explain your answer.
2. What is the difference between free recall and serial recall? Give an example of each to demonstrate your understanding.
3. Which of the following is the most sensitive measure of retrieval: free recall, cued recall or relearning? Why?
4. Explain the difference between recognition and recall. Give an example to demonstrate your understanding.
5. Vicki was anxious about sitting her Psychology exam. However, she felt better when she noticed that a large proportion of the exam was multiple-choice. What type of memory do multiple-choice questions test?
6. What would Roger's savings score be if it took him eight hours to learn a list of Australian native plant names at the beginning of term, and then only four hours to relearn the same Australian native plant names for his Biology exam? Calculate the savings score using the formula and explain its meaning.

Encoding specificity: context- and state-dependent cues

As we saw in Chapter 10, forgetting usually refers to an inability to retrieve information rather than the total disappearance of information from memory. Forgetting refers to material 'lost' because it cannot be retrieved *at the time*. This is usually because the correct cues are not present.

The **encoding specificity principle** (Tulving & Thomson 1973) states that the **associations** formed at the time of encoding new memories will be the most effective retrieval cues.

This means that if we are trying to retrieve information under conditions that are similar to those under which it was learnt, we will retrieve it more easily than under different conditions.

The two main conditions that assist retrieval are the learner's external environment (the *context*) and the internal environment (the internal *state*). Consequently, we refer to these conditions as **context-dependent** (extrinsic) **cues** and **state-dependent** (intrinsic) **cues**.

It is easy to remember which is which – just think of it as 'contEXTernal' and you'll never get them mixed up!

Context-dependent cues

Context-dependent cues refer to the learner's external environment (the context) in which the memory was formed. Environmental cues include sounds, smells, temperature, sights and other environmental stimuli that were linked to the material being learnt at the time. At a later time, context cues can stimulate memories – these are often especially vivid if a smell is the stimulus.

People can appear to have forgotten details of an event but upon returning to the place where the original memory was formed they are flooded with detailed memories. This will often happen if you return to a street where you lived as a child, or if you are taken to the scene where you witnessed a crime.

Did you know?

Another aspect of the encoding specificity principle is that items are stored in memory according to their meaning at the time of encoding. For example, consider the following list of words: *spectacles*, *monocle*, *glasses*, *vision*, *eyes*, *contact lenses*. You are likely to associate the word *glasses* with eyewear.

Now consider this list: *mugs*, *goblets*, *glasses*, *beakers*, *tumblers*. This time you might associate the word *glasses* with drinking vessels.

Context-dependent cues and state-dependent cues are also examples of the encoding specificity principle.

We are likely to do this in everyday life. Imagine that you can't recall where you put your keys: you set about re-tracing your steps to all the places you have been since you last used them and suddenly you remember that you were wearing your blazer when you were at your locker. Sure enough, your keys are in your blazer pocket!

In the investigation of the murder of Peter Falconio in the Northern Territory, Australia on 14 July 2001, the sole eyewitness was his girlfriend Joanne Lees. As part of the investigation, the police took her back to the scene of the crime so that the context might assist her retrieval of important details to help in the hunt for the murderer.

FIGURE 11.4 What steps do you take when you can't find your house keys? Do you put them in the same place each night to avoid losing them?

REVIEW 11.2

1 Explain what Tulving was proposing with the 'encoding specificity principle'.
2 Explain the difference(s) between context-dependent and state-dependent cues. Use different examples to demonstrate your understanding.

KEY STUDY

GODDEN AND BADDELEY

Godden and Baddeley (1975) found that divers who had learnt a list of words on land recalled them almost twice as well when they were tested on land than when tested underwater. However, divers who learnt the words underwater recalled the words almost twice as well when tested underwater than they did on land. In this study, the context in which the learning took place served as a retrieval cue.

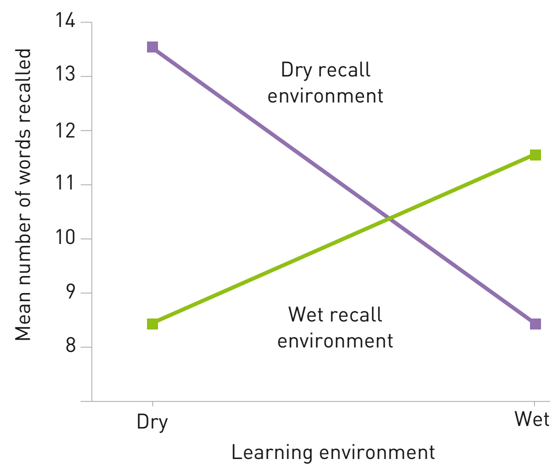


FIGURE 11.5 Divers were found to remember words better in the environment in which they learnt them – on land or under water.

INVESTIGATE 11.1

1. What was the aim of Godden and Baddeley in conducting their experiment?
2. Identify the independent variable and the dependent variable in this experiment.
3. What experimental design was used in this experiment?
4. Write an experimental hypothesis for this experiment and state how the dependent variable is to be operationalised.
5. What did the researchers conclude from their experiment and why did they reach this conclusion?
6. Name two ethical principles with which the experimenters needed to comply in this particular experiment.

State-dependent cues

State-dependent cues refer to the 'internal environment', which are factors within the person – in other words, the physiological and/or psychological state that the person was in at the time of learning, such as a person's mood (happy or sad), level of anxiety, whether they were intoxicated, medicated or sober. These are intrinsic retrieval cues.

It has been found that when we are happy we are more likely to remember happy events, but if we are sad we tend to have unhappy memories.

State-dependent learning and retrieval cues might help explain why some people have difficulty recalling information when they are in examinations because in the exam they might be highly aroused whereas when the learning of the material took place the examinee was in a more relaxed emotional state.

KEY STUDY

MILES AND HARDMAN (1998)

Miles and Hardman (1998) read a list of words to participants who were either resting quietly on an exercise bike or were pedalling furiously so that their heart-rate was well over 100 bpm. When asked to recall the words later, both the resting and exercise groups recalled the words significantly better (over 20 per cent more) when recall was attempted in the same condition in which learning occurred, compared with those who attempted recall under the opposite condition.

INVESTIGATE 11.2

1 What was the aim of Miles and Hardman in conducting this experiment?
2 Identify the independent variable and the dependent variable in this experiment.
3 Write an experimental hypothesis for this experiment and state how the dependent variable was operationalised.
4 What were Miles and Hardman's findings?
5 Name two potential ethical issues that could arise for people participating in this experiment.

Improving memory: mnemonics

Unusual events or events that are particularly significant to us are normally lodged in memory as an indelible record, but much of the information we learn at school is more difficult to retain. We have to make a very conscious effort to put it into long-term memory. The tricks and strategies that we use to help improve our ability both to encode material into memory and to retrieve it when needed include **mnemonics**.

There are many forms of mnemonics including visualisation, verbalisation, rhythm and rhyme. Different systems suit different people and you should choose the methods that suit you best. The Study Design lists three of the *verbal mnemonics*.

Verbal mnemonics

Examples of verbal mnemonics include acronyms, acrostics and narrative chaining (linking).

FIGURE 11.6 QANTAS is an acronym for Queensland and Northern Territory Aerial Service.

ACRONYMS

An acronym is a word or pronounceable syllable made up of the first letters of the items we are trying to remember or the words in the phrase we are trying to remember.

We use acronyms all the time. Common examples include SEATO (South-East Asian Treaty Organisation), UNICEF (United Nations Children's Fund), ANZAC (Australian and New Zealand Army Corps) and QANTAS (Queensland and Northern Territory Aerial Services). You can make up your own acronym to help commit ideas and facts to memory – for example, SACL (pronounced 'sackle') for the function of Broca's area (Stores the Articulation Codes for Language).

The term 'acronym' is not always well understood: many people refer to abbreviations such as AFL (Australian Football League), NBL (National Basketball League) or the OBP (the endangered Orange-bellied parrot) as acronyms but this is incorrect – they are simply abbreviations as they cannot be pronounced. Even the WHO (World Health Organisation) is not an acronym, as it is always referred to by its individual letters (W–H–O), not as 'the who'!

ACROSTICS

Acrostics are phrases, rhymes or poems in which the first letter of each word serves as a cue to help you retrieve a word or idea that begins with the same letter. For example, 'My Very Energetic Mother Just Sits Up Near Pop' is an acrostic to help remember the ordering of the planets in our solar system: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto (this was before Pluto was disqualified as a planet in 2007!). Likewise, 'Every Good Boy Deserves Fruit' is an acrostic to help remember the order of the notes on the lines of the treble clef in written music – E, G, B, D, F.

NARRATIVE CHAINING

When a series of items or terms are to be remembered, they can be incorporated into a story – and the more bizarre the story, the better it will be remembered!

Did you know?

When early Christians were being persecuted in Rome, individuals tried to keep their identities secret but still wished to identify themselves to other Christians. When meeting other people they would often swing one foot around so that it drew a simple outline of a fish in the dust. This is because in Greek, the word 'fish' (ICHTHYS) uses the initial letters of the phrase 'Jesus Christ, God's Son, Saviour' ('Iesous CHristos, THeou Yios, Soter').

FIGURE 11.7 A simple drawing resembling a fish had therefore become a symbol of Christianity.

FIGURE 11.8 The sequence of the colours of the rainbow or the visible spectrum – red, orange, yellow, green, blue, indigo, violet – have been identified by both a common acronym and acrostic. The acronym is the 'name' ROY G BIV and the acrostic is 'Richard Of York Gained Battles In Vain'.

Imagine that you were trying to remember a shopping list of milk, bread, dog food and cereal, you might make up a story as follows:

> *Maria* ***Milk*** *and Bernie* ***Bread*** *were madly in love and decided to run away together, but Dirty Dan* ***Dog-food*** *was jealous as he wanted Maria for himself. He arranged for Con the* ***Cereal*** *Killer to cut the brake lines on their car and they crashed in flames before they could escape from the town.*

When you get to the supermarket, you recite the story to yourself and remember what it is that you have to buy.

REVIEW 11.3

1. Explain the difference between an acrostic and an acronym. Create your own unique examples to demonstrate your understanding
2. Outline what a mnemonic device is and how it can assist us with memory.
3. Identify two key differences between narrative chaining and acrostics.
4. Using the following words, create your own example of narrative chaining: milk, dog food, bananas, flour, dental floss, apple, tomato sauce, napkins and peas.

INVESTIGATE 11.3

MEMORY GAMES

Explore a range of memory games by searching for 'Neuroscience for Kids/Games'.

Find one example that illustrates each of the mnemonic devices described in this chapter.

Eyewitness testimony

'I know it's true – I saw it with my own eyes!'

Can anyone make a stronger declaration of certainty than that? Almost certainly not, yet we know that many people convicted of crimes on the basis of eyewitness testimony have later been found to be innocent. How can this happen?

In her book *Eyewitness Testimony*, Elizabeth Loftus reports a case from 1975 in which eyewitness testimony was the only factor leading to a conviction.

Richard Hinson, assistant manager of a department store in North Carolina, was forced into a car at gunpoint by two men who quickly pulled stocking masks over their faces. They forced him to lie down on the back seat of the car and drove him back to the store. Hinson claimed not to know the combination needed to unlock the store's safe, so the men stole all the money he had on him ($35.00) and left in the car, which Hinson recognised as a 1965 Dodge (Chrysler) Dart.

When Hinson reported the crime to police, he indicated that he had seen the men briefly before the masks obscured their faces: one of them 'looked Hispanic' and one looked like someone who had applied for a job at the store a short time before. From this meagre information, an artist's impression of one of the perpetrators was constructed.

FIGURE 11.9 Eyewitness testimony is only as good as the memory of the person who saw the event.

Three days later, Sandy (20 years old) and Lonnie (18 years old) Sawyer were arrested driving their 1965 Plymouth Valiant. Neither of them looked like the artist's picture, neither had applied for a job at the store and both proclaimed their innocence. At the trial, four witnesses testified that Sandy was at home at the time of the kidnapping and four witnesses testified that Lonnie was at a printing plant, visiting his girlfriend. The jury retired and after two hours were deadlocked – nine of the jury were in favour of conviction, three against. The judge instructed them to attempt to reach a unanimous verdict and a few minutes later they returned with a verdict of 'guilty'. Sandy was sentenced to 32–40 years and Lonnie to 28–32 years in jail. As they were taken from the court, the brothers cried out to their parents to prove their innocence.

Usually there is little hope for an appeal in these cases, but this time, a year later, another prisoner, Robert Thomas, confessed to the crime to a fellow inmate. It was discovered that the police had concealed certain parts of the evidence – such as the artist's sketch and the fact that there had been a number of job applications at the store from a week before the crime, none from either of the brothers but one from Thomas.

It was not until January 1977 that the brothers received a pardon and were released from jail. (Note that a pardon does not mean that they were declared innocent – only that they were released without further punishment for their crime!)

The impoverished Sawyer family was ruined by having to find money to conduct the investigation and to pay a private detective and lawyers to conduct the defence.

This case demonstrates the weight that is given to eyewitness testimony by judge and jury. The major question is, of course, why did the jury accept the evidence of *one* eyewitness and reject the evidence of *eight* independent people who provided alibis?

Did you know?

The Innocence Project founded in 1992 by Barry C Scheck and Peter J Neufeld at the Law School at Yeshiva University has a mission to assist prisoners who can be proven innocent through DNA testing.

As of 25 July 2013 in the United States, 311 convicted 'criminals' have been proven innocent by DNA testing – some even served time on death row. On average, these people had served 13.6 years in prison before their innocence was proven. In 72 per cent of these cases, eyewitness testimony was a factor leading to the conviction, while unvalidated or improper forensic science was a factor in approximately 50 per cent of wrongful convictions.

Source: www.innocenceproject.org

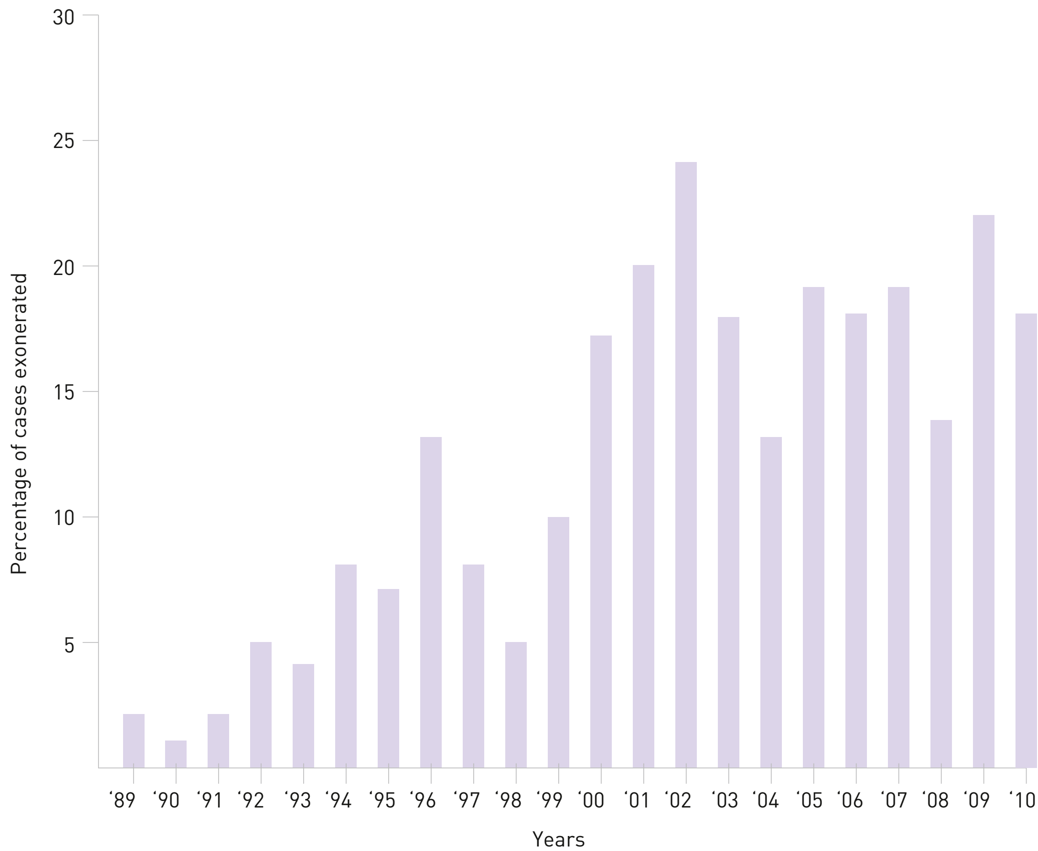


FIGURE 11.10 DNA exonerations by year in the United States

Why does eyewitness testimony fail?

One major cause of the failure of eyewitness testimony lies in the reconstructive nature of such memories. Usually the eyewitness sees the perpetrator for only a few seconds, often in very poor viewing conditions such as in shadow or dim light, partially obscured or from a distance. When asked to describe the scene and the perpetrator, therefore, the witness will build on their own expectations, created by similar experiences from the past, from stories in books, films and on television, or even their own feelings at the time.

Police procedures in identification line-ups need to be absolutely rigorous and follow strict guidelines. Where this is not done, it is almost certain that the person the police have as a suspect will be identified by the witness as the perpetrator; this is especially due to the reconstructive nature of such memories. Consider the following real-life example.

On 24 March 1985, a 24-year-old student, Michele Mallin, was parking her car when an African-American man approached, reached in through the car window and unlocked the door. She bit his thumb but then noticed that he had a knife. He forced her to lie down in the car while he drove her to a deserted paddock and raped her – chain-smoking throughout the ordeal. The perpetrator then stole Michele's watch, a ring and $2 before escaping on foot.

Michele called the police and two weeks later Timothy Cole was arrested.

Cole had been studying at home at the time of the offence while his brother and several friends were in the house. He also suffered severe asthma and could not be in the presence of cigarette smoke without a serious reaction.

When Michele went to the police precinct, she was shown six photographs: five were side-on black-and-white 'mug-shots' of criminals and one was a full-face colour photograph of Cole. Michele indicated that she thought the colour photograph might be her attacker. The next day the police conducted a line-up with six individuals, including Cole. Michele picked him out of the line-up (not surprisingly, since none of the others in the line-up had been in the photographs) and again identified him when in court at his trial.

This shows the reconstruction of memory at work. In court, Michele was remembering her memory of the line-up, and at the time of the line-up she had remembered Cole from the colour photograph – these memories built up until she had reconstructed her memory of the rape.

Timothy Cole was sentenced to 25 years jail in 1986. He died in jail of an asthma attack in 1999. In 2008, DNA evidence proved his innocence and he was declared innocent by a Texas judge in April 2009.

INVESTIGATE 11.4

Go to the Innocence Project website and click on 'News and Resources' 'Fact Sheets' then 'Eyewitness Identification Reform' and answer the following questions.

1. Why is *sequential* presentation of persons or photographs likely to lead to more reliable identification than *simultaneous* presentation?
2. What does '*double-blind* procedure' refer to in this case? Why is this so critical?
3. Why is it important that the witness is aware that the suspect may not be in the line-up?
4. Why is there a problem if 'fillers' (non-suspects) are chosen for their likeness to the suspect, rather than their similarity to the witness's description of the perpetrator?
5. Explain how these procedures can help overcome the problems encountered with reconstruction of events in memory.

FIGURE 11.11 A crime scene

Misleading questions and the misinformation effect

During questioning in court or, prior to that, during the police investigation, it is possible for misinformation to be implanted in the witness's memory. This can gradually take on greater significance for the witness until they begin to believe that the implanted information was a genuine memory.

This was shown by Loftus and Palmer (1974) in an experiment where they showed participants a video of a motor accident, after which they interrogated them as if they were being cross-examined in court.

Some participants were asked 'How fast were the cars going when they *collided with* each other?', while others had other words such as *bumped into, hit, contacted, smashed into* substituted for 'collided with'. The speeds reported by the participants are presented in Table 11.1. One week later, they were asked 'Did you see any broken glass in the accident?' The percentage reporting broken glass is presented in Table 11.2.

TABLE 11.1 Estimates of speed of cars in collision according to key word in question

WORD USED TO DESCRIBE COLLISION	ESTIMATED SPEED (KPH)
'contacted'	49.59
'hit'	54.74
'bumped into'	61.34
'collided with'	63.27
'smashed into'	65.69

TABLE 11.2 Percentage reporting seeing broken glass by key word in question

WORD USED TO DESCRIBE COLLISION	PERCENTAGE REPORTING BROKEN GLASS
'hit'	14
'smashed into'	32

The language used does not even need to be as descriptive as in the experiment above. In another experiment, Loftus and Zanni (1975) showed 100 participants a film in which a car turned quickly into traffic and caused a five-car nose-to-tail collision. Afterwards, participants were asked about certain details of the accident, including whether certain items were present or not. The only difference in questioning was that 50 per cent of the questions were phrased as 'Did you see *the* (broken headlight)?' and half as 'Did you see *a* (broken headlight)?'

TABLE 11.3 Effect of certain words on response

	ITEM PRESENT	ITEM PRESENT	ITEM NOT PRESENT	ITEM NOT PRESENT
Response	'the'	'a'	'the'	'a'
'Yes'	18	15	20	6
'No'	62	28	69	56
'I don't know'	20	57	11	38

Even this small difference had a significant effect on the responses, as shown in Table 11.3.

Clearly, participants were much more comfortable responding 'I don't know' when there was no suggestion that there had been a broken headlight – '… *the* broken headlight' than when this specific suggestion did not exist '… *a* broken headlight'.

Harris (1975) also demonstrated this by asking participants questions such as 'How tall was the basketball player?' which drew an average response of 200.7 cm as opposed to 'How short was the basketball player?' which resulted in a mean response of 175.3 cm. This is a difference of 11.5 per cent.

Other questions showed similar results:

- the mean response to the question 'How long was the movie?' was 130 minutes while 'How short was the movie?' elicited a mean response of 100 minutes
- 'How many other products have you tried? One? Two? Three?' gained a mean response of 3.3, while 'How many other products have you tried? One? Five? Ten?' gained a mean response of 5.2
- the mean response to the question 'Do you get headaches occasionally? If so, how often?' was 0.7 times per week while 'Do you get headaches frequently? If so, how often?' had a mean response of 2.2 times per week.

It is clear from the examples given above that eyewitness testimony should be regarded with skepticism by judges, juries and the general public. Even when the eyewitness is convinced that they are correct, research has shown there can be considerable differences between reality and recall, yet the vast majority of judges and prosecutors believe that a conviction should be possible even if the only evidence available is eyewitness testimony.

FIGURE 11.12 Asking how tall someone is compared to how short someone is will result in a matching taller or shorter answer.

→ CHAPTER SUMMARY

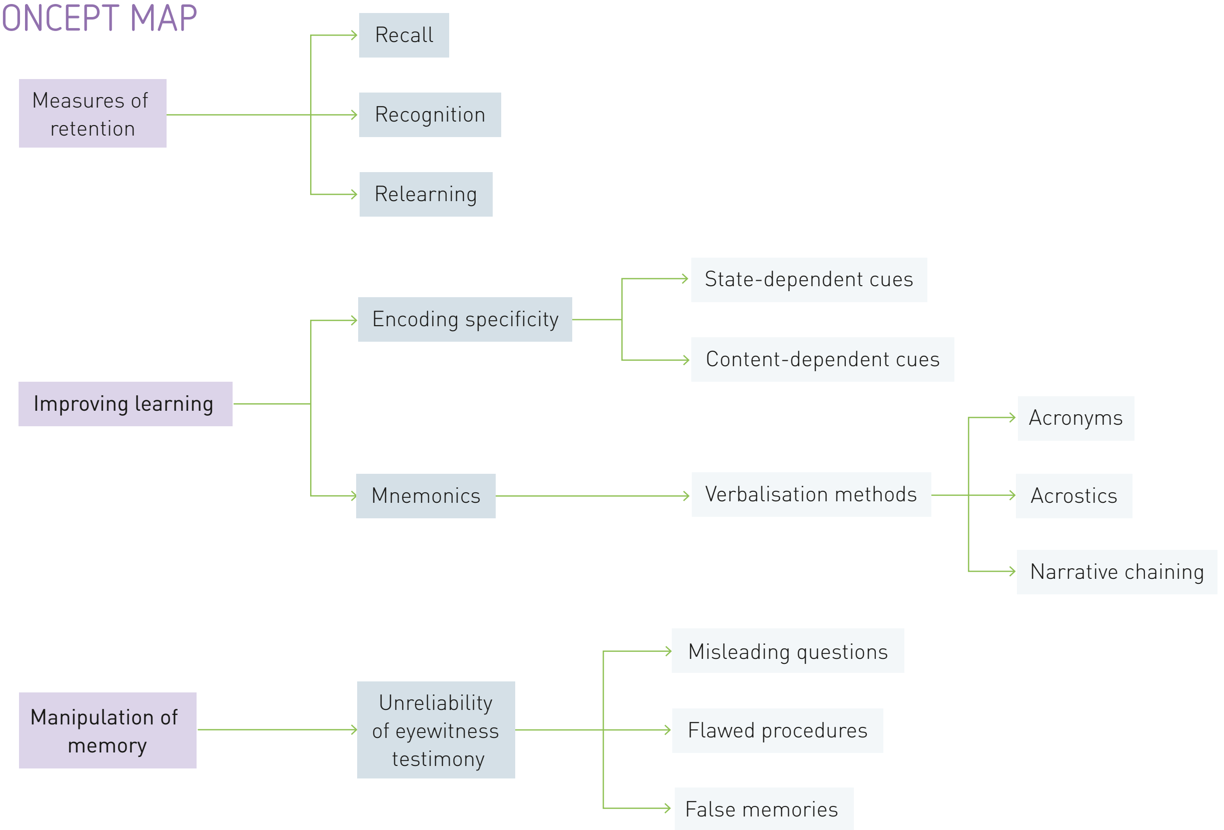
11:

- Three measures of retention used are:
  - recall (free recall, cued recall)
  - recognition
  - relearning.
- Relearning is calculated using a 'savings score', which is a measure of the improvement in learning speed (either by trials or by time) when relearning material that was learnt on a previous occasion. The formula for calculating the savings score is where T1 is the number of trials (or amount of time) taken to learn the material on the first occasion and T2 refers to the number of trials (or amount of time) taken to (re-) learn the material on the second occasion.
- Relearning is the most sensitive measure of retrieval while recall is the least sensitive measure of retrieval.
- The encoding specificity principle states that the associations formed at the time of forming new memories will be the most effective retrieval cues.
- Retrieval is more efficient under conditions that are similar to those in which learning took place.

- Two significant conditions that assist retrieval are the learner's external environment (the context) and the internal environment (the internal state), i.e. context-dependent (extrinsic) cues and state-dependent (intrinsic) cues.
- Mnemonics include visualisation, verbalisation, rhythm and rhyme. Most mnemonics work to improve encoding, storage and retrieval.
- Verbal mnemonics include acronyms, acrostics, and narrative chaining (linking).
- An acronym is a word or pronounceable syllable made up of the first letters of the items we are trying to remember (e.g. 'ROY G. BIV' for the colours of the rainbow).
- Acrostics are phrases, rhymes, or poems in which the first letter of each word serves as a cue to help remember a word or idea that begins with the same letter (e.g. 'Richard Of York Gained Battles In Vain' for the colours of the rainbow).
- Narrative chaining involves incorporating the items to be remembered into a story to assist with encoding, storage and retrieval.
- Eyewitness testimony fails because of the reconstructive nature of memories. The witness builds on their own expectations, created by past experiences, stories and their own current feelings.
- During questioning, both throughout the police investigation and in court, misinformation may be implanted in the witness who begins to believe that the false memory is genuine.
- Loftus and Palmer (1974) asked some participants 'How fast were the cars going when they *collided with* each other?', others had other words such as *bumped into*, *hit*, *contacted*, *smashed into* instead of *collided with*. The more the word used implied increased severity, the greater was the estimate of the speed.
- Loftus and Zanni (1975) showed that even the difference between saying 'Did you see *a* ...' and 'Did you see *the* ...' had a significant effect on the responses given.
- It is clear that eyewitness testimony should be regarded with skepticism by judges, juries and the general public – even when the eyewitness is convinced that they are correct, research has shown considerable differences between reality and recall.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concetpts and be able to relate them to an example where appropriate:

acronym
acrostic
context-dependent cues
cued recall
encoding specificity
eyewitness testimony
false memories
flawed procedures
free recall
measures of retention
misinformation effect
misleading questions
mnemonic
narrative chaining
recall
recognition
reconstructive memories
relearning
savings score
serial recall
state-dependent cues

KEY KNOWLEDGE

For the exam, you must have an understanding of:

- measures of retention:
  - relative sensitivity
  - calculation of savings score

- encoding specificity:
  - associations formed at the time of encoding
  - state-dependent cues
  - context-dependent cues
- mnemonics:
  - verbalisation (narrative chaining; acrostics; acronyms)
- eyewitness testimony:
  - how memories can be manipulated: the reconstructive nature of memory, misleading questions, misinformation effect.

RESEARCH METHODS

For the exam, you must be able to:

- be aware of research into encoding specificity
  - Godden and Baddeley (1975)
  - Miles and Hardman (1998)
- be aware of research into Eyewitness testimony
  - Loftus and Palmer (1974)
  - Loftus and Zanni (1975)
  - Harris (1975).

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

Questions 1, 2 and 3 refer to the following information:

Carl is trying to list all the people who attended his 11th birthday party 10 years ago so that he can invite them to his 21st birthday celebration. He knows they all went to his school.

1 Which of the following would be most useful in helping him remember who went to his party?
   a a photograph of Carl's Year 6 class when he was 11
   b a list of all the names of the students in Year 6 at Carl's school when he was 11
   c a photograph of the parents of the children who attended Carl's 11th birthday party
   d an invitation list for the 11th birthday party that only has the first names of the guests

2 With which of the following would Carl be able to use *recognition*
   a looking at a photograph of Carl's Year 6 class when he was 11
   b reading a list of all the names of the students in Year 6 at Carl's school when he was 11
   c looking at a photograph of the parents of the children who attended Carl's 11th birthday party
   d reading an invitation list for the 11th birthday party that only has the first names of the guests

3 With which of the following would Carl be able to use *cued recall*?
   a looking at a photograph of Carl's Year 6 class when he was 11
   b reading a list of all the names of the students in Year 6 at Carl's school when he was 11
   c looking at a photograph of the parents of the children who attended Carl's 11th birthday party
   d reading an invitation list for the 11th birthday party that only has the first names of the guests

4 Which of the following statements is *not* true of different measures of retention?
   e Recognition is more sensitive than cued recall but less sensitive than relearning.
   f Relearning is more sensitive than recall but less sensitive than recognition.
   g Recall is the least sensitive measure, while relearning is the most sensitive.
   h Cued recall is more sensitive than free recall.

5 Relearning is calculated using a 'savings score' which is a measure of the improvement in learning speed (either by trials or by time) when relearning material that was learnt on a previous occasion. The formula for calculating the savings score, where T1 is the number of trials (or amount of time) taken to learn the material on the first occasion and T2 refers to the number of trials (or amount of time) taken to relearn the material on the second occasion is
   a $\frac{T_1 - T_2}{T_1} \times 100\%$
   b $\frac{T_2 - T_1}{T_1} \times 100\%$
   c $\frac{T_1 - T_2}{T_2} \times 100\%$
   d $\frac{T_2 - T_1}{T_2} \times 100\%$

6 The mnemonic device referred to as an acronym is represented by which of the following?
   a Richard Of York Gained Battles In Vain.
   b ROYGBIV.
   c ROY G. BIV.
   d AFL.

7 The mnemonic device referred to as an acrostic is represented by which of the following?
   a Richard Of York Gained Battles In Vain
   b ROYGBIV
   c ROY G. BIV
   d AFL

8 Inspector Clouseau is trying to solve a murder. He takes witnesses to the scene of the crime and asks them to tell him everything they can remember. Soon, a witness provides accurate information that leads to an arrest. The strategy used by the Inspector was aimed at:
   a stimulating the procedural memories of the witnesses.
   b stimulating the semantic memories of the witnesses.
   c stimulating context-dependent cues to assist memory.
   d stimulating state-dependent cues to assist memory.

9 When Jacqui studied for her Psychology exam at home, she used an oil-burner that filled the room with the scent of lavender. On the day of her exam, she tipped a few drops of lavender onto her handkerchief and found that sniffing this occasionally helped her to remember her Psychology. Jane was (mainly) using:
   a state-dependent cues to assist memory.
   b cued recall to assist memory.
   c context-dependent cues to assist memory.
   d context-dependent and state-dependent cues to assist memory.

10 Jane studied hard for her boat-operator's licence and went to the traffic office to sit the test. While waiting for her appointment, she became increasingly anxious but did as her Psychology teacher had advised and imagined that she was sitting at her desk at home, relaxing and studying the regulations. When it was time for her to answer the questions, she passed the test. Jane's strategy enabled her to remember material by using:
   a state-dependent cues to assist memory.
   b cued recall to assist memory.
   c context-dependent cues to assist memory.
   d context-dependent and state-dependent cues to assist memory.

11 Eyewitness testimony is often unreliable due to:
- a the way in which questions are phrased.
- b deliberate misrepresentation of the truth by witnesses.
- c the stress of speaking in a courtroom.
- d deliberate coaching of witnesses by police.

12 Reconstruction of memories involves:
- a putting together fragmentary memories and filling in the gaps.
- b remembering according to one's preconceived ideas.
- c gradual build-up of memories over time.
- d all of the above.

13 In his research into eyewitness testimony, Harris discovered that if people were asked 'Did you see *a* broken headlight?' rather than 'Did you see *the* broken headlight?' they were most likely to respond:
- a 'Yes'.
- b 'No'.
- c 'I don't know'.
- d All responses were equally common.

14 In researching the effectiveness of using mnemonics to maximise efficiency of learning, Maria used three psychology classes of Year 11 and Year 12 students and each class used a different mnemonic device to assist with learning of a list of 40 words. Maria obtained permission from the parents of 22% of the students; she did this because
- a 22% of the students were aged 18 or more
- b 22% of students were under the age of 18
- c Only 22% of the students lived at home
- d 22% of students did not volunteer so she needed their parents to make them participate

SHORT ANSWER

15 The three main measures of retention are recognition, recall and relearning. Put these in order from least sensitive (1) to most sensitive (3).

2 marks

16 a Use an example to show how memory may be improved by using narrative chaining.

3 marks

b Use an example to show how memory may be improved by using context-dependent cues.

2 marks

17 a Use an example to show how memory may be improved by using an acrostic.

2 marks

b Use an example to show how memory may be improved by using state-dependent cues.

2 marks

18 When a witness is asked 'How fast were the cars going when they hit each other?' compared with the question 'How fast were the cars going when they smashed into each other?' what is likely to be the difference in the response?

2 marks

19 We refer to the type of memory used in eyewitness testimony as 'reconstructive memories'. What factors are involved in these memory reconstructions?

2 marks

RESEARCH METHODS AND ETHICS IN THE STUDY OF MEMORY

KEY KNOWLEDGE

Research methodologies and ethical principles associated with the study of memory, as outlined in Chapter 1.

(VCE Study Design 2013)

Evaluation of research

CASE STUDY 1

Does the hippocampus retain memories that were formed many years ago? Neuroscientist Larry Squire from the University of California, San Diego, and the Veterans Affairs San Diego Healthcare System observed patients that had hippocampal damage. The study found that these patients had little memory of news events and current affairs reported in the media during the ten years prior to the date when they had received a head injury that damaged their hippocampus. However, these patients were able to remember news events that were reported in the media more than ten years prior to their head injury.

To investigate this event further, the researcher conducted a study of 15 participants aged 50–70 years of age. In the study, *f*MRI scans were carried out on the participants' brains. During the scan, the participants were asked questions about news events which had happened over the past 30 years. For the hippocampus, activity reached a floor for recalling the oldest news events. However, the pattern for frontal, temporal and parietal lobes was the reverse: their activity increased for the past 12 years, with the most activity being for the memory of older events, reaching a plateau for the 12 year and older events.

Squire L R, (2006). Lost forever or temporarily misplaced? The long debate about the nature of memory impairment. Learning & Memory 13: 522–529

Questions

Answer the following questions with reference to this research.

Review

1 What was the aim of this experiment?
2 How were participants selected?
3 How many participants were involved in the study?
4 What were the dependent and independent variables in this research?
5 What experimental design was used?

Apply

6 How were the dependent and independent variables operationalised in this study?
7 Write a possible experimental hypothesis for this study.
8 What is the population to which a conclusion for this study can be generalised?
9 What ethical considerations might have been breached in this study? What must the researchers have done to ensure that this study satisfied ethical guidelines?
10 Write your own conclusion for this study.

Discuss

11 How would you feel if you were a participant in this study?

12 What ethical considerations would need to have been made prior to, during and after this experiment?

13 How do you think this experiment might have made a contribution to psychological research?

CASE STUDY 2

In a study of memory, Melina Uncapher and colleagues recruited 20 volunteer participants for a study of tests involving the recall of features of a series of 100 words which the participants had been asked to memorise.

For the learning phase of the experiment, the participants were asked to memorise the 100 words.

Next, while undergoing *f*MRI brain scans, the participants were presented with the words in capital letters in one of the four quarters of a small screen. The words were written either in black or in a colour (red, green, blue or pink). For black words, the participants were required to determine whether the object would fit inside a shoebox. For coloured words, the participants were required to determine whether the object written in colour was a living organism.

Afterwards, the participants were tested for their recall of the words, their colour and in which quarter of the screen each of the words had been presented. The participants' answers were compared with the information gathered from the *f*MRI which had been conducted during the learning phase.

Results indicated that the parts of the brain which are involved with identification of colour (of the words) and location (which quarter of the screen) were more active when the participants had been specifically instructed to learn either the word colour or the word location. However, when they had been instructed to memorise all three word features (the word, its colour, and its location), the *intraparietal sulcus* was activated. The intraparietal sulcus is the fold in the brain which connects the upper and lower parts of the parietal lobe and is thought to enable us to perceive different qualities of an object simultaneously, rather than one at a time. In other words, the research indicated that the intraparietal sulcus is important for memorising the qualities of objects as a whole.

Uncapher also reported that the hippocampus indicated some increased activity during the *f*MRI scan phase. However, the study did not scan the participants' brains during the period when they were memorising the 100 words.

Uncapher, M R, Wagner A D, (2009). Posterior parietal cortex and episodic encoding: Insights from fMRI subsequent memory effects and dual-attention theory. Neurobiology of Learning and Memory 91: 139–154

Questions

Answer the following questions with reference to this research.

Review

1 What was the aim of this experiment?

2 How were participants selected?

3 How many participants were involved in the study?

4 What were the dependent and independent variables in this research?
5 What experimental design was used?

Apply

6 Write a possible experimental hypothesis for this study.
7 Indentify some possible confounding variables for this study.
8 How might this study have been improved?
9 What ethical considerations might have been breached in this study? What must the researchers have done to ensure that this study satisfied ethical guidelines?
10 Write your own conclusion for this study.

Discuss

11 How would you feel if you were a participant in this study?
12 What ethical considerations would need to have been made prior to, during and after this experiment?
13 How do you think this experiment might have made a contribution to psychological research?

ASSESSMENT ACTIVITIES

Outcome

On completion of Area of Study 2, the student should be able to 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 (VCE Study Design, 2013).

The following assessment tasks cover a range of topics from Chapters 10–13 and are designed to assist you in gaining a deeper understanding of the information covered.

The assessment rubric on the following page is designed to help guide your responses.

Research investigation 1

1 Using the syllables in Table 1, design your own memory experiment. Choose one of the following to test:
 - serial position curve (using just one list and plotting results onto a graph)
 - forms of memory (recall, recognition, relearning)
 - forgetting (plot the forgetting curve over time)
 - levels of processing (using List C only)

Note: if you are testing forgetting or levels of retention, you will need to decide which measure of retention you intend to use.

2 Conduct your research using the appropriate procedures and experimental design.
3 Collate the data for this research investigation according to the guidelines.
4 Formally write up this research investigation, following the assessment criteria outlined on pages 356–7.

TABLE 1: Items

ITEM NUMBER	LIST A: MEANINGLESS SYLLABLES	LIST B: SYLLABLES WITH VOWELS	LIST C: MEANINGFUL SYLLABLES
1	SZK	KAL	PIN
2	DPG	BIM	BAY
3	KQF	SOV	HEM
4	LKV	ARJ	RUM
5	FZX	POK	COG
6	JVK	LIJ	ATE
7	PGK	ZAB	DUB
8	WBP	BEP	WEB
9	JDL	WEK	DAM
10	TGV	HUK	HIT
11	WJX	RUP	TOP
12	MHC	KUG	KID
13	RKL	ZUD	JET
14	TFG	YUF	RAP
15	SZD	GUX	MUD

TABLE 2: Descriptive statistics

	LIST A	LIST B	LIST C
Total correct (%)			
Mean score (%)			

Research investigation 2

1 Using the assessment activity, design your own experiment to investigate interference theory. You could use your knowledge of interference theory to design your own list of items to be memorised. Choose one of the following to test:
   > you will need to decide which measure of retention you intend to use.
   > (serial OR free recall, or recognition)
   > decide how many words in the lists (15 or 20 is a good quantity) and then create your two word lists, making sure that the words are all *different* and that it would be difficult for participants to link them meaningfully to aid their memory of them.*
2 Conduct your research using the appropriate procedures and experimental design.
3 Collate the data for this research investigation according to the guidelines.
4 Formally write up this research investigation, following the assessment criteria outlined on pages 356–7.

Variations for this experiment:

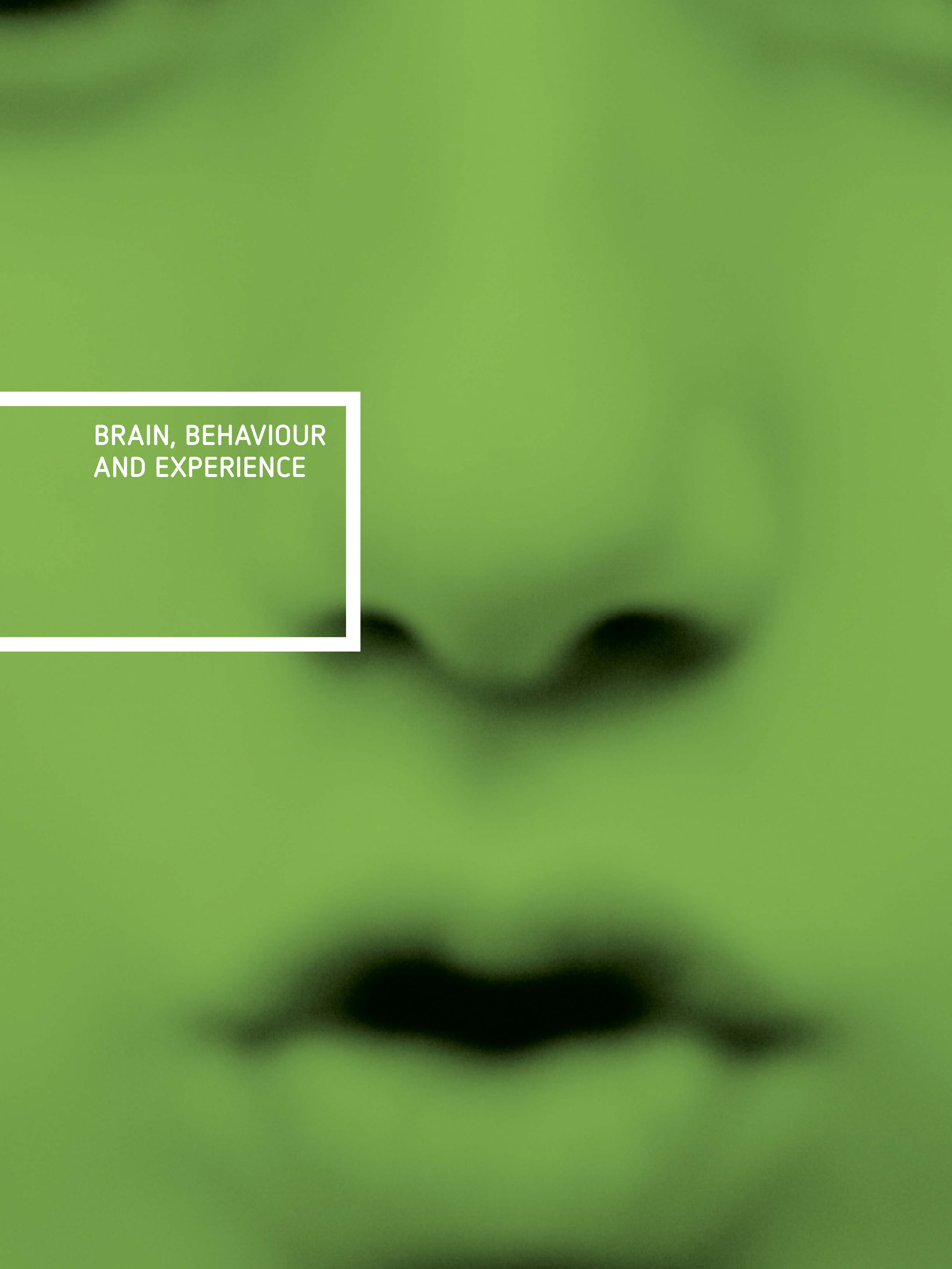
*You might prefer to test an additional variable by making List B words similar to List A, and then have a third list (List C) with words that are different to List A. You can then compare the list retention for participants who learnt List B with that of participants who learnt List C. (Remember to first decide if you intend to test retroactive or proactive interference).

ASSESSMENT RUBRIC

CRITERION	0 TO 1
1 Psychological knowledge and understanding The work demonstrates an accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices.	Limited knowledge and correct use of psychological terminology, concepts and practices.
2 Evidence-based arguments Employs higher-order thinking (analysis, synthesis, evaluation and application) to complete task. Constructs evidence-based arguments that draw on psychological research findings and theoretical models to justify the student's explanations, evaluations and applications.	Limited display of higher order thinking and/or incorrect or inappropriate application of psychological knowledge to draw relevant conclusions.
3 Location and use of psychological information Locates and draws on a range of appropriate and legitimate (valid and reliable) psychological sources to complete the assessment task.	Limited or inappropriate use of legitimate psychology sources of information have been drawn upon to complete this task.
4 Strategies to complete the task Displays initiative, independence, critical reflection and cooperation while completing the task. Develops, monitors and executes effective strategies to successfully complete the task.	Little or ineffective planning and monitoring of appropriate strategies to complete the task.
5 Communicating Communicate psychological ideas and information in a concise, focused and logical manner to meet the demands of the assessment task.	Assignment lacks logical structure and/or relevant psychological information to communicate ideas.
6 Referencing Cite and reference sources of information within body of text and reference list according to APA format (if relevant).	Sources of information are inaccurately referenced or not shown.

2 TO 3	4 TO 5	6 TO 7
Correct use of psychological terminology appropriate to the assessment task.	Correct and appropriate use and understanding of the psychological terms, concepts and practices in a manner that directly relates to meeting the demands of the assessment task.	Accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices to clearly meet the demands of the assessment task.
Demonstrates understanding of the task and summarises information to state conclusion. Relies on source material rather than transform psychological information to demonstrate higher-order thinking.	Able to differentiate the key elements of the task and psychological understandings and draw logical conclusions. Uses evidence-based arguments to support student's point of view.	Able to analyse and evaluate psychological information to draw insightful, appropriate and meaningful conclusions. Constructs evidence-based arguments to explain, analyse and justify the student's point of view including explanations, evaluations and applications.
Legitimate psychological sources have been located and used to address the requirements of the task.	A comprehensive range of relevant and legitimate psychological sources have been located and used effectively to address the requirements of the task.	
Development of strategies to complete the task.	Develops, monitors and executes strategies to successfully complete the task. Displays initiative, independence, critical reflection and cooperation while completing the task.	Displays initiative, independence, critical reflection and cooperation throughout the process of completing the task. Develops, monitors and executes effective and efficient strategies to successfully complete the task.
Logical structure is used to communicate psychological ideas in an appropriate manner suitable for the intended audience.	Focused and logical structure is used to communicate psychological ideas and information in a clear and concise manner suitable for the intended audience.	
Sources of information are correctly referenced and cited using APA format.		

BRAIN, BEHAVIOUR AND EXPERIENCE



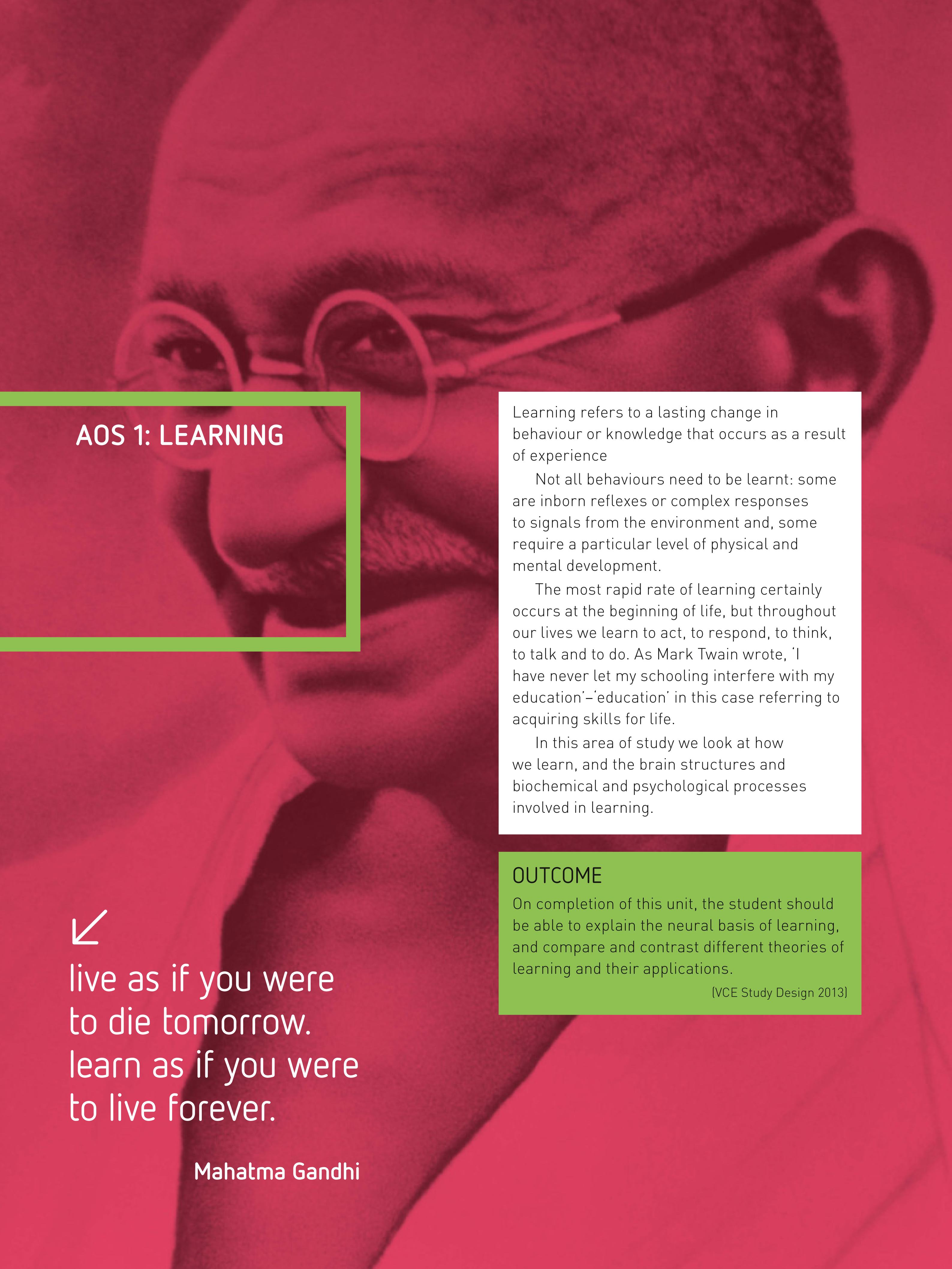
UNIT 04

Throughout our lives we continue to learn – all the actions we take, all the feelings we have and all the thoughts we process contribute to the totality of who we are and what we are capable of doing. Recent research has shown that the brain is able to continue to change and develop throughout our lives – contradicting the earlier scientific belief that such changes were possible only until early adulthood.

In this unit we examine how we learn through experience, as the biochemistry of the body and brain and the psychological processes of thought and feeling enable these ongoing changes.

Many well-known and respected psychologists have studied this aspect of human behaviour. Their findings have allowed us to understand how learning occurs and to take the opportunity to use that knowledge in productive ways.

Mental health and well-being are amongst the prime goals for society and for any individual. Major initiatives from those involved in the mental health industry (psychologists, psychiatrists, nurses, speech pathologists, occupational therapists and social workers) aim, as a first choice, to promote mental well-being or, where this is not possible, to understand, diagnose and treat people with mental illness.



AOS 1: LEARNING

Learning refers to a lasting change in behaviour or knowledge that occurs as a result of experience

Not all behaviours need to be learnt: some are inborn reflexes or complex responses to signals from the environment and, some require a particular level of physical and mental development.

The most rapid rate of learning certainly occurs at the beginning of life, but throughout our lives we learn to act, to respond, to think, to talk and to do. As Mark Twain wrote, 'I have never let my schooling interfere with my education'–'education' in this case referring to acquiring skills for life.

In this area of study we look at how we learn, and the brain structures and biochemical and psychological processes involved in learning.

OUTCOME

On completion of this unit, the student should be able to explain the neural basis of learning, and compare and contrast different theories of learning and their applications.

(VCE Study Design 2013)

live as if you were
to die tomorrow.
learn as if you were
to live forever.

Mahatma Gandhi

BEHAVIOURS NOT DEPENDENT ON LEARNING: PRE-PROGRAMMED BEHAVIOUR

KEY KNOWLEDGE

Behaviours not dependent on learning including reflex action, fixed action patterns and behaviours due to physical growth and development (maturation).
(VCE Study Design 2013)

OVERVIEW

BEHAVIOURS NOT DEPENDENT UPON LEARNING	
Reflex actions	> Simple reflexes > Adaptive
Fixed action patterns	> Complex behaviour > The same for every member of a species > Species specific
Behaviours dependent on maturation	> Behaviour that cannot occur until the organism is sufficiently developed

Not all that we know is learnt. Some things are pre-programmed, or seem to be in-built and require no previous experience or learning. Examples of these behaviours include **reflex actions**, **fixed action patterns** and **behaviours due to maturation**.

REFLEX ACTIONS

Reflex actions are automatic, involuntary responses that do not require prior experience. For example, we do not even think about whether to blink when an object comes near our eyes. Reflexes are *adaptive* for survival, meaning that we would be in danger if we did not have these built-in mechanisms to help protect us from environmental hazards. If we had to stop and make a decision every time we encountered a sudden danger, the consequences would be injury or death.

Many different species of animals have similar reflexes – blinking, coughing etc.

Newborn babies have many unlearnt reflex actions necessary for survival. It may not be immediately obvious why all of these are *survival* instincts, but they are (see Table 1).

FIGURE 1 Reflex actions are not dependent upon learning and are important for our survival.

TABLE 1 Examples of reflex actions in infants

REFLEX	STIMULATION	RESPONSE	FUNCTION
Withdrawal	Prick sole of foot with pin	Foot withdraws, with flexion of knee and hip	Protects infant from unpleasant tactile stimulation
Sucking	Place finger in infant's mouth	Infant sucks finger rhythmically	Permits feeding
Palmar grasp	Place finger in infant's hand and press against palm	Spontaneous grasp of finger	Prepares infant for voluntary grasping
Stepping	Hold infant under arms and permit bare feet to touch a flat surface	Infant lifts one foot then another in stepping response	Prepares infant for voluntary walking

Source: Knobloch & Pasamanaick (1974); Prechtl & Beintema (1965)

FIGURE 2 The funnel-web spider uses inherited behaviour to create its characteristic tubular web.

FIXED ACTION PATTERNS

A fixed action pattern is an inborn predisposition to behave in a certain way when appropriately stimulated by environmental stimuli.

The term is used to describe behaviour that is inherited by every individual member of a species. For example, a male bowerbird creates a mound of twigs and coloured (preferably blue!) objects to attract a female. A funnel-web spider creates its characteristic tubular web. Short-tailed shearwaters (mutton birds) leave Australia in April each year and migrate to Alaska and they arrive back on 21 or 22 September every year, returning to the exact same location to nest.

This type of behaviour is also referred to as *instinctive* behaviour or *species-specific* behaviour. It is distinguished from reflex action patterns in two important ways:

1 these behaviours are not simple; instead, they are *complex* behaviours
2 these behaviours are unique to a particular species of animal.

BEHAVIOURS DEPENDENT ON MATURATION

Some behaviours require the development of the body and the structures of the nervous system. For example, most children will begin walking around 10–14 months and it is impossible to make any child walk until he or she is physically ready. Similarly, fledgling birds are unable to fly until their wings and flight-feathers have reached the required level of maturity.

FIGURE 3 Baby birds are unable to fly and humans cannot walk until they are sufficiently developed, mentally and physically.

1 REVIEW

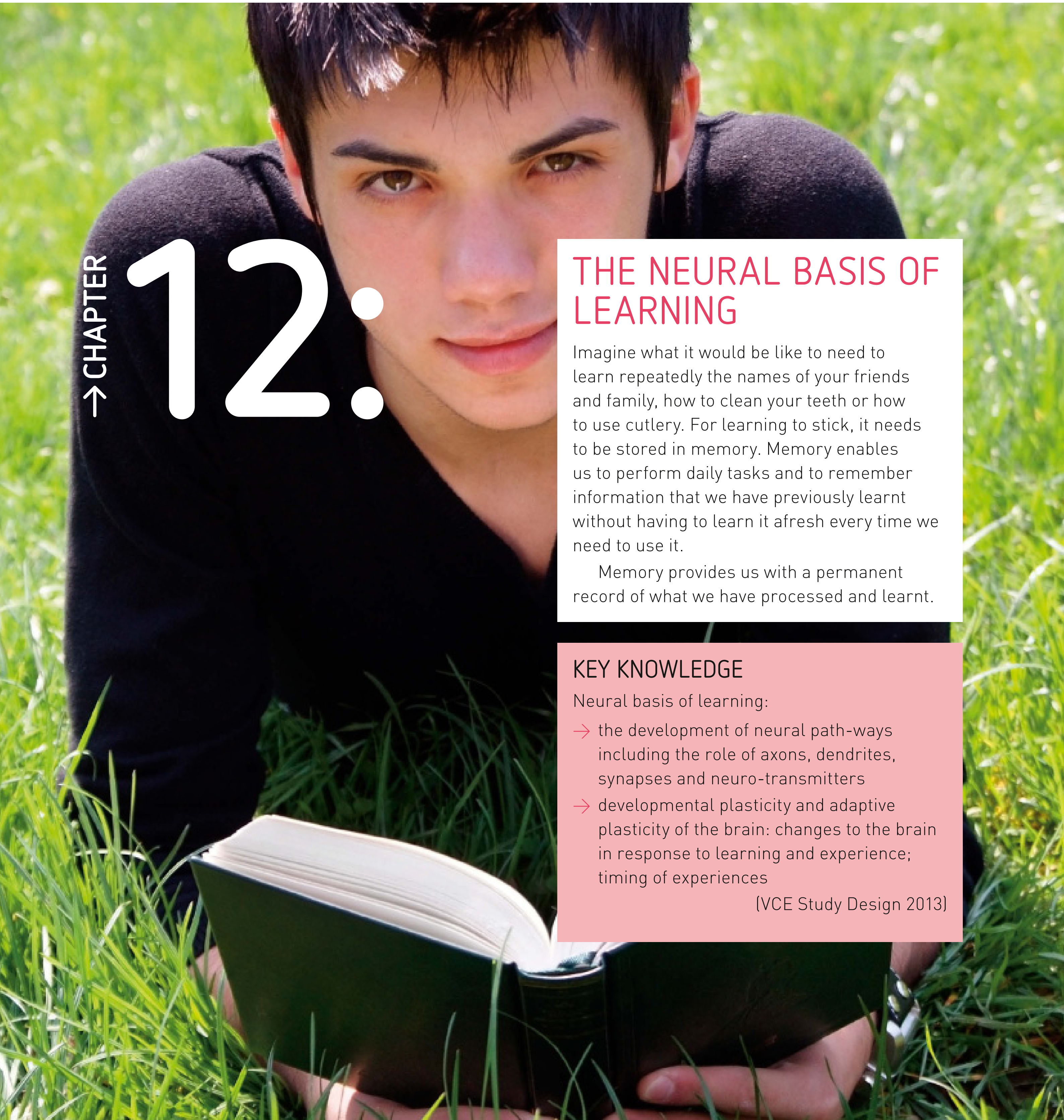
1. Explain what is meant by the term 'learning'.
2. Name the three types of behaviour that are not dependent on learning and explain why.
3. Using your own examples, explain the difference(s) between a 'reflex action' and a 'fixed action' pattern.
4. Give an example to demonstrate your understanding of 'behaviour due to maturation'.

1 INVESTIGATE

VISUAL PRESENTATION

Complete the table below using your own examples (not from the textbook).

LEARNING TYPE	DESCRIPTION/DEFINITION	EXAMPLE
Reflex action		
Fixed action pattern		
Maturation		



→ CHAPTER 12:

THE NEURAL BASIS OF LEARNING

Imagine what it would be like to need to learn repeatedly the names of your friends and family, how to clean your teeth or how to use cutlery. For learning to stick, it needs to be stored in memory. Memory enables us to perform daily tasks and to remember information that we have previously learnt without having to learn it afresh every time we need to use it.

Memory provides us with a permanent record of what we have processed and learnt.

KEY KNOWLEDGE

Neural basis of learning:

- the development of neural path-ways including the role of axons, dendrites, synapses and neuro-transmitters
- developmental plasticity and adaptive plasticity of the brain: changes to the brain in response to learning and experience; timing of experiences

(VCE Study Design 2013)

The ability to learn and retain what is learnt in memory distinguishes organisms with greater brain capacity, such as humans, from other organisms with less complex brains. For example, simple organisms such as water insects are able to learn to avoid a light which will give them an electric shock. They can learn this sufficiently for the purpose of survival but their brain has no capacity for storing this learning as memory. If the light is turned off and then turned on again, they are likely to swim towards it; they must learn to avoid the light all over again. These insects are unable to be trained beyond simple actions such as avoiding danger or moving towards food sources for the purposes of survival (Garrett 2009). In contrast, organisms with more complex brains only need to learn this once.

The neural basis of learning

CHAPTER OVERVIEW

The neural basis of learning	Brain development during adolescence
Neural pathways synapse formation and the role of neurotransmitters	Synapse formation in learning
Plasticity of the brain	Developmental plasticity Adaptive plasticity Timing of experiences > Sensitive periods > Critical periods

FIGURE 12.1 Memory enables us to perform daily tasks such as reading.

SUPPORTING UNDERSTANDING

Brain structures involved in learning and memory

You will recall from your study of memory formation in Unit 3 that some parts of the brain play a key role. It is useful to refresh your own memory of this so that you are well prepared to understand changes to the brain during learning.

When higher-order animals such as mammals and humans learn to retain information in memory, different parts of their brain become active, depending upon the type of learning that is taking place – for example, whether learning a skill or learning factual information. Learning also involves interaction between these brain structures.

Some key areas of the brain that are more responsible for learning include the hippocampus, the amygdala, the lobes of the cerebral cortex (which are all located in the forebrain) and the cerebellum (which is located in the hindbrain).

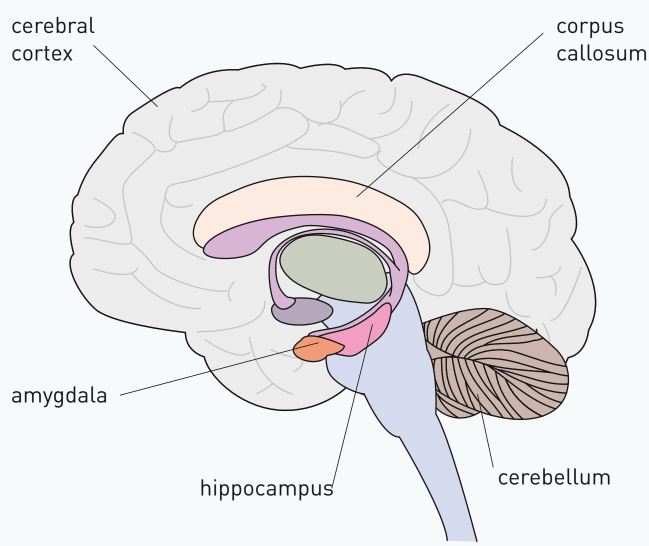


FIGURE 12.2 Some of the key structures of the brain which are involved in learning

Hippocampus

The hippocampus plays a central role in the process of learning. Learning new information that will become declarative memory typically involves an interaction between the hippocampus and relevant areas of the cortex that specialise in storing declarative-type information, such as the occipital lobe for visual memory of written words.

Higher-order animals and humans who have damage to both their left and right hippocampi are able to *feel* the emotion of fear when they experience pain from a stimulus (for example, an electric shock). However, they are unable to *learn* or remember to be fearful the next time they experience a situation in which they will receive the electric shock again.

For example, an animal with damaged hippocampi that is put into an experimental cage (context) will learn to associate the noise of a bell with the pain of an electric shock that is delivered just after the bell has been sounded. However, because its hippocampi are damaged, when the same animal is placed in a different cage (context), it will be unable to remember that the noise of a bell is a warning that an electric shock is coming, and so will not react fearfully when it hears the bell. This is because learning the declarative information about the pain that is associated with the bell noise has to be processed by the hippocampus; because the animal has a damaged hippocampus, it is unable to learn and remember this information (Bechara et al. 1995; Burton, Westen, & Kowalski 2009).

12.1 REVIEW

1 Explain what problems might arise if a person was unable to remember what he or she learns. Give a real-life example to illustrate your understanding.
2 Are there any physiological differences between the way humans and animals learn? Explain.
3 Which structures/areas of the human brain are linked with the formation of memories?
4 How can damage to the hippocampus affect an animal's ability to remember?

KEY STUDY

RESEARCH METHODS: THE HIPPOCAMPUS IN LEARNING

In a study that used rats in an apparatus called a radial arm maze (see Figure 12.3), rats with damage to both hippocampi were able to learn to go into each arm of the maze to obtain food. However, because of their damaged hippocampi, they were unable to remember which arms they had already entered and therefore repeatedly entered the same arms from which they had already eaten the food (McDonald & White 1993).

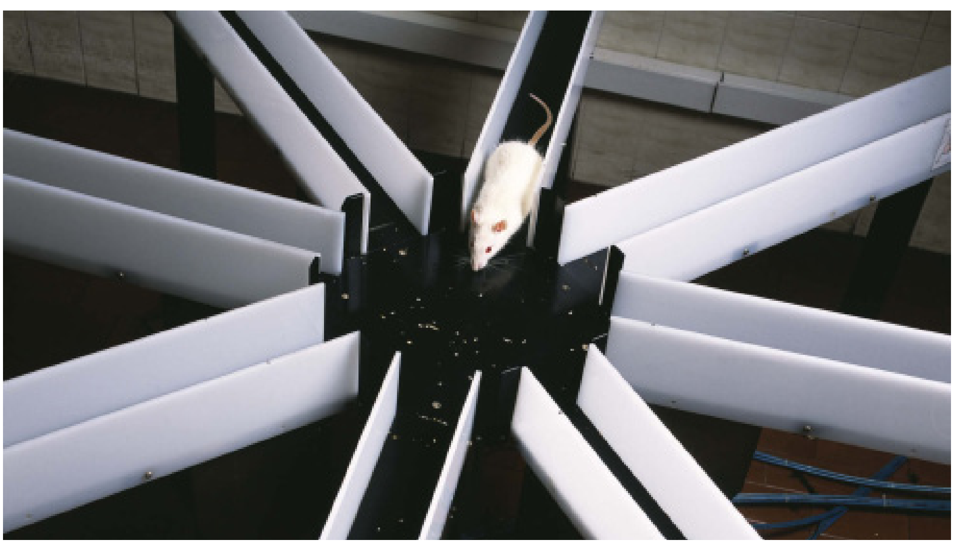


FIGURE 12.3 Experimenters used a radial arm maze with brain-damaged rats to study different parts of the brain responsible for learning.

12.1 INVESTIGATE

EVALUATION OF THE RADIAL ARM EXPERIMENT

1 What was the aim of the radial arm experiment?
2 Write an operational hypothesis for the experiment.
3 Identify the independent and dependent variables.
4 What conclusions could be drawn from this experiment?
5 Can the results from this experiment be applied to humans? Explain.

SUPPORTING UNDERSTANDING

Amygdala

The amygdala has a role in emotional learning – in learning to associate fear with a new unpleasant stimulus. This makes the amygdala essential for an organism's survival.

Humans with damage to their amygdala are unable to be classically conditioned (to learn) to fear a dangerous object (stimulus), even if they *know* that every time a bell sounds they will receive a shock (Burton *et al.* 2009). In other words, when a person's hippocampus is intact, they can learn and be fearful of bees because bees have a painful sting. However, if a person has a damaged amygdala, they will not display the physical signs of fear (such as raised galvanic skin response, increased heart rate) when confronted by a bee (Bechara *et al.* 1995).

FIGURE 12.4 The amygdala plays a role in a person's learning to fear bees, but if they have damage to their amygdala they will show no fear towards the bee.

The amygdala also has a role in learning because it can strengthen the learning of information that will become declarative memory if that memory is associated with positive or negative emotions. Stimulation of the amygdala activates the hippocampus and, in humans, learning and memory for pleasant and unpleasant emotional information is linked to the amount of activity in the amygdala when the learning occurs (Garrett 2009).

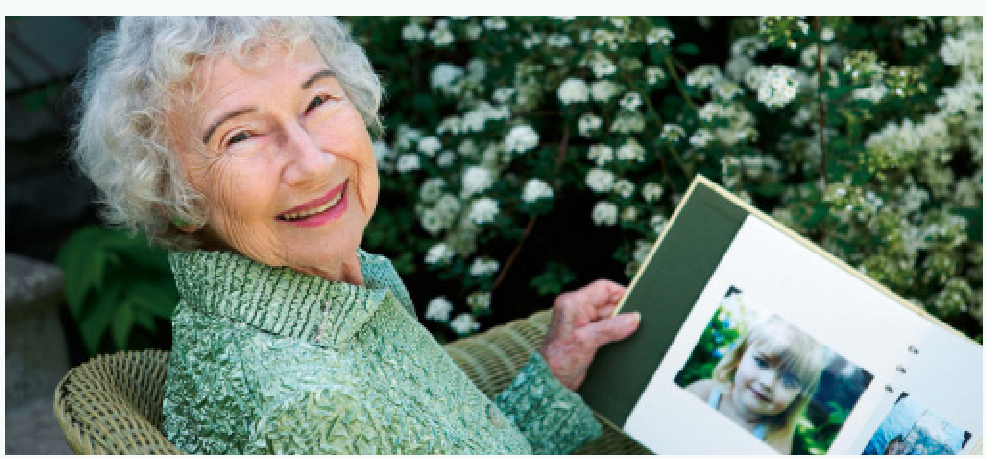


FIGURE 12.5 Stimulation of the amygdala activates the hippocampus and, in humans, learning and memory for pleasant and unpleasant emotional information is linked to the amount of activity in the amygdala when the learning occurs.

Cerebral cortex

Many areas of the lobes of the cerebral cortex are involved in learning and memory storage. One key area is the basal ganglia, in the frontal lobes, which use information from the primary and secondary motor areas of the frontal lobes, as well as from the somatosensory cortex, to integrate and smooth bodily movements. People who suffer from diseases that damage the basal ganglia, such as Parkinson's or Huntington's disease, have great difficulty learning to do tasks that result in non-declarative memory, such as learning skills that result in procedural memory.

Cerebellum

The cerebellum is located in the hindbrain and plays a role in the order of muscular movement, balance and posture. It is also necessary for learning motor skills, as well as contributing to non-motor learning (Garrett 2009). The cerebellum and basal ganglia work together in learning movement sequences so that the movements can be carried out together.

Ventral tegmental area

The ventral tegmental area is located in the midbrain and is thought to have a role in learning through operant conditioning. In particular, it plays a role in the rewarding effects of primary reinforcers in operant conditioning, for example food or sex. This part of the brain has a key role in gambling for humans. It is referred to in Area of Study 2 Unit 4 in this book.

FIGURE 12.6 The cerebellum plays a role in the order of muscular movement, balance and posture. It is also necessary for learning motor skills.

FIGURE 12.7 The ventral tegmental area is thought to have a role in learning through operant conditioning.

Brain development during adolescence

During adolescence in humans, there is a large amount of development in structures of the brain that have a role in learning:

- cerebellum: there is an increase in the number of neurons and synapses in the cerebellum, the part of the brain responsible for balance, muscle tone, and the performance of motor skills
- amygdala: the amygdala becomes more active in adolescence
- corpus callosum: the corpus callosum thickens and there is an increase in the number of connections between the two hemispheres
- frontal lobe, including prefrontal cortex: motor movement and higher-order thinking.

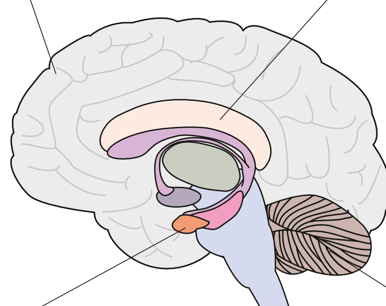


FIGURE 12.8 Developmental changes to the adolescent brain

REVIEW 12.2

1 Complete the table below:

BRAIN STRUCTURE	ROLE IN LEARNING	EFFECT OF DAMAGE ON ABILITY TO LEARN
Hippocampus		
Amygdala		
Cerebral cortex		

2 What changes take place in the brain during adolescence?

Neural pathways, synapse formation and the role of neurotransmitters

Before studying the role of neurons in learning it is essential that you refresh your knowledge of the anatomy of neurons and how information is passed between them. (Refer to Chapter 9).

Synapse formation in learning

The process of synapse formation during learning involves either the creation of new **neural pathways** or the strengthening of existing neural pathways. A neural pathway (also referred to as a neural tract) is a bundle of myelin-covered neurons (white matter) that provide a connection between one part of the nervous system and another.

When learning takes place (and depending on the type of learning), existing synapses are sometimes moulded or new synapses are formed (synaptogenesis). Synaptogenesis is particularly evident during early childhood but it is also evident in parts of an adult brain.

To understand this process, it is important to review the zone that acts as a junction between two neurons, called a **synapse**. It is comprised of the axon terminal of the presynaptic neuron, the synaptic gap, and the dendrite of the postsynaptic neuron.

During learning, the axon terminals (terminal buttons) of the presynaptic neuron release a **neurotransmitter** called glutamate into the synaptic gap between the presynaptic neuron and the dendrites of a neighbouring postsynaptic neuron.

As the process of learning new information or a new skill is acquired, the neurons form new connections with each other. This means that new 'sprouts', called filigree appendages, begin to grow from the axon terminal of a presynaptic neuron towards the dendrites of neighbouring postsynaptic neurons.

As a result of learning, there is a strengthening of the neural pathway between neurons. This enables the newly learnt information to be transferred from one neuron to the next more efficiently. The more that a particular neural pathway is activated during learning, the more likely it is to be strengthened, and the less likely the learning will be forgotten. This is what happens when, for example, someone learns spelling, the multiplication tables, to play a piece of music or to perform a specific task. When particular neural pathways are *not* activated, the learning may be forgotten if the synapses become weakened through infrequent use (Pastorini & Doyle-Portillo 2010).

The research on the neurobiological basis of learning has really only just begun and there is much that still needs to be understood. As increasingly sophisticated research technology becomes available, a clearer picture will emerge of precisely what happens to neurons during the learning process. This might make it possible to apply this understanding to all sorts of practical applications such as treatment of learning disabilities, psychological disorders such as anxiety disorder and phobias, and addictions.

12.3 REVIEW

1. Hand draw or use a graphics/multimedia package to represent one of the following:
   - **a** a detailed directional flow chart to show the neural steps involved in learning
   - **b** two or more interconnecting neurons to show the processes involved in learning.
2. Do actual physical changes take place as new learning occurs?
3. What happens if a new neural connection is not frequently activated?

Development of neural pathways involved in learning

DENDRITES AND NEUROTRANSMITTERS

When learning takes place, neurons excite one another through the release of neurotransmitters. In this process, glutamate is released by the presynaptic neurons. Glutamate is the main excitatory neurotransmitter in the brain for learning. When glutamate is released by the presynaptic neuron, it acts on two types of glutamate receptors in the postsynaptic neuron: the AMPA receptor that activates the postsynaptic neuron and the NMDA receptor that produces long-lasting modifications to the synapse. The repeated glutamate release also stimulates the release of dopamine, which in turn activates genes in the neuron. This prompts growth in the postsynaptic neuron of an increased number of dendritic spines. Dendritic spines are outgrowths from the dendrites in the synaptic gap (see Figure 12.9). These make the postsynaptic neuron more sensitive to future firing by other neighbouring presynaptic neurons. This process has been mainly studied in the hippocampus but it is understood that it also occurs in other parts of the brain, including the visual, auditory and motor cortices (Garrett 2009).

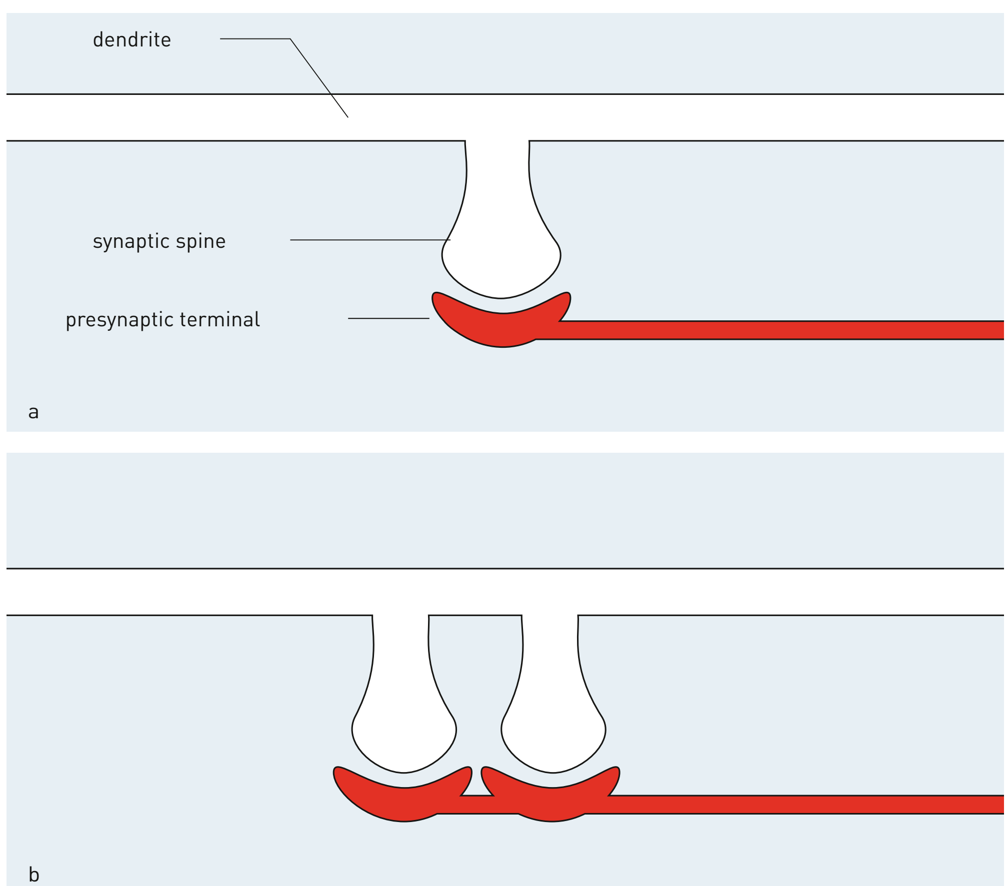


FIGURE 12.9 (a) A single synaptic spine on a dendrite (white) and a presynaptic terminal (red) and (b) the same spine split into two.

Consider this example of the operant conditioning of a rat in a Skinner box (see Chapter 14). The hungry rat will receive a tasty food pellet each time it presses a lever. The rat is likely to press the lever repeatedly to obtain the desired food pellet. In the rat's brain, learnt behaviour (pressing the lever) to get the reward (food) will cause the release of glutamate from the presynaptic neurons into the synaptic gap between the presynaptic and postsynaptic neurons. The glutamate stimulates the growth of dendritic spines on the postsynaptic neuron, making it more receptive to future bursts of glutamate from the presynaptic neuron. This process results in long-lasting structural changes to the glutamate receptors of the rat's postsynaptic neurons. This process also results in the release of dopamine, which interacts with genes in the neuron to generate new proteins in the neuron. Altogether, this process has the effect of producing long-lasting structural changes in the dendrites and increased efficiency of the neural pathways for the learnt behaviour (Carlson et al. 2007).

Did you know?

Synaesthesia is an intriguing phenomenon that is thought to occur when circuit pruning is incomplete. It is a cross-modal experience – stimulus from one sensory modality (system) automatically triggers a perception in a second sensory modality or cognitive process, such as seeing a certain colour in response to the sound of a certain word, or experiencing certain smells when hearing a particular sound.

The experience only occurs in one direction – the sound of a specific word might elicit a certain taste but the taste does not elicit the sound of the word.

Most studies suggest that more females than males experience synaesthesia, but recent random sampling found no difference between the sexes (Simner *et al.* 2006).

Plasticity of the brain

The brain is capable of learning throughout the lifespan because of its **plasticity**. Plasticity of the brain refers to the way it changes in response to stimulation from the environment. The process of plasticity occurs at the synaptic connections in the brain. Plasticity is necessary for learning to take place and is present throughout a healthy person's lifetime.

Developmental plasticity

Generally, an infant or a child's brain will have more plasticity than an adult's brain. This is referred to as **developmental plasticity** – the ability of synapses to be modified (Garrett 2009). Although changes to the brain occur more frequently in the foetal stage as well as in babies, children and adolescents (developmental plasticity), these changes continue throughout life as learning takes place (adaptive plasticity).

Prior to birth and for the first years of life, a child's neurons are quite flexible in terms of their function. The development of the nervous system starts before birth when the brain and spinal cord are formed. Development then goes through five stages:

- proliferation
- migration
- circuit formation
- circuit pruning
- myelination.

Proliferation is the process whereby the unborn baby's cells that will become neurons divide and multiply, creating approximately 250 000 cells per minute.

During **migration**, newly formed neurons move outward to their destined location. The role that a particular neuron might have is determined by where it is located at its time of formation. Different brain structures form during different stages of development. However, before a baby is born and just after birth, the neurons are flexible. This is why brain tissue from a foetus can be transplanted into a part of an adult brain and the transplanted neurons will adapt, form synapses and take on the function of the brain area into which they have been placed (Garrett 2009).

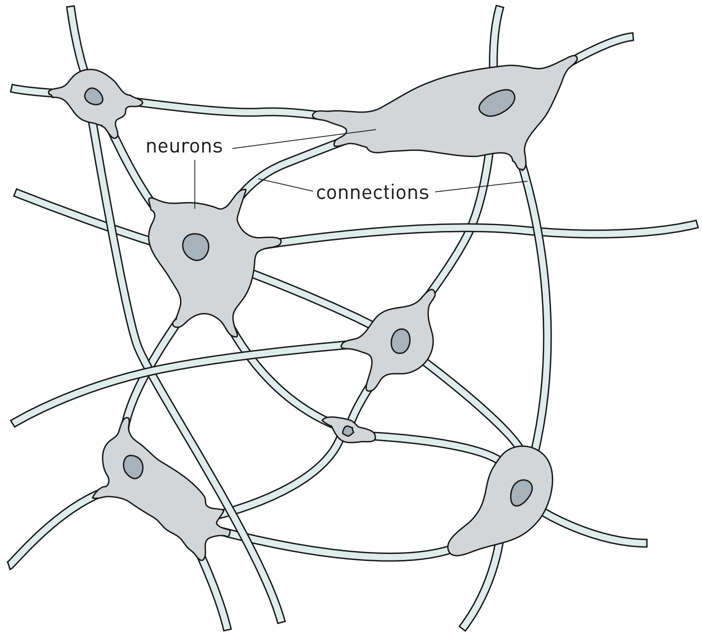


FIGURE 12.10
During development in childhood and adolescence, the brain develops many neural pathways or connections and unused connections are pruned.

Circuit formation occurs when the axons of new neurons grow out to target cells and form synapses with them, for example, axons for motor neurons grow to the spinal cord where the neurons form synapses with other neurons on this location.

Circuit pruning involves the elimination of excess neurons and synapses; that is, those which have not established a connection with a target cell die. The nervous system also refines itself by eliminating excessive synapses and strengthening or weakening synapses according to whether their presynaptic and postsynaptic neurons fire together. A neuron that does not fire at the same time as its neighbouring neurons is probably a neuron that has found its way into an inappropriate area during circuit formation, and might be part of circuit pruning. Pruning occurs during infancy and childhood but there is a second wave of pruning in early adolescence. During this entire process, the brain produces many more extra neurons than will ever be used, and will eventually be eliminated through pruning. However, it does this as a way of making up for the errors that happen when some neurons fail to reach target cells.

Myelination, a process where the axons of the neurons in the child's brain become covered in myelin, is the final stage that needs to happen for a brain to become fully mature. Myelin is a white, fatty, waxy substance that coats some axons and protects them from electrical interference from other neurons. Myelin speeds up the rate of transmission of signals within the neuron. The myelination process commences before a baby is born and does not finish until late adolescence or beyond (Sowell et al. 1999). The lower structures of the brain are the first to be myelinated. This is followed by the cerebral hemispheres, where myelination begins at the occipital lobes, followed by the temporal and parietal lobes and, finally, the frontal lobes. The frontal lobe of the left hemisphere is the very last part of the brain to undergo this process.

During early adolescence, there is a second burst of production of cortical grey matter. Cortical grey matter is the covering of the cerebral hemispheres – it looks grey in colour because the axons do not have myelin covering them. The last part of the brain to develop is the prefrontal cortex, which is responsible for problem solving, planning, impulse control and critical thinking – perhaps a possible reason why adolescents can be very impulsive!

Because a child's brain has greater plasticity than an adult's, it is able to utilise other parts of the brain to form alternative neural connections, which can compensate for any missing or damaged part of the brain. For example, it is more likely that a child will recover from damage to the part of the brain that is responsible for language than will an adult (Garrett 2009).

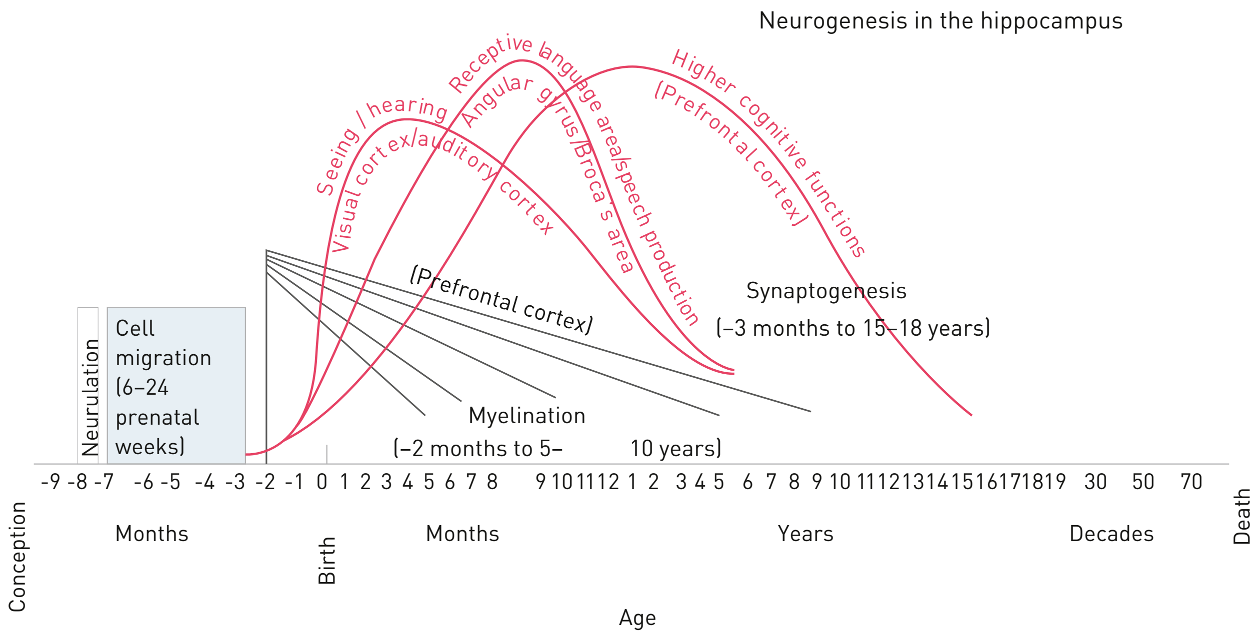


FIGURE 12.11 The development of different parts of the brain

TABLE 12.1 Developmental plasticity stages

DEVELOPMENTAL PLASTICITY STAGES	
Proliferation	Foetal neurons divide and multiply, creating about 250 000 cells per minute.
Migration	Once formed, neurons move to their final location in the CNS and the locations determines what their function will become.
Circuit formation	The axons of the new neurons move outwards towards adjacent cells and circuits are completed.
Circuit pruning	Pruning occurs in childhood and a second phase during adolescence. Far more neurons are created than will eventually be needed. During circuit pruning extra neurons are removed.
Myelination	Gradually, throughout childhood and adolescence and into young adulthood (about age 23), *Myelin* sheathing grows around the axons of many neurons, insulating them and making neural transmission more efficient.

↙ GIRL RECOVERS AFTER HALF OF BRAIN REMOVED

A US child who had half her brain removed in a risky operation to stop her suffering seizures has made a full recovery.

Cameron Mott, a curly-haired nine-year-old from North Carolina, shows no sign of the drama that surrounded her health for the last six years.

She was having up to ten seizures a day and was losing the ability to speak before doctors in Baltimore diagnosed her with Rasmussen's syndrome in 2007.

Rasmussen's syndrome is a rare disorder that causes deterioration on one side of the brain and, for Cameron, treatment involved a hemispherectomy – the removal of the entire right side of the brain.

Her parents were initially apprehensive about their six-year-old daughter undergoing the seven-hour surgical procedure, which took place three years ago.

'It was very scary, because you just can't imagine what your child will be like after such a dramatic brain surgery,' Cameron's mother, Shelly Mott, told the US *Today* show. 'It just doesn't seem like they can be the same child.'

Dr George Jallo, a neurosurgeon at the Johns Hopkins Medical Centre where Cameron was treated, was confident she would recover because children's brains can rewire themselves.

'We like to do children because of their ability or their plasticity – that's the ability of the other side of the brain that we haven't removed to take over and control the function of the diseased half we're removing,' Dr Jallo said.

After two days of complete immobilisation, followed by four weeks of intense physical therapy, Cameron walked out of the hospital.

Now Cameron is at school and enjoying a normal life, apart from a slight limp and some loss of her peripheral vision.

Source: 29 March 2010
news.msn.co.nz

Adaptive plasticity

Although the developmental plasticity of a young person's brain will diminish with age, the areas of the cerebral cortices retain plasticity throughout life, This is known as **adaptive plasticity** where the brain changes and develops as a result of new experiences. In other words, these parts of the brain can be shaped by learning and experience (Kandel & O'Dell 1992; Katz & Shatz 1996; Singer 1995).

Adaptive plasticity enables older brains to be modified through experience or learning (Garrett 2009). Adult humans continue to develop synapses as a result of their experiences; stimulating experiences and environment shape the construction and remodelling of a person's brain throughout life.

This process of reorganisation refers to a shift in connections that might alter the function of a particular area of the brain (Garrett 2009). Adult humans continue to develop more synapses as they learn and have new experiences. The brain can also continue to develop and recover from serious injury. Stem cells in some parts of the brain continue to create neurons throughout life, enabling the brain to adapt and cope with any new experiences an individual might encounter. Remember from Unit 3 that age-related memory decline is not inevitable. The more different cognitive activities a person undertakes throughout life, and the more active the brain remains, the more plastic it stays throughout life.

12.4 REVIEW

1 Explain what is meant by the term 'plasticity'.
2 Describe the processes involved in developmental plasticity.
3 What is meant by the term 'pruning' in the development of neurons in children and adults?
4 Explain what happens during the myelination process.
5 What is the role of myelin and why is its formation so important?
6 What is adaptive plasticity? Explain.
7 Draw a table outlining the stages of developmental and adaptive plasticity

FIGURE 12.12 The hearing and eyesight development of young children must be regularly checked for deficits.

Timing of experiences

SENSITIVE PERIODS

As children and adolescents grow, their brains become less plastic and their neural pathways become more set. Certain periods in development are particularly suited to learning certain things. These periods are referred to as **sensitive periods** and are the best or optimum times for a developing individual to learn specific things. At these times, the growing brain needs specific types of stimulation so that neural pathways are established. Usually, this stimulation occurs as part of a person's natural development. However, it is vital that the individual be exposed to the necessary experiences to allow for the changes through learning. This is **experience-expectant learning** (experience-expectant synaptogenesis). These are situations in which a species' typical experience (that all members of a species experience in normal conditions) plays a necessary role in the developmental organisation of the nervous system. Normal brain growth relies on these forms of environmental exposure. For example, the visual cortex 'expects' exposure to light and patterned

Did you know?

Research has suggested that new neural pathways formed during learning will remain in place even if they are rarely used. The inactive neural pathways can sometimes be reactivated, enabling relearning of the same material at a faster rate.

visual information, and is genetically programmed to utilise these inputs for normal development. Deprivation of these essential forms of environmental input can have permanent effects, so it is essential to detect and treat sensory deficits in children (visual or hearing problems) to ensure that these expected experiences take place. An example is young children learning to speak in their native tongue. If the opportunity is missed in infancy and early childhood, it is significantly more difficult to achieve fluency.

Experience-expectant learning differs from **experience-dependent learning** (experience-dependent synaptogenesis). Experience-dependent learning is a form of learning that can occur at any time during an individual's life, whereas experience-expectant learning refers to learning that can be most effective only at a particular time in life for each particular species. Experience-dependent learning refers to adaptive plasticity, encoding new experiences that occur throughout life, fostering new brain growth and the refinement of existing brain structures. These vary for every individual according to their unique set experiences throughout life. For example, learning to read and write in one's native tongue is a form of experience-dependent learning.

If an individual misses out on the appropriate experience-dependent learning opportunities during a sensitive period, it does not necessarily mean that learning will never occur. A person learns throughout life so it is possible for the missed learning to take place outside of the sensitive period, but it will require more time and cognitive energy and in some cases the learning might not be as efficient or strong.

FIGURE 12.14 Human infants need to be exposed to language in the first year of life to allow them to use and understand language.

CRITICAL PERIODS

In some lower order animals, there is a **critical period** – a very narrow period of time in an animal's development when it must have a particular experience in order for something very specific to be learned – in other words, a time in a particular species' lifespan in which the animal is pre-programmed to learn something. For example, ethnologist Konrad Lorenz studied how young birds imprint (form an immediate attachment) to the first moving object they see after they hatch from the egg. Lorenz found that greylag geese hatchlings imprinted on him and followed him wherever he went. For these geese, the critical period was the first few moments of their life (Lorenz 1937).

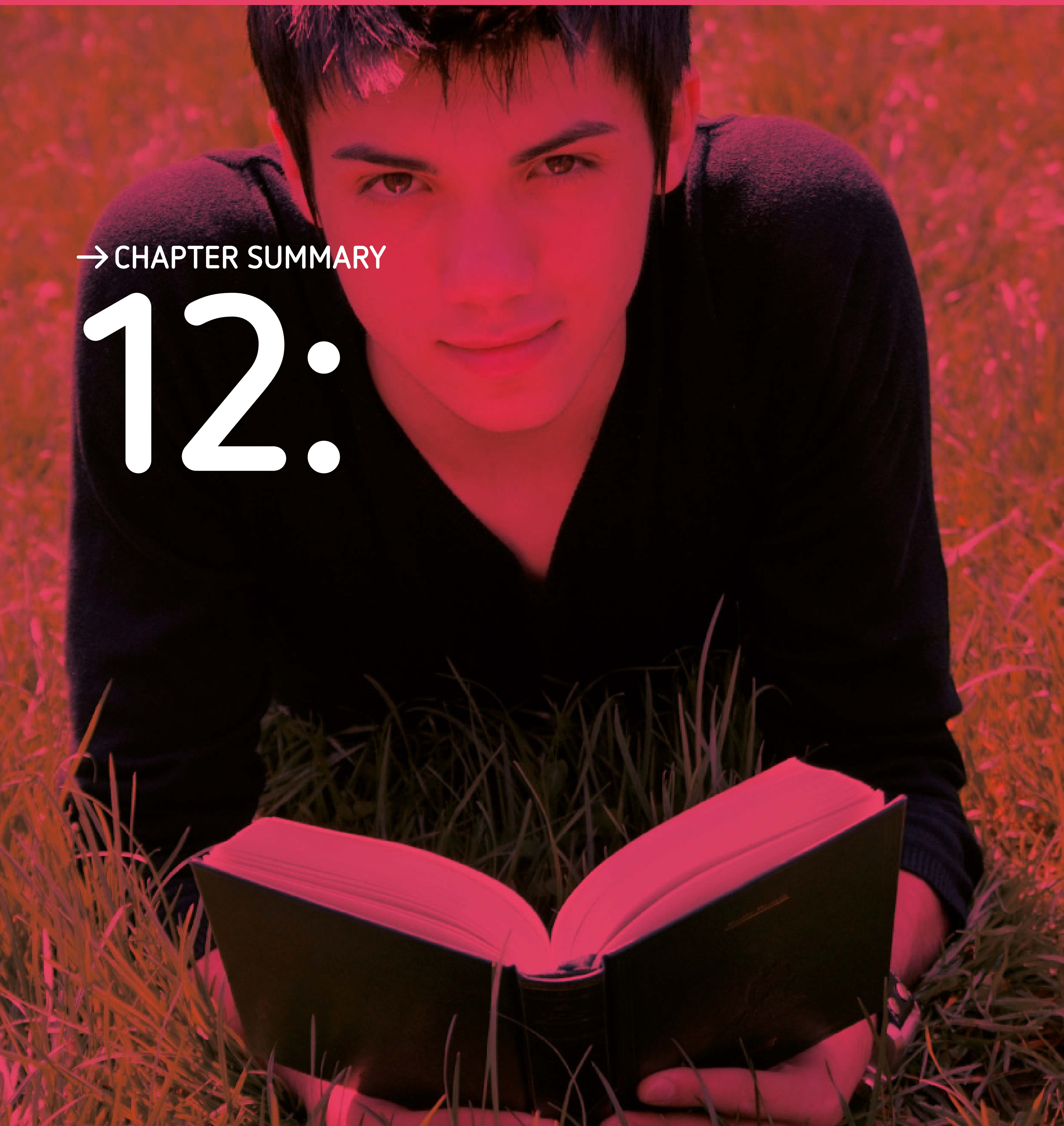
FIGURE 12.13 These goslings have imprinted on their carer as their substitute mother because she was the first moving thing they saw in the critical period just after they hatched.

In humans, there are few, if any critical periods for learning – we tend to have sensitive periods, such as learning to speak in the first years of life. One example of a critical period for humans is the development of vision; human babies must receive exposure to light in the first few days of life so that the sensory neurons in the retina develop. If this does not happen, the baby might be visually impaired.

SENSITIVE AND CRITICAL PERIODS

INVESTIGATE 12.2

1 Answer the following three questions using your textbook and further research.
   a Explain what is meant by sensitive and critical periods in development.
   b When is it considered a sensitive period for humans to learn speech?
   c Why is it important for human newborns to be exposed to light?
2 Using the Internet, find a documented study about a 'feral child' and write a 300-word description of the case.



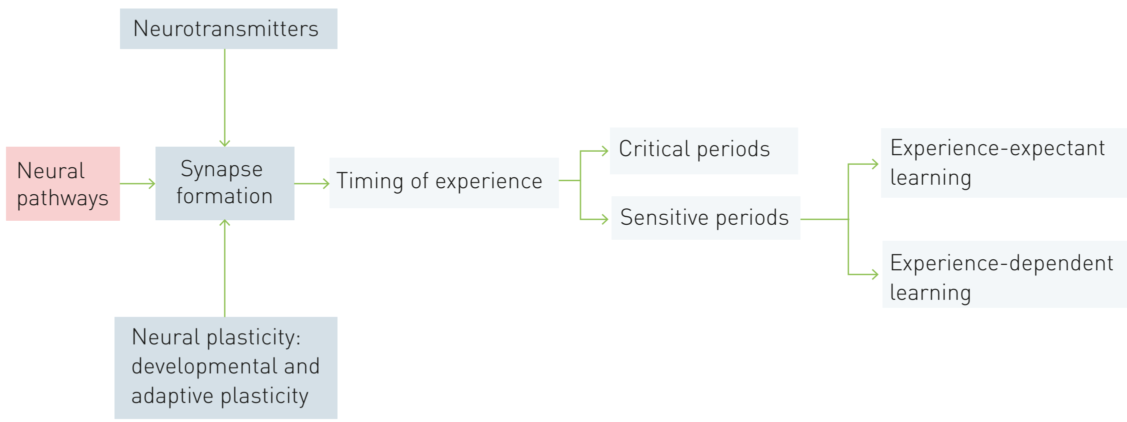
→ CHAPTER SUMMARY

12:

- As learning takes place, neurons become more responsive to neurotransmitters and there is an increase in the strength of the synaptic connections between neurons. This involves change in the presynaptic neuron so that it becomes more prepared to release neurotransmitters, and change to the postsynaptic neuron, which becomes more readily excited by the neurotransmitter. The postsynaptic neuron changes increase the number of dendrite connections for receiving the neurotransmitter that has been released from the neighbouring presynaptic neurons.
- Plasticity of the brain refers to the way the brain can be modified. Developmental plasticity refers to the development and consolidation of neural pathways in babies, children and adolescents, including proliferation, migration, circuit formation, circuit pruning and myelination. Adaptive plasticity refers to the plasticity of parts of the adult brain and also the process of reorganisation.
- A young brain has more plasticity because it is packed with a greater number of neurons. Developmental plasticity is thought to enable growing children to readily adapt and learn from their circumstances and environment. It also assists in helping the developing brain to cope with injury by reorganising neural connections and using 'spare' neurons before pruning takes place.
- Certain periods in development are particularly suited to learning certain things. These periods are referred to as sensitive periods because they are the best or optimum times for a developing individual to learn specific things.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

adaptive plasticity
circuit formation
circuit pruning
critical periods
developmental plasticity
experience-dependent learning
experience-expectant learning
migration
myelination
neural pathway
neurotransmitter
proliferation
reorganisation
sensitive periods
synapse formation (synaptogenesis)

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of the neural basis of learning.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study
- identify ethical considerations in relation to researching the neural basis of learning.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 What does synapse formation during learning involve?
- a circuit pruning
- b priming
- c the process of myelination
- d development of neural pathways

2 The term 'adaptive plasticity' refers to changes in the brain:
- a in response to hormones.
- b in a newborn baby.
- c in response to learning and experience.
- d in size.

3 Studies have shown that learning often results in relatively permanent changes in the __________ of animals' neurons.
- a myelin
- b synapses
- c neurotransmitters
- d perception

4 The process of developmental plasticity is thought to involve:
- a proliferation, experience, pruning and myelination.
- b proliferation, migration, pruning and myelination.
- c migration, pruning, learning and experience.
- d pruning, priming, experience and learning.

5 In adaptive plasticity, what does 'reorganisation' involve?
- a surgery to transplant brain tissue
- b removal of a part of the brain
- c a shift in the neural connections which results in changes to the function of a part of the brain
- d a shift in the neural connections which enables the same brain parts to perform their roles after head injury

6 Plasticity of the brain is thought to occur:
- a aonly in children.
- b bonly in response to medication.
- c cas a result of head injury.
- d dthroughout life.

SHORT ANSWER

7 Researchers believe that learning involves either a strengthening or creation of neural pathways. Describe a neural pathway.

2 marks

8 a What is 'synaptogenesis'?

b Research suggests that, as a result of learning, there is a strengthening of the neural pathways between neurons. What is likely to happen if the same type of learning continues?

2 marks

9 Name and briefly describe the five stages of developmental plasticity.

5 marks

10 With reference to sensitive periods in learning, what is the difference between experience-expectant learning and experience-dependent learning?

2 marks

11 What is the difference between critical periods and sensitive periods in learning?

2 marks

CHAPTER 13: CLASSICAL CONDITIONING

Do you get a feeling of excitement when you smell newly cut grass at the beginning of spring? Does the first frosty morning of winter cause the same feeling? When people develop an allergy (such as to cats and dogs), they often begin to sneeze as soon as they see one of the animals.

Stimulation of any of our senses can cause a reflexive emotional response; this is the result of classical conditioning. Any time a stimulus that was originally neutral (i.e. had no effect) now causes a behavioural or emotional reaction, classical conditioning has occurred.

KEY KNOWLEDGE

Applications, 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
- the extent to which ethical principles were applied to classic research investigations into learning including John Watson's 'Little Albert' experiment.

(VCE Study Design 2013)

Elements of classical conditioning

CHAPTER OVERVIEW

Elements of classical conditioning	Pavlov's research Examples of classical conditioning in practice > Simple behaviour (conditioned reflexes) > Complex behaviour (phobias)
Classical conditioning applied in psychotherapy	Graduated exposure Flooding Aversion therapy John B. Watson and Little Albert

Classical conditioning is a form of learning in which a previously neutral stimulus comes to elicit a reflexive response by repeated association with a stimulus that automatically elicits the reflex response.

- Your dog gets excited when you pick up his lead.
- You start to feel anxious when you walk through the entrance of a hospital, even though you are only going to visit an aunt who has a new baby.
- You are driving with your P-plates when you hear a siren and see flashing lights behind you. You get a sinking feeling in your stomach but then realise, with relief, that it's a fire truck and not the police, so you pull over to let them through.

All of these behaviours have been learnt through a very simple learning process, known as **classical conditioning**.

Pavlov's research

Classical conditioning was first described in the early twentieth century.

Ivan Pavlov, who had won the Nobel Prize for physiology in 1904, was continuing his research on the digestive system of dogs when he noted that the dogs salivated before they received food.

Pavlov hypothesised that the dogs had come to associate the footsteps of the laboratory technician who fed the dogs with the presence of the food that was given

FIGURE 13.1 If you show a dog its walking lead it will get excited. This is the result of classical conditioning.

to them, and that this sound had been conditioned to cause the reflex response of salivation.

Originally, the *stimulus* (food) produced the *response* (salivation). Eventually, the sight or sound of the laboratory technician became the stimulus, which produced salivation. The salivation response, which is biologically based in the nervous system and occurs involuntarily (i.e. a reflex response), had now been conditioned to a new stimulus (the sight or sound of the technician).

Pavlov began to experiment by associating various sounds (a bell, a tuning fork and a metronome) with the food and found that, after a few trials, the dogs could be conditioned to respond to the sound by salivating.

As a result of Pavlov's work, clear evidence was provided for a very simple type of learning that was based on the repetitive association of different stimuli – classical conditioning.

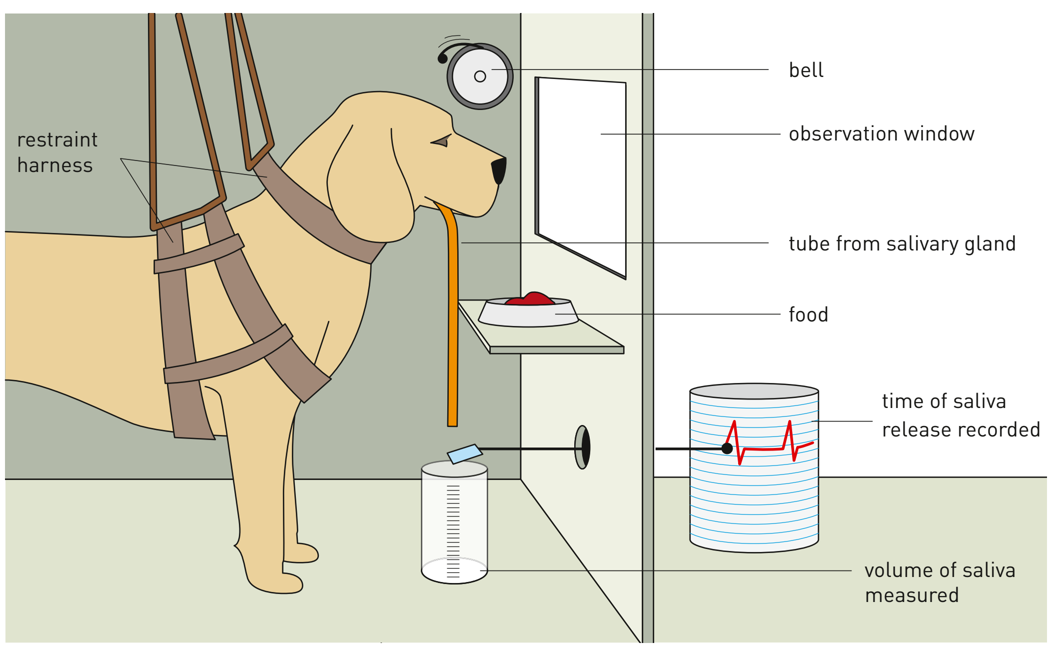


FIGURE 13.2 Pavlov's research with dogs provided evidence for a very simple type of learning which was based on the repetitive association of different stimuli. This is called classical conditioning.

BEFORE CONDITIONING

neutral stimulus (NS) → no response
bell

unconditioned stimulus (UCS) → unconditioned response (UCR)
food → *salivation: due to food*

DURING CONDITIONING

NS + UCS → UCR
bell + *food* → *salivation: due to food*

Repeated pairings of these two stimuli

AFTER CONDITIONING

conditioned stimulus (CS) → conditioned response
bell → *salivation: due to bell*

FIGURE 13.3 Classical conditioning

Pavlov also discovered that **extinction** would occur if the bell was rung many times without ever again being paired with the food. The amount of saliva produced each time the bell was sounded would gradually reduce until ringing the bell did not cause salivation.

After a pause of some hours, during which the bell was never sounded, ringing the bell again caused a small amount of saliva to be produced – **spontaneous recovery** had occurred.

Pavlov discovered that after a dog had been conditioned to salivate in response to the sound of a bell, it would also salivate when a buzzer was sounded, even though the buzzer had never been paired with the unconditioned stimulus (UCS) of food. This was a demonstration of **stimulus generalisation**. If the buzzer was frequently sounded but never paired with the food, the dog will soon 'learn' not to respond with salivation – extinction of that response has occurred. If the bell is still occasionally paired with the food, the dog will salivate to the sound of the bell but not the buzzer. **Stimulus discrimination** has now taken place.

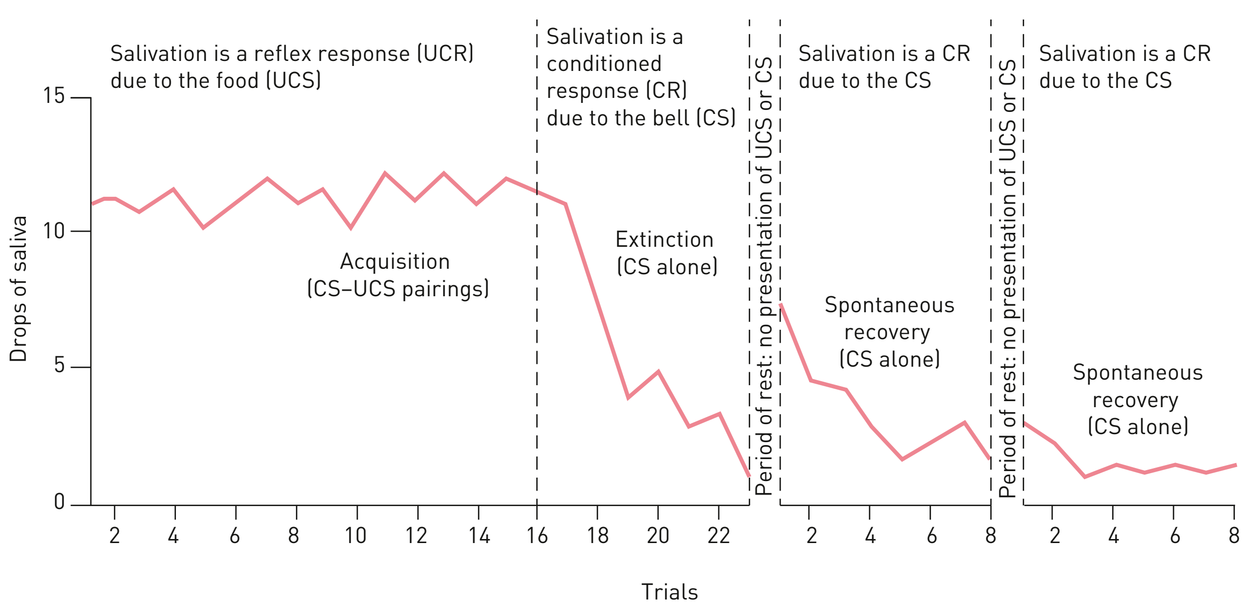


FIGURE 13.4 Learning, extinction and spontaneous recovery in classical conditioning

CASE STUDY

HUGO'S STORY

Consider the following (true) story.

Hugo, a middle-aged man, was walking along the footpath lost in thought, when a girl walked past him in the opposite direction. Hugo didn't even notice her but suddenly he caught her scent and experienced a feeling of pleasure. Realising that there was no obvious reason for this feeling, he asked his friend, a psychologist, what had occurred.

'Did you recognise the scent?' asked the psychologist.

'Yes, it was the perfume my first girlfriend used to wear, when I was 17!' Hugo laughed.

'That's it, then,' replied the psychologist. 'You have been conditioned to experience feelings of pleasure in response to that particular scent!'

'What, after 30 years?'

'Oh yes, it has become a classically conditioned response. Unless it is extinguished, it will continue to happen – forever!'

Examples of classical conditioning in practice

Classical conditioning is happening all around us – and happening to us – all the time. For example, if you start to feel happy because you are walking down the street where your boyfriend/girlfriend lives, that's because you've been classically conditioned! The following are some common examples.

SIMPLE BEHAVIOUR (CONDITIONED REFLEXES)

- Any mother who has breastfed her baby will tell you about this response: when it is approaching feeding time and she hears or sees her baby, the breastmilk will be suddenly 'let down' and start to flow from her.
- People who have been 'swooped' by magpies will often develop feelings of anxiety when they see a magpie sitting in a tree and may even experience the anxiety when other birds are seen (stimulus generalisation). If this fear is reinforced by extreme 'swooping' events, it may become strong enough to be a **phobia**.

REVIEW 13.1

1 Define classical conditioning.
2 Explain the difference between the neutral stimulus and the conditioned stimulus.
3 What happens at each stage of the classical conditioning process?
4 It is quite common for pet owners to notice that their dog or cat anticipates being fed in response to a particular neutral behaviour such as the opening of a cupboard or the sound of a can opener in operation. Using the classical conditioning model, explain how a pet might initially have associated the sound of the cupboard opening or the can opener being used with being fed. Describe the three stages of classical conditioning using the pet example (this can also be shown in the form of a sequential flow chart).
5 Using your own examples, explain the following terms: extinction, spontaneous recovery, stimulus discrimination and stimulus generalisation.

COMPLEX BEHAVIOURS (PHOBIAS)

- Phobias are intense, irrational and persistent fears of specific objects or situations. These are often acquired by classical conditioning. See Chapter 20 for a detailed explanation of phobias.

Classical conditioning applied in psychotherapy

Graduated exposure

Classical conditioning has been successfully applied in behavioural therapies, such as dealing with phobias, through **graduated exposure** and **systematic desensitisation**. This therapy involves the person being taught relaxation techniques followed by the gradual exposure to the feared object or animal over several sessions.

A person with a phobia of snakes, for example, will be taught relaxation techniques such as *breathing relaxation* or *progressive muscle relaxation* that they will use during the course of their treatment. The psychologist begins by showing a drawing of a snake and giving the person time to practise using the relaxation technique to control their fear.

FIGURE 13.5 Photos of snakes in different circumstances provoke different levels of anxiety.

Over the next few sessions, the person will eventually be exposed to increasingly frightening snake-related stimuli and will use the relaxation technique to reduce the level of arousal. Stimuli that provoke increasing anxiety in someone with a snake phobia might include:

- a black-and-white illustration of a snake
- a realistic painting of a snake
- a photograph of a snake in the distance
- a close-up photograph of a snake
- a photograph of someone handling a snake
- touching snake skin
- being in the same room as a live snake in an aquarium case
- being in the same room as a live snake being held by someone else
- handling a live snake.

Obviously, a therapist would not want the patient to become relaxed to the point of being careless when around snakes that may be dangerous. The aim is to make the patient's response rational and at a reasonable level. This type of therapy is covered in detail in Chapter 18.

Flooding

Flooding is another exposure technique based on classical conditioning. While graduated exposure may use other types of exposure, such as visualisation techniques or imagination, flooding uses actual exposure to the feared stimulus at a level greater than usual. Under controlled conditions, a patient is placed in contact with the stimulus that provoked the original trauma. The therapist helps the patient use relaxation techniques in order to calm themselves. The theory, of course, is that the patient comes to associate a relaxation response with the objects that previously caused fear.

This is not a commonly used technique – can you imagine a person with a spider phobia being confronted with a table-top crawling with large spiders? Careful control is needed to ensure that there are no ill-effects.

Aversion therapy

Aversion therapy is another application of classical conditioning where a person with an unwanted behaviour learns to associate the unwanted behaviour with an unpleasant event. For example, in order to get you to stop biting your fingernails, a substance that tastes very bitter might be painted on your fingers so that every time you bite your nails, you taste something horrible. In theory, this repeated association between the unwanted behaviour and the unpleasant-tasting substance will stop you from biting your nails. The 1972 movie *A Clockwork Orange* used an extreme form of aversion therapy to change the violent behaviour of a young man.

In adults, aversion therapy is widely used in the treatment of people who wish to stop smoking or drinking alcohol. For example, in the treatment of alcoholism, patients might be given a drug called Antabuse to help them stop drinking. After taking Antabuse and drinking alcohol, the concentration of acetaldehyde (one of the major causes of hangover symptoms) in the blood will be up to 10 times higher than

FIGURE 13.6 Flooding uses actual exposure to the feared stimulus at a level greater than usual.

after drinking the same amount of alcohol alone. About ten minutes after alcohol intake, the patient may show symptoms of a severe hangover for periods of up to several hours. Nausea, vomiting, increased heart rate, flushing, mental confusion and throbbing headache will all develop.

In terms of classical conditioning this means:

BEFORE CONDITIONING		
neutral stimulus (NS) *alcohol*	→	no response
unconditioned stimulus (UCS) *Antabuse*	→	unconditioned response (UCR) *hangover symptoms: due to Antabuse*

DURING CONDITIONING		
NS + UCS *alcohol* + *Antabuse*	→	UCR *hangover symptoms: due to Antabuse*
Repeated pairings of these two stimuli		

AFTER CONDITIONING		
conditioned stimulus (CS) *alcohol*	→	conditioned response (CR) *hangover symptoms: due to alcohol*

FIGURE 13.7 Aversion therapy: classical conditioning in practice

REVIEW 13.2

1 What are the key differences between 'graduated exposure' and 'flooding'? Explain, using your own example.
2 Hab-Bitual Scaredy goes to see his psychologist because of his fear of flies. Whenever a fly buzzes around him, he breaks out into a sweat, begins screaming and finds the closest place to hide. Even photos of flies upset him. Suggest a method that Hab-Bitual Scaredy's psychologist could use to help him get over his phobia of flies. Outline the steps that might be involved.
3 Explain the process used in aversion therapy and how it is usually applied.

FIGURE 13.8 Even photos of flies can scare some people with phobias.

Did you know?

What became of Little Albert? There has been much interest in this question over the past 90 years! Unfortunately, the story does not have a happy ending (although this was not as a result of Watson's experiment).

'Albert' was almost certainly the pseudonym given by Watson to a little boy named Douglas Merritte, who was the son of a woman employed at a pediatric facility on the Johns Hopkins University campus. Douglas became a sickly child who tragically died of hydrocephalus (water on the brain) on 10 May 1925 at the age of six.

John B. Watson and 'Little Albert'

One of the most famous (and infamous) pieces of research in the area of classical conditioning and behaviourism was carried out in 1920 by John B. Watson, an American psychologist.

Little Albert (a pseudonym), who was nine months of age, was 'borrowed' from a child-care facility at prestigious Johns Hopkins University. Little Albert, a placid child who was selected on the grounds that he had never been seen to cry, was placed on the floor in Watson's laboratory and allowed to play with a white rat. Little Albert showed no fear; nor did he respond negatively to other animals and objects such as a rabbit, a dog, a monkey, cotton wool and human masks. He did, however, show fear when a steel bar was struck with a hammer, making a loud noise just behind his back. Two months later, Watson paired the rat with a loud noise by striking an iron bar with a hammer just behind Albert's head when he touched the rat. At first, although this caused Albert to jump in fear, he did not cry. After seven pairings of the rat and the noise (over two sessions, one week apart), Albert did cry and, soon afterwards, when the rat was presented but no noise sounded, Albert cried and tried to crawl away from it.

Little Albert also showed fear when presented with a dog, a rabbit, a fur coat and a Santa Claus mask, though it is interesting to note that the fear response was much reduced when he was in a different and much larger laboratory.

Details of the research can be found on the York University website.

This research would certainly contravene many ethical principles that are in place today and is specifically addressed in the section on 'Research methods and ethical principles' (pages 352–7).

INVESTIGATE 13.1

VISUAL PRESENTATION

1 Use PowerPoint to create an animation or draw a series of cartoons to show the sequence of Little Albert's conditioning. Set your cartoon out in terms of the three steps of classical conditioning:

> before conditioning
> during acquisition
> after conditioning.

Use speech balloons or comment bubbles to explain each step in terms of classical conditioning and apply the following terms: *neutral stimulus*, *unconditioned stimulus*, *unconditioned response*, *conditioned stimulus* and *conditioned response*.

2 Answer the following questions in a written report, on a poster or as an oral presentation.

a What was the aim of Watson's research?
b Identify two ethical principles that were breached in this study.
c Explain why the Little Albert study was not an experiment.
d Suggest an alternative method of conducting this research.

FIGURE 13.9 The Little Albert research would contravene many ethical principles in place today.

→ CHAPTER SUMMARY

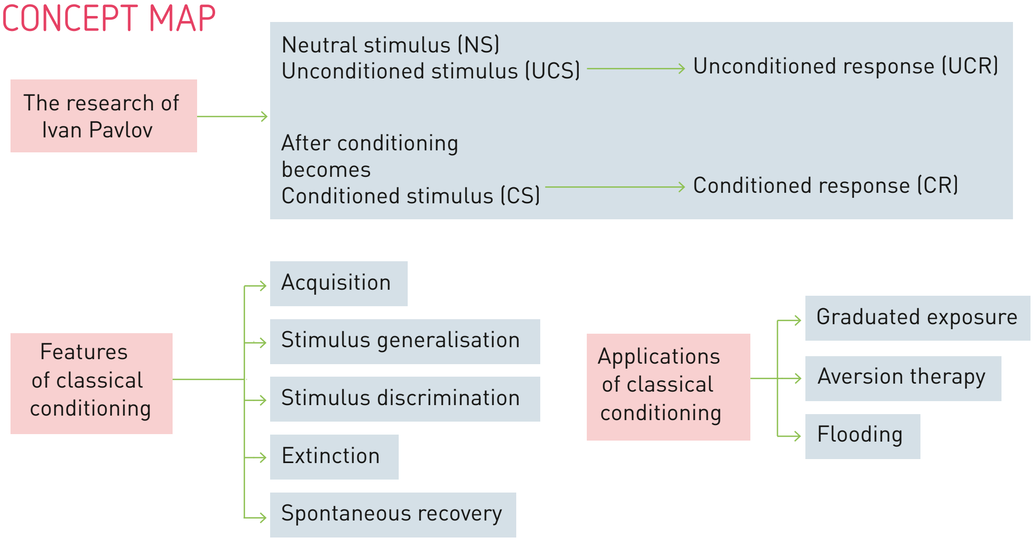
13:

- Many behaviours can be learnt through a very simple learning process, known as classical conditioning, discovered by Ivan Pavlov in the early twentieth century.
- In his work with dogs, Pavlov experimented by associating various sounds with food and found that after a few trials the dogs could be conditioned to salivate when the sound occurred.
- Extinction will occur if the conditioned stimulus (CS) occurs many times without ever again being paired with the unconditioned stimulus (UCS). The strength of the response will gradually reduce until there is no conditioned response (CR) when the CS is presented.
- Spontaneous recovery is said to have occurred if, after a pause of some time during which the CS is never presented, re-introduction of the CS will again cause a low level of the CR.
- After conditioning has occurred, the subject may show the CR on presentation of a stimulus that is similar, but not identical, to the CS. (Pavlov discovered that after a dog had been conditioned to salivate in response to the sound of a bell, it would also salivate when a buzzer was sounded even though the buzzer had never been paired with the UCS). This is a demonstration of stimulus generalisation.

- If the stimulus that is similar to the CS is frequently presented but never paired with the UCS, there will soon be no response. If the CS is still occasionally paired with the UCS, the response will occur only with the CS, not with a similar stimulus; stimulus discrimination has now occurred.
- Acquisition, maintenance, extinction and spontaneous recovery may be illustrated with a learning curve.
- In humans, many reflex responses can be conditioned to occur as a result of a previously neutral stimulus. An example is your mouth watering at the sight of a photograph of your favourite meal.
- Phobias are intense, irrational, and persistent fears of specific objects or situations. These are often acquired by classical conditioning.
- Classical conditioning is applied in behavioural therapies such as dealing with phobias through graduated exposure. This therapy involves a person being taught relaxation techniques such as breathing relaxation or progressive muscle relaxation, followed by the gradual exposure to increasing levels of the feared object or animal over several sessions.
- Flooding is another exposure technique based on classical conditioning. It uses actual exposure to the feared stimulus at a level greater than usual. The therapist helps the patient use relaxation techniques in order to calm themselves when exposed to the fear-provoking stimulus. The theory is that the patient comes to associate a relaxation response with the objects that previously caused fear. This is not a commonly used technique and careful control is needed to ensure no ill-effects occur.
- Aversion therapy is another application of classical conditioning where a person with an unwanted behaviour (for example, nail biting, alcoholism) learns to associate the unwanted behaviour with an unpleasant event. The repeated association between the unwanted behaviour and the unpleasant outcome stops the unwanted behaviour.
- One of the most famous (and infamous) cases in the area of classical conditioning was the research conducted by John B. Watson with 'Little Albert'. This experiment contravened many ethical principles that are in place today.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

association
aversion therapy
classical (Pavlovian) conditioning
conditioned response
conditioned stimulus
extinction
flooding
graduated exposure
learning
learning curve
neutral stimulus
Pavlov's research
spontaneous recovery
stimulus discrimination
stimulus generalisation
unconditioned (reflex) response
unconditioned stimulus

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of:

- classical conditioning in everyday life
  - simple behaviours
  - complex behaviours
- applications of classical conditioning
  - graduated exposure and systematic desensitisation
  - flooding
  - aversion therapy
- John B. Watson and 'Little Albert'
  - consideration of ethical principles in Watson's experiments in classical conditioning.

RESEARCH METHODS

For the exam, you must be able to:

- → use your knowledge of research methods to evaluate a research study
- → use your knowledge and understanding from this chapter to apply to a related research study.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

The questions that follow may be answered by information contained in this chapter but also refer to the 'Behaviours not dependent on learning' section on pages 361–3.

1 When babies are first born, they are able to feed by sucking. As they get older they are weaned onto solid food that requires them to chew. Sucking can be described as a ______ while chewing is a ______.

- a species-specific behaviour; fixed-action pattern
- b reflexive response; behaviour due to maturation
- c response due to classical conditioning; response due to operant conditioning
- d behaviour due to maturation; response due to modelling

2 Newborn calves can stand and walk within minutes of being born; newborn wolf cubs are blind and cannot move around for several days after birth. This difference is due to evolutionary pressure influencing:

- a species-specific behaviour.
- b reflexive responses.
- c fixed-action patterns.
- d behaviours due to maturation.

3 Which of the following is *not* an essential feature of learning?

- a there must be a change in behaviour
- b the organism must have learnt from experience
- c the organism must be aware of the learning taking place
- d the learning must be long-lasting

4 After classical conditioning, learning *not* to respond to a stimulus that is similar but not identical to the conditioned stimulus is called:

- a response generalisation.
- b stimulus generalisation.
- c response discrimination.
- d stimulus discrimination.

Questions 5 and 6 refer to the following information.

Max, who on his P-plates, was driving friends home one day when one of his friends in the back seat turned on a blue flashing light. Max immediately panicked: his heart raced and his hands started to sweat. Soon, however, he realised that this was not a police car following him and he calmed down.

5 In terms of classical conditioning, what was Max's emotional reaction an example of?

- a an unconditioned response to the blue flashing light
- b a conditioned response to the blue flashing light
- c a conditioned stimulus causing fear
- d an unconditioned stimulus causing fear

6 The fact that the response was shown to be a harmless stimulus that had not been experienced before suggests that this was a case of:

- a stimulus generalisation.
- b stimulus discrimination.
- c response discrimination.
- d response generalisation.

7 In the process of classical conditioning, when the organism shows the response to a stimulus that is neither the original unconditioned stimulus nor the conditioned stimulus it is said that ___________ has occurred.

a response generalisation
b stimulus generalisation
c response discrimination
d stimulus discrimination

8 For several weeks, Tom's grandmother has been boarding his dog while he's been away on holidays. Tom's grandmother opens cans of dog food with her electric can-opener. When he brings his dog home, Tom notices that it begins to salivate when Tom turns on the electric fan in the laundry. After about five times of doing this, Tom turns on the fan and the dog does not respond. What has the dog demonstrated?

a response discrimination followed by response generalisation
b response generalisation followed by response discrimination
c stimulus discrimination followed by stimulus generalisation
d stimulus generalisation followed by stimulus discrimination

9 After two days in which he does not turn on the fan, Tom uses the laundry again. He turns on the fan and the dog begins to salivate. The dog has now shown:

a response re-generalisation.
b response re-acquisition.
c response re-learning.
d spontaneous recovery.

10 In classical conditioning, the conditioned response (CR) will gradually be extinguished if the conditioned stimulus (CS) is continually presented alone. If the unconditioned stimulus (UCS) is again presented together with the CS, the CS will rapidly begin to elicit the CR. This is a process of ___________ with the unconditioned stimulus acting as a ___________.

a re-acquisition; reinforcer
b conditioning; reward
c re-learning; reinforcer
d re-learning; reward

11 In the process of classical conditioning, which of the following is likely to occur when the UCS and NS are no longer paired?

a The rate of responding will immediately decline.
b The rate of responding will become erratic at first and then show steady decline.
c The rate of responding will remain constant for a few trials and then decline.
d The rate of responding will decline at first and then remain steady.

12 Aversion therapy has been used to:

a help alcoholics to stop drinking alcohol.
b help people to quit smoking.
c stop children from biting their fingernails.
d all of the above.

13 Graduated exposure has been used to treat

a alcoholism
b fear of snakes
c generalised anxiety disorder
d eating disorders

14 To use graduated exposure, the first step in the process is to

a work out a hierarchy of fear objects with the patient
b expose the patient to intense levels of the fear object
c expose the patient to low levels of the fear object
d teach the patient relaxation techniques

SHORT ANSWER

15 Define 'learning'.

1 mark

16 a Give an example of a reflex action.

1 mark

b What is it that distinguishes this behaviour from a fixed-action pattern?

2 marks

17 Using the language of classical conditioning, explain exactly how Pavlov's dogs were conditioned to salivate at the sound of a bell.

3 marks

18 Gustav sometimes experiences headaches for which he takes paracetamol tablets – these work well and the headaches become much less severe. One day, he takes tablets and his headache clears as usual, but he later finds that he took sugar pills rather than paracetamol. Using classical conditioning theory, explain why Gustav's headache may have been cleared by the familiar action of taking a tablet.

3 marks

19 Explain how graduated exposure could be used to help Harry, who is scared to leave the house because of his fear of open spaces.

2 marks

20 What is 'flooding'? What problems could arise if the technique of flooding was used to attempt to cure Marcia of her fear of snakes?

2 marks

21 Copy and complete the following diagram for Watson's conditioning of Little Albert.

4 marks

Before conditioning

NS ______________________________

UCS ______________ UCR ______________

During conditioning

NS

+

UCS ______________ UCR ______________

After conditioning

CS ______________ CR ______________

TRIAL-AND-ERROR LEARNING

KEY KNOWLEDGE

Trial-and-error learning

(VCE Study Design 2013)

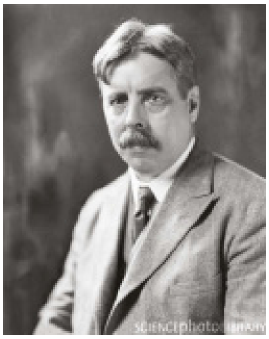


FIGURE 1
Edward Lee Thorndike (1874–1949)

At the same time as Pavlov was classically conditioning his dogs in St Petersburg, Edward Thorndike was teaching cats to escape from a 'puzzle box' in New York.

Thorndike never earned a Nobel Prize (as Pavlov did in 1904) but he made major contributions to psychology: he developed the first widely used 'group' IQ tests, was president of the American Psychological Association in 1911 and president of the American Psychometric Association in 1937. Above all, he was a very significant pioneer investigating the psychology of learning.

Thorndike placed a hungry cat in a 'puzzle box' with a plate of food outside the box (see Figure 2). The cat was keen to escape but the only way out of the box was to pull a string that opened the door.

After making random movements attempting to escape (trial-and-error), the cat eventually pulled the string and was rewarded by being able to eat the food.

When the cat became hungry again, Thorndike put it back in the box with the food outside and again timed how long it took the cat to escape. He repeated this many times. The results are shown in Figure 3.

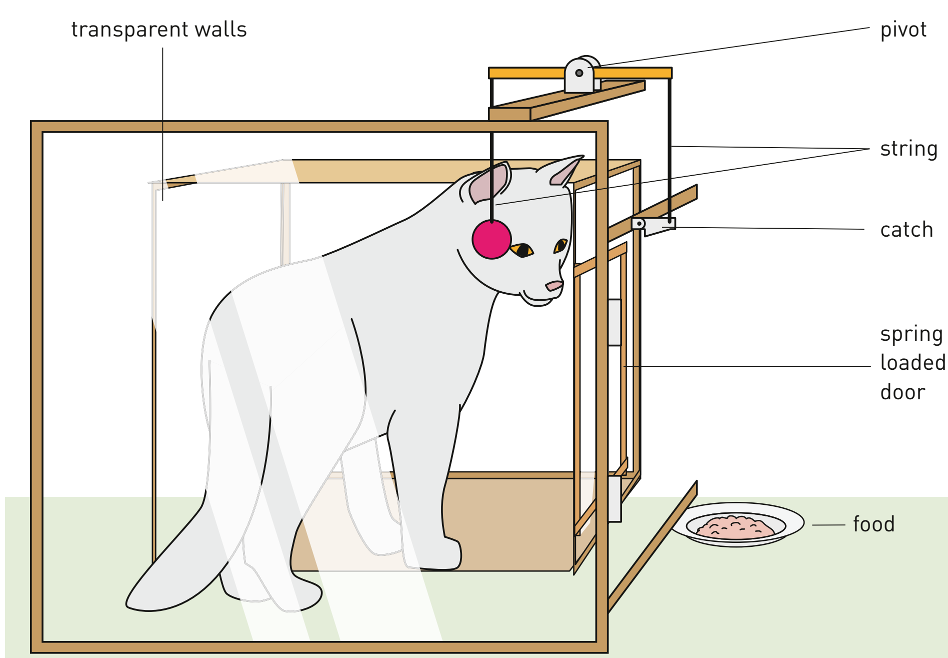


FIGURE 2 Hungry cat in a puzzle box

Looking at the results, we can see that there was no sudden drop in the time taken to escape: in trial 11 it took over eight for the cat to escape although trial 1 took less than three minutes. Instead, the average reduction in time taken was gradual as trial-and-error learning took place.

Thorndike reasoned that if the animals were showing insight, then the time taken to escape would suddenly drop to a negligible period, which would be shown in the learning curve as an abrupt drop. If the cat was using a more ordinary method of trial and error, the drop in time would be more gradual. His finding was that cats consistently showed gradual learning.

Thorndike specified three 'laws' that maximise learning:

1 the 'law of effect' that states that behaviour becomes controlled by its consequences – if it feels good, we do it again; if it feels bad (or has no outcome at all), we don't. This law is now accepted as the definition of operant conditioning
2 the 'law of recency' that states that the most recent response is the one with the greatest effect
3 the 'law of exercise' that states that stimulus-response connections are strengthened through repetition and weakened when there is no repetition.

Did you know?

Thorndike also stated several other 'laws of learning'. These also help to describe how learning can be maximised, for example:

The 'law of readiness':

a when someone is ready to perform an act, performing it gives satisfaction (positive outcome)
b when someone is ready to perform some act, to fail to do so causes frustration (negative outcome)
c when someone is not ready to perform some act but is forced to do so, it causes frustration (negative outcome)

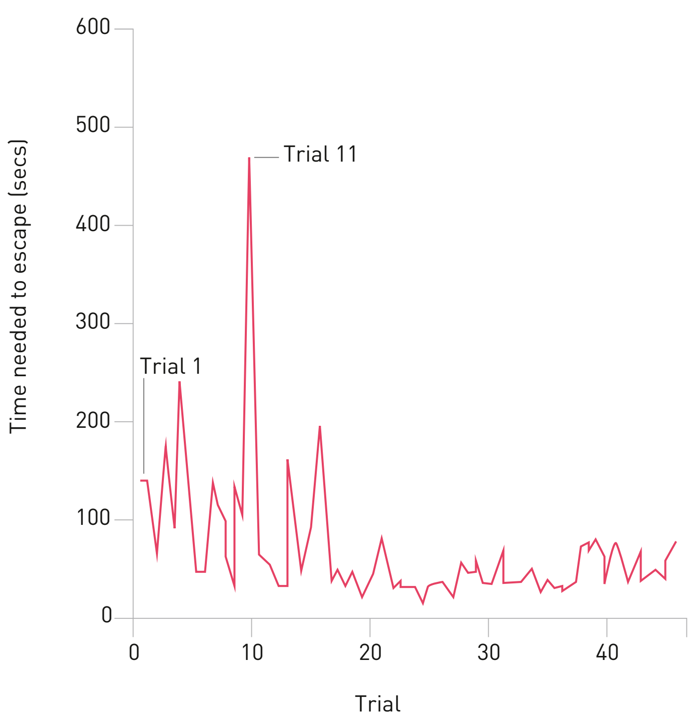
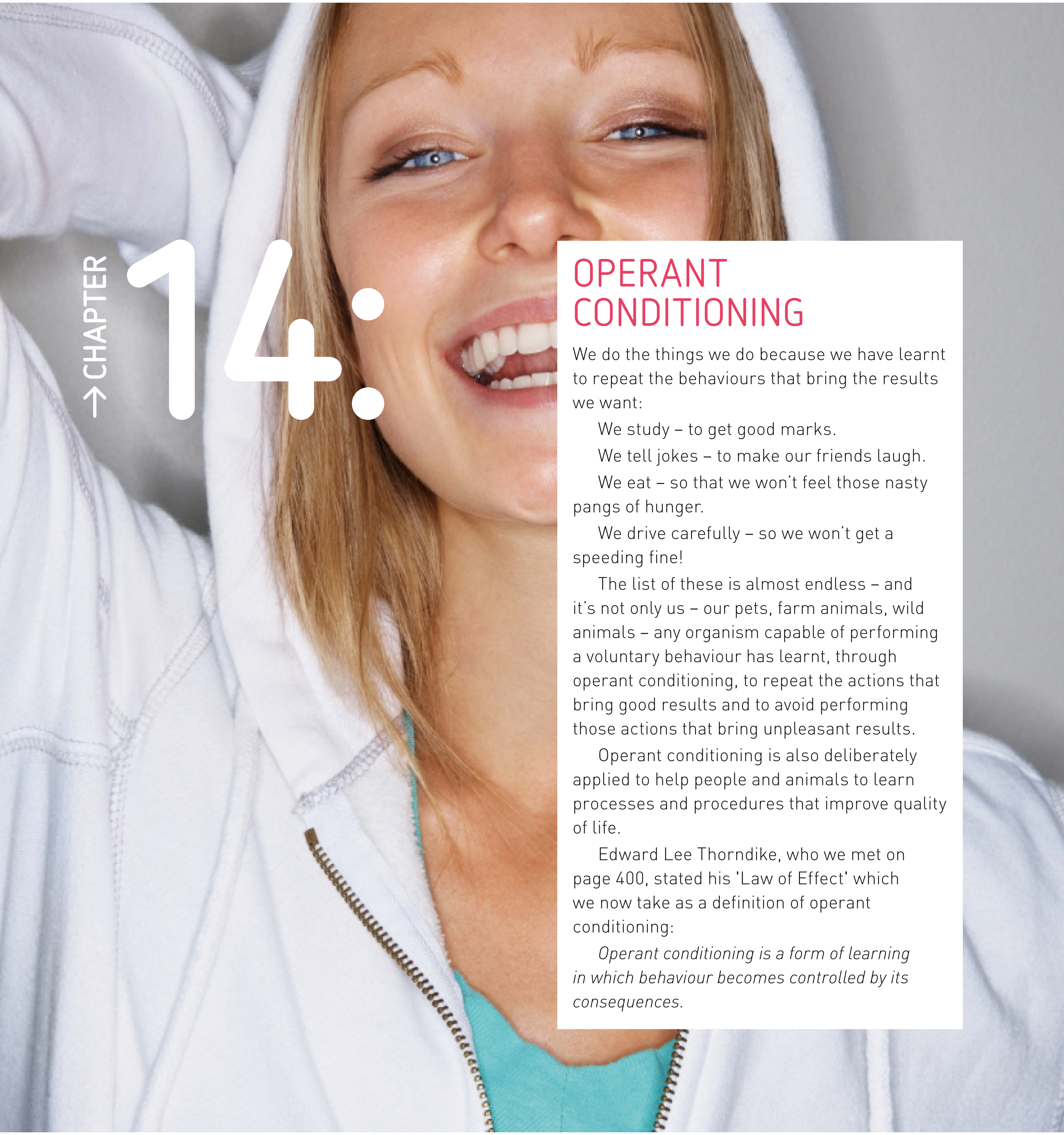


FIGURE 3 Trial-and-error learning showing the time taken for the cat to escape from the puzzle-box

1 REVIEW

1 What is 'trial-and-error' learning?
2 a Describe Thorndike's puzzle-box experiment.
  b Draw a graph to illustrate change in 'time to escape' compared with number of trials.
3 State Thorndike's 'law of effect'. What form of learning is described by this 'law'?



CHAPTER 14:

OPERANT CONDITIONING

We do the things we do because we have learnt to repeat the behaviours that bring the results we want:

We study – to get good marks.

We tell jokes – to make our friends laugh.

We eat – so that we won't feel those nasty pangs of hunger.

We drive carefully – so we won't get a speeding fine!

The list of these is almost endless – and it's not only us – our pets, farm animals, wild animals – any organism capable of performing a voluntary behaviour has learnt, through operant conditioning, to repeat the actions that bring good results and to avoid performing those actions that bring unpleasant results.

Operant conditioning is also deliberately applied to help people and animals to learn processes and procedures that improve quality of life.

Edward Lee Thorndike, who we met on page 400, stated his 'Law of Effect' which we now take as a definition of operant conditioning:

Operant conditioning is a form of learning in which behaviour becomes controlled by its consequences.

KEY KNOWLEDGE

Applications, and comparisons of, learning theories:

- 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

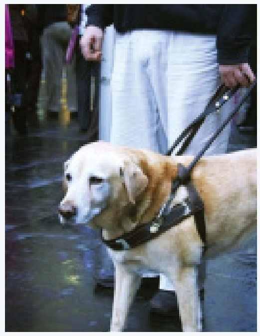
(VCE Study Design 2013)

Identifying behaviour and consequences

CHAPTER OVERVIEW

Skinner and the three-phase model of operant conditioning	The D-B-C (A-B-C) of operant conditioning
Elements of operant conditioning	Reinforcers and punishers > Punishment and negative reinforcement Schedules of reinforcement Other elements of operant conditioning > Extinction and spontaneous recovery > Generalisation and discrimination Shaping > Shaping in everyday life > Animal training Token economies

Consider the following scenarios.



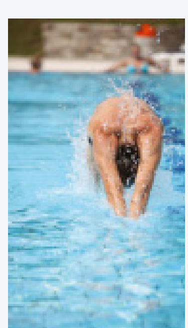
- **Scenario 1:** Your blind friend's guide dog stops at the edge of the pavement until there are no cars passing.

- **Scenario 2:** Your little sister, Emily, is trying to say the word 'hospital'.
- You: 'Look, there's a hospital, Em!'
- Emily: 'Hopil.'
- You: 'Good try. Hos-pit-al.'
- Emily: 'Hos-pil.'
- You: 'That's great, nearly there. Try again – hos-pit-al.'
- Emily: 'Hos-pilt.'
- You: 'Ever-so nearly, clever girl. Hos-pit-al.'
- Emily: 'Hos-pit-al.'
- You: 'Yay! Good girl!'
- Emily: 'Yay!' [big smile] 'Hospital, hospital!'

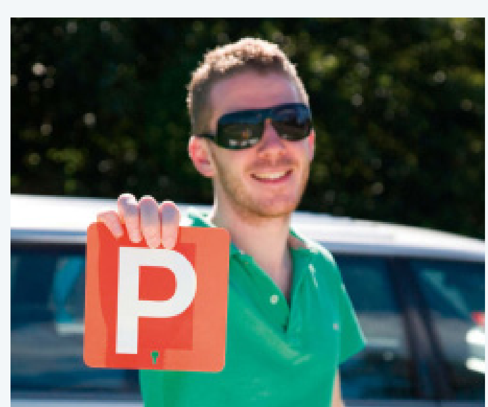
- **Scenario 3:** Your parents offer to give you $50 for every SAC in which you get an A+; you work very hard!

- **Scenario 4:** You bring your girlfriend/boyfriend a special card for your six-month anniversary and you get a huge, loving hug.

- **Scenario 5:** You are training more than four hours each day to get into the AIS swimming squad.



- **Scenario 6:** When you first got your P-plates, you were excited to drive to all your friends' houses. A few weeks later, you got a letter saying you had been 'pinged' by a speed camera for doing 65 kph in a 60 kph zone; you were fined over $150 and you lost one demerit point. Since then, you have become a very careful and observant driver.



1 For each of the previous scenarios:
   - identify the behaviour
   - identify the consequences.
2 Provide two examples of your own.

14.1 REVIEW

Skinner and the three-phase model of operant conditioning

B. F. Skinner began experimenting with rats and pigeons in the 1930s.

He trained the animals to perform certain behaviours, such as turning in a circle when a light flashed or pressing a lever when a bell rang. He trained them by simply rewarding them with food if they performed the behaviour; after only a few training trials, the pigeons would perform the behaviour every time.

Skinner called this type of learning **operant conditioning** because animals and people learn to operate on their environment to produce desired consequences. An operant is a response that occurs without any stimulus – this is a **voluntary behaviour** that acts upon the environment in the same way each time.

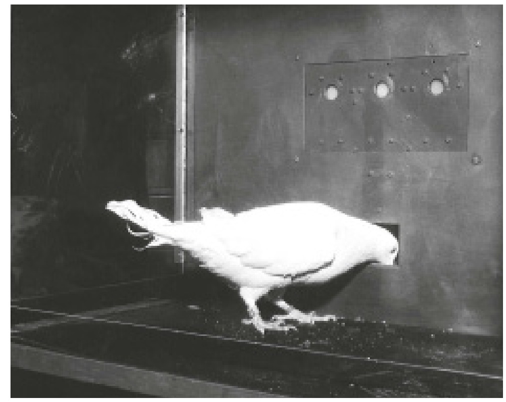


FIGURE 14.1 Skinner used pigeons in his experiments. A pigeon can be trained to press either the red or blue button to receive a food reward.

The D-B-C of operant conditioning

One thing that Skinner noticed was that the conditions needed to be right before the behaviour occurred. These can be referred to as the D-B-C of operant conditioning: the **D**iscriminative stimulus (the environment) that makes conditions right for the **B**ehaviour to follow and be reinforced by its **C**onsequences.

Skinner described the **discriminative stimulus** as the condition that influences behaviour by predicting the likely outcome of a behaviour. A good example of this is found when a guy wants to ask a girl out on a date: if she has smiled at him, laughed with him and her body language generally has shown encouragement, he will be more likely to show the behaviour (asking) that will lead to the consequence (accepting the invitation). NB: The discriminative stimulus can also be referred to as the **A**ntecedent condition, and some people refer to it as the A-B-C of operant conditioning.

Identify the D, B and C in the following examples:
- As I am driving to work, I see that the traffic light is red. I stop the car (and therefore avoid a traffic accident).
- I am cold. I put on a jumper and feel warm.
- Your mobile phone rings so you press the 'receive' button and talk to your friend.
- Johnny's mother often buys him a chocolate when they go to the supermarket. When they went shopping the other day, Johnny screamed and screamed until his mother gave him a chocolate. (Note: two people are being conditioned here; provide an answer for both Johnny and his mother.)

14.2 REVIEW

A very important contribution that Skinner made to psychological research was the invention of the Skinner box (see Figure 14.2). The important characteristics of this device were that it had:

- a means of giving a signal (a light or buzzer)
- a means of recording a response (a bar, button, lever or touch pad)
- a means of providing a reward (food) or punisher (mild electric shock)
- a means of automatically recording that the response had been made (a cumulative recorder).

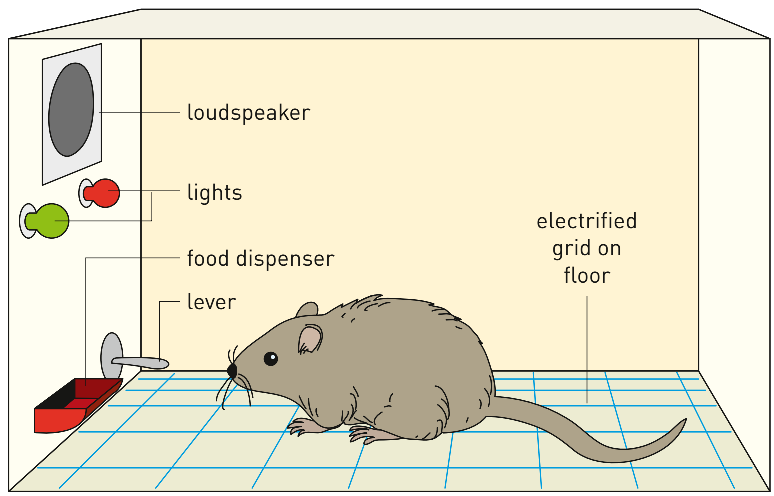


FIGURE 14.2 Skinner box

The Skinner box revolutionalised research into learning. Previously, an assistant would need to stand beside each animal, give the signal, provide the consequence and record the event – a very time-consuming, labour-intensive and expensive process. With the Skinner box, hundreds of animals could take part in the research at the same time. Results therefore became very robust, since the more times the behaviour could be recorded for different animals, the more likely it was that generalisation of the results was appropriate.

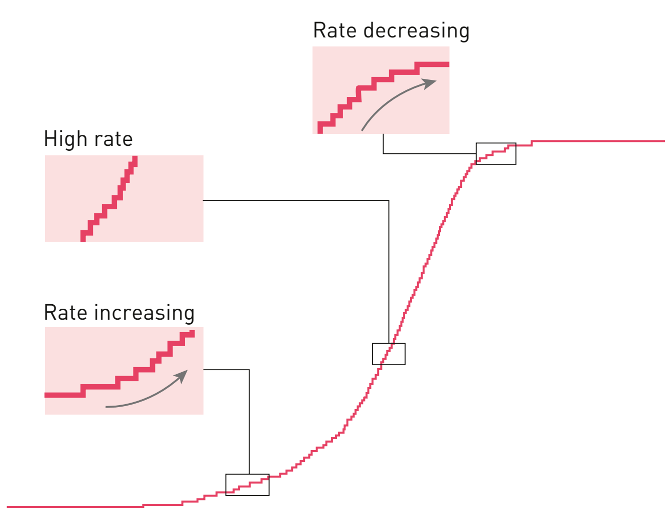


FIGURE 14.3 Cumulative response graph generated by a Skinner box, showing rate of learning at the beginning, middle and end of training.

Elements of operant conditioning

Reinforcers and punishers

Reinforcers and punishers are key core elements in operant conditioning. They may be either positive or negative.

- **Reinforcer**: any stimulus (action or event) that strengthens or increases the likelihood of a response (behaviour).
  - Positive reinforcer: a reward which strengthens a response by providing a pleasant or satisfying consequence. If you take a bite of a delicious piece of cake, you are very likely to have another bite.
  - Negative reinforcer: the removal, reduction, or prevention of an unpleasant stimulus. If you wake up with a headache the day after a rock concert and are able to fix it by taking a particular headache tablet, it makes it very likely that you will take that particular headache tablet any time you want to get rid of a headache.
- **Punisher**: any stimulus (action or event) that weakens or decreases the likelihood of a response (behaviour). Punishers are any consequences that lead to a decrease in a given response. The consequence does not need to be intended to be a punisher! For example, a quiet student who is 'fussed over' by the teacher every time she offers a response in class, may see such attention as threatening (punishing) rather than rewarding (reinforcing), as the teacher had probably intended.

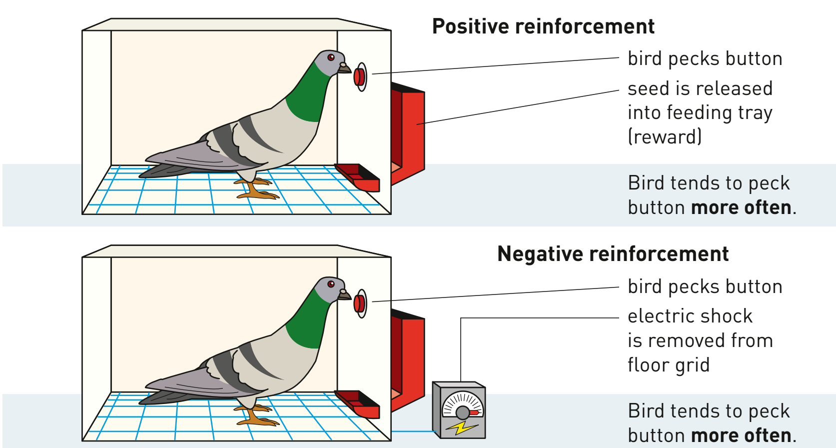


FIGURE 14.4 Positive and negative reinforcement

- **Punishment** (sometimes called positive punishment): a behaviour followed by a negative experience. For example, if you stand up quickly in an aeroplane and bang your head on the overhead luggage-locker, you will probably stand up more slowly and carefully next time! A parent yells at a child who has drawn on his bedroom wall; a mother cat picks up a kitten that has run away and shakes him.
- **Response cost** (could be called negative punishment): a form of punishment that entails something desirable being removed, such as being grounded (losing freedom) or having your mobile phone taken away, or being fined for speeding on the roads (losing money).

Did you know?

Do you feel that Friday school detentions are not a good system for changing a student's behaviour? There are good reasons for that!

- The punishment is not immediate (for example, throwing a pen across the classroom on Tuesday and being kept in at 3.30 pm on Friday).
- The punishment is not linked with the behaviour in the mind of the student (for example, cleaning the desks in a classroom has nothing to do with throwing a pen).
- The punishment is not linked with the person who was affected by the action (for example, the teacher taking detention is often not the classroom teacher).
- 'Good' behaviours have not been encouraged to replace the 'bad' behaviour.

PUNISHMENT AND NEGATIVE REINFORCEMENT

Punishment is distinct from negative reinforcement. Punishment decreases the probability of the response, while negative reinforcement (like positive reinforcement) increases the probability of a response.

Although both negative reinforcement and punishment involve an unpleasant stimulus (for example, a reprimand or a fine), it is considered punishment when this unpleasant stimulus follows the response (such as an inappropriate behaviour). It is considered negative reinforcement when the response (the behaviour) stops an existing unpleasant stimulus.

There are several side effects that result from punishment. Frustration, aggression and feelings of helplessness may develop in a person who is punished frequently, with the punished person feeling aggrieved and aggressive towards the person administering the punishment (for example judges are sometimes targeted as victims by criminals they have sentenced to prison). Children may resent teachers or parents who have punished them – even if the punishment was fair and appropriate – and the effects on their interpersonal relationships may be wide-ranging and long-lasting.

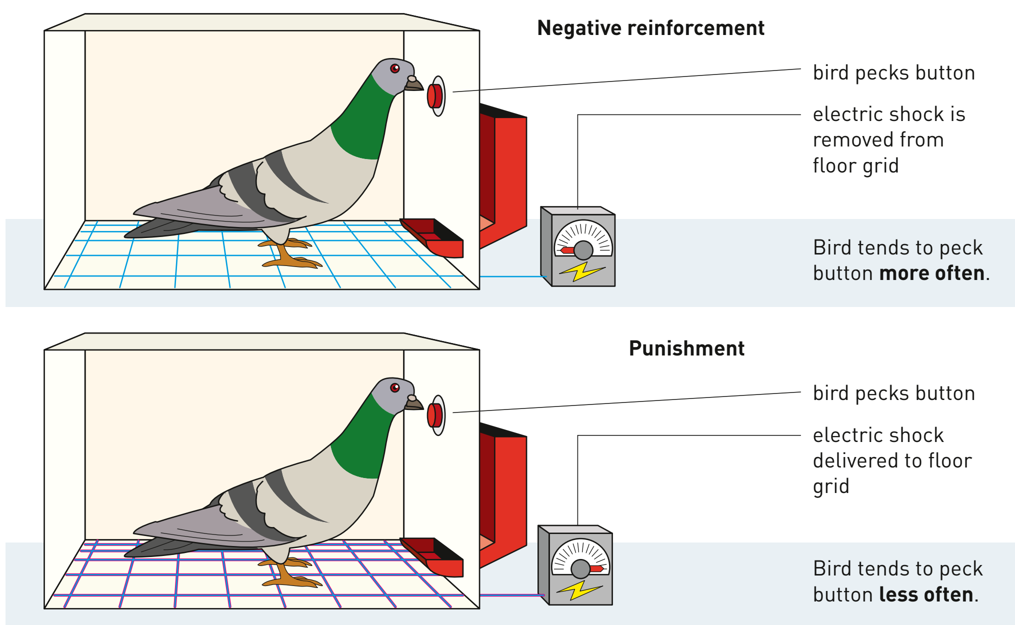


FIGURE 14.5 Punishment and negative reinforcement

Punishment can also have unintended outcomes. Administering the punishment may be an outlet for the frustrations of the punisher. Sometimes punishment is administered simply because it makes the punisher feel better, not because the person being punished deserves it.

Effective punishment needs to be brief, immediate and linked to the undesired behaviour in the mind of the person (or animal) being punished. It is only effective if a positive behaviour can be developed to replace the 'bad' behaviour.

14.3 REVIEW

1 What is the key difference between a reinforcer and a punisher?
2 What is the difference between positive reinforcement and negative reinforcement? Give an example to demonstrate your understanding.
3 Outline some possible side effects of punishment.
4 Outline conditions necessary for punishment to be effective.
5 Identify which elements of operant conditioning are present in the following scenarios (positive reinforcement, negative reinforcement, response cost and punishment):
   a patting your dog on the head when he sits on command
   b receiving a high score on your exam
   c having your mobile phone confiscated by your teacher after it rings during class
   d opening the door of a beeping microwave to take out your cooked dinner
   e a mother smacking her child
   f turning the air-conditioning on because you are hot

Schedules of reinforcement

Schedules of reinforcement – the frequency and manner in which a response is reinforced (or punished) – can have a major effect on changing behaviours.

Skinner aimed to find the most efficient way of training through operant conditioning. Would learning occur faster if every response was reinforced, or just some of them? Under what circumstances would learning be most resistant to extinction?

Skinner experimented with the following schedules of reinforcement:

- **Continuous reinforcement** (CRF): when a correct response is reinforced every time it is given. Behaviours are acquired rapidly using this schedule but it has very low resistance to extinction.
- **Partial reinforcement**: when only some correct responses are reinforced. Responses conditioned under partial reinforcement are acquired more slowly but take longer to extinguish than those conditioned using continuous reinforcement (see Figure 14.6). Different schedules of partial reinforcement are:
  - fixed interval schedule (FI) – reinforcement is delivered after a fixed time period (e.g. every 10 seconds), as long as at least one correct response has been given
  - fixed ratio schedule (FR) – reinforcement is delivered after a fixed number of correct responses (e.g. every tenth response)
  - variable interval schedule (VI) – reinforcement takes place on an average of a set time interval but not with regular frequency (e.g. every 10 seconds on average but with variations from 4 to 16 seconds)
  - variable ratio schedule (VR) – reinforcement takes place on the basis of a set average number of correct responses but is not regular in its occurrence (e.g. every tenth response on an average but with variations from the fifth to the fifteenth response).

Did you know?

There is another schedule, used in gambling, referred to as 'random ratio reinforcement.' It is just like 'variable ratio' except that there is no fixed mean number about which it varies. In random ratio, you may be reinforced three times in a row and then not for 100 trials – just like Tattslotto or 'the pokies'.

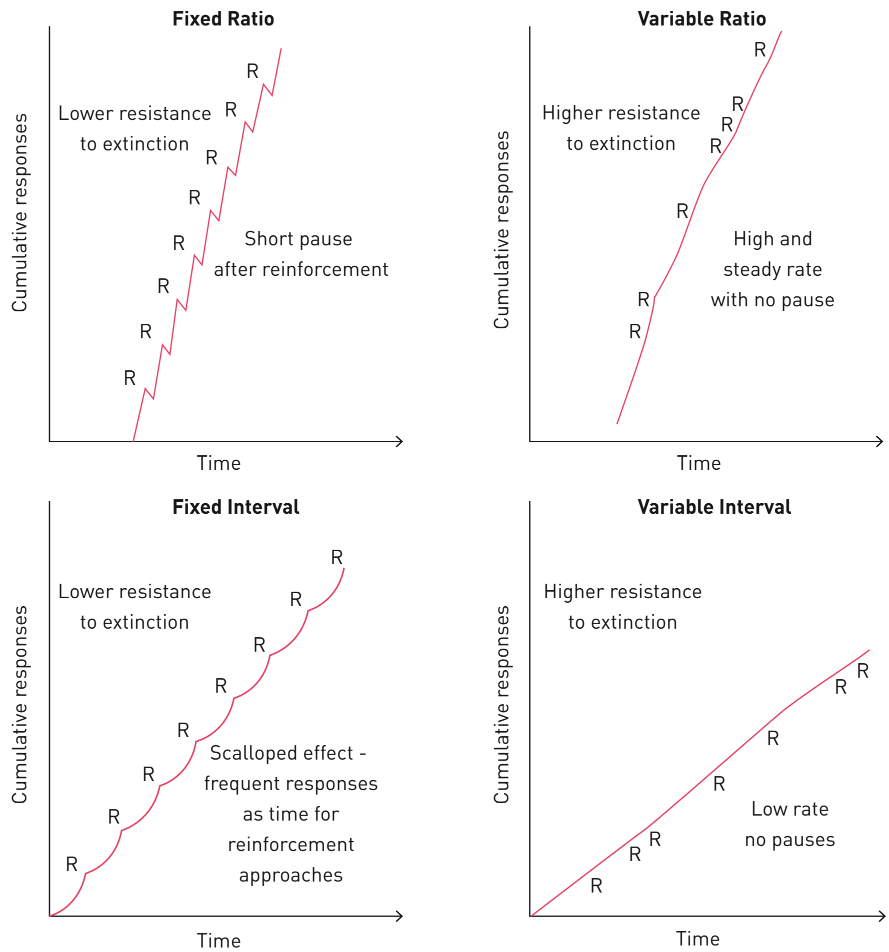


FIGURE 14.6 Schedules of partial reinforcement

REVIEW 14.4

1 Skinner experimented with continuous and partial reinforcement schedules. Overall, which of these two did he find most difficult to extinguish?
2 Explain the key difference(s) between the terms 'ratio' and 'interval'.
3 Explain what is meant by 'fixed' and 'variable' in terms of a partial reinforcement schedule.
4 Which are the most effective partial reinforcement schedules (hardest to extinguish)? Explain.
5 Which are the less effective reinforcement schedules (the easiest to extinguish)?
6 Provide your own examples for each of the following reinforcement schedules:
   a continuous
   b fixed ratio
   c fixed interval
   d variable ratio
   e variable interval.
7 What schedule of reinforcement is being used in each of the following examples?
   a Robert has lost some money on the 'pokies' but he keeps trying because he is sure he'll win it back in the end.
   b Jill is waiting with other pedestrians to cross the road. It seems to be taking ages for the light to change so she presses the button a few more times.
   c Maria is training her dog, Roger, to sit on command. Each time she says 'sit' and Roger does so, he gets a treat.

Other elements of operant conditioning

EXTINCTION AND SPONTANEOUS RECOVERY

Extinction is when the conditioned response disappears over time after reinforcement has ceased (see Figure 14.7). Spontaneous recovery is the reappearance of an extinguished response after a rest period.

GENERALISATION AND DISCRIMINATION

In operant conditioning, the terms 'generalisation' and 'discrimination' mainly refer to the discriminative stimulus (activating event).

Generalisation is where a behaviour is elicited as a result of a discriminative stimulus that is similar (but not identical) to the original; for example, your dog, who normally comes running when the electric tin-opener is used, might come running at the sound of the blender. Soon, if there is no reinforcement when responding to this noise, the dog will no longer act in this way with the blender, only with the tin-opener – the dog has learnt stimulus discrimination.

Discrimination takes place when a human or animal learns to know the circumstances under which responses will be reinforced and when they will not.

Shaping

Shaping is a procedure in which a reinforcer is given for any response that gets closer and closer and eventually leads to the desired response or target behaviour. This is also known as the method of successive approximations. Scenario 2 on page 404 (Emily learning to pronounce the word 'hospital') is a good example of shaping. Shaping is also widely used in animal training.

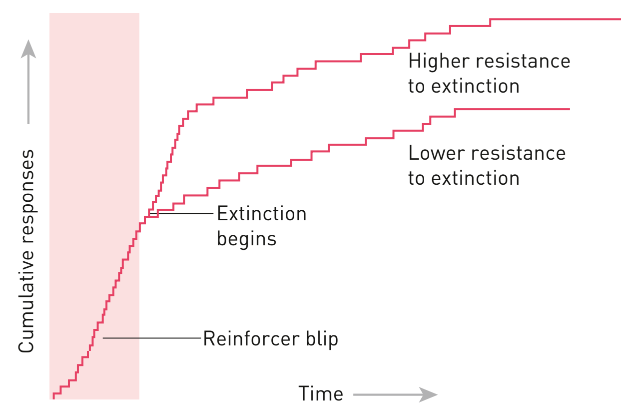


FIGURE 14.7 Extinction in operant conditioning

SHAPING IN EVERYDAY LIFE

As we saw with the example of Emily, shaping is a very common and successful way of teaching children. We even use shaping ourselves – all the time – to help us learn new skills.

For example, consider this situation. You are learning to play piano and you have a new piece of music you want to play perfectly. You attempt the new piece and play until you make a mistake. Next, you try again, make it a little further through the piece before making a mistake and feel good about your progress. The next time, you get a little further and feel good again. This goes on until you play it perfectly. You have been using shaping.

Let us examine this example of shaping in terms of operant conditioning. The discriminative stimulus – the piano is available for you. The behaviour – attempting the piece to be learnt. The consequence – feeling good (positive reinforcement).

REVIEW 14.5

Repeat the D-B-C analysis for each of the following situations:

1 you are determined to make it into the cricket team as the master leg-spinner
2 you have the lead role in the school play and you are working at learning your lines
3 you are keen to learn all you can about psychology in readiness for the exam.

FIGURE 14.8 Animals can be trained to do amazing things through shaping and chaining.

ANIMAL TRAINING

You may have seen movies and television shows in which animals perform complicated and apparently very intelligent actions. You might have seen guide-dogs helping their sight-impaired owners to live active lives; perhaps you have seen *Border Security* or *Dog Squad* where working dogs perform amazingly skilful acts. All of these dogs have been trained using shaping procedures.

Dogs are not the only animals trained by this method – dolphins, cats, horses, birds, reptiles and even fish have been trained to perform on command.

The procedure for shaping is as follows:

- identify the 'target' or desired behaviour
- identify steps that lead from the present behaviour to the target
- reinforce the first step, then do not reinforce until the second is performed, and so on.

For example, imagine you are trying to train your dog to 'drop' on command. You might use the following shaping procedure:

1 Say 'drop' and give the dog a treat when he begins to put his haunches on the ground.
2 Say 'drop' but don't reinforce until his chest touches the ground.
3 Say 'drop' but don't reinforce until he stays down for 2 seconds.
4 Increase the time to 4, then 10, then 20 seconds before reinforcement.

Did you know?

Most complex behaviours cannot all be taught at the same time. First, one simple behaviour is shaped, then another is added to it in the process of chaining.

Suppose that you want your dog to 'drop and roll over'. First, you train the dog to drop. The next step is to train him to roll over, and add it to the 'drop' behaviour already trained. This is an example of chaining.

Token economies

A 'token' is something that has no value in itself. An 'economy' is a system of trade. A **token economy** is a form of behaviour modification in which tokens are earned for performing target behaviours and these tokens can be exchanged later for some reinforcer (reward) that is valued by the learner. Consider the following case.

Miss Jones, teacher of Grade 1, has been having difficulty with the aggressive behaviour of student Johnny. She has tried many strategies: talking to Johnny about how the other children feel, showing understanding for his difficult family situation, getting extra help for him so that he is less angry about his learning issues and using operant conditioning (punishing aggressive behaviours). Nothing has worked!

After talking to the school counsellor, Miss Jones sets up a token economy for Johnny, using the following steps:

1 identifying behaviours that she wants to encourage:
   - staying in his desk
   - speaking quietly to other children
   - saying 'please' and 'thank you'
   - not making physical contact with another child

2 identifying reinforcers that are positive for Johnny:
   - using the computer reading program
   - feeding the class's pet rabbit
   - playing with Lego
3 setting up a system so that Johnny knows:
   - how he can earn a token (a sticker)
   - how many stickers he needs to exchange for a reward (a 'price-list')
4 designing a chart so that Johnny can easily see what he has in 'the bank'.

Apart from its common use in the classroom and in the family situation (view episodes of *Supernanny* for many applications), token economy is the preferred and most common form of intervention in intensive behavioural therapy with children with Autism Spectrum Disorder or Asperger's syndrome. Research has also shown that it is useful in many other situations, such as with long-term institutionalised schizophrenic patients whose maladaptive behaviours included incontinence, physical assaults on staff and uncontrolled screaming (Paul & Lenz 1977; McMonagle & Sultana 2000) and with people in jail (Morris 1980).

CASE STUDY

BENNY AND THE TOKEN ECONOMY

Eight-year-old Benny had been on a program for several days. He had worked hard, his behaviours were improving and he had 15 stars on his chart. When another child took his pencil, Benny relapsed, shouting and trying to get the pencil back with force. His teacher became angry and said 'Right – you are losing five stars for that' and removed them from the chart. What do you predict would happen?

Benny went berserk! He screamed in helpless anger, tore the chart from the wall, ripped it up, ran from the classroom in tears, climbed to the top of the play equipment and stayed there sobbing for over an hour. Afterwards he refused to have anything to do with a star-chart.

This is not the way to use a token economy! What the teacher should have done is to say:

'Oh Benny! You had been doing so well and you were only two minutes from another star; now you're going to have to start the ten-minute time all over again. Never mind, you're still doing well and I know you'll be up to 20 stars by the end of the day!'

INVESTIGATE 14.1

ORAL PRESENTATION

With reference to the case study 'Benny and the token economy', discuss the scenario with a partner, then, in point form, address the following questions. Present your answers/suggestions to the class.

1 Why were you not surprised by Benny's reaction?
2 What could a psychologist do to repair the damage?
3 What else might the teacher have done to reduce Benny's angry response?

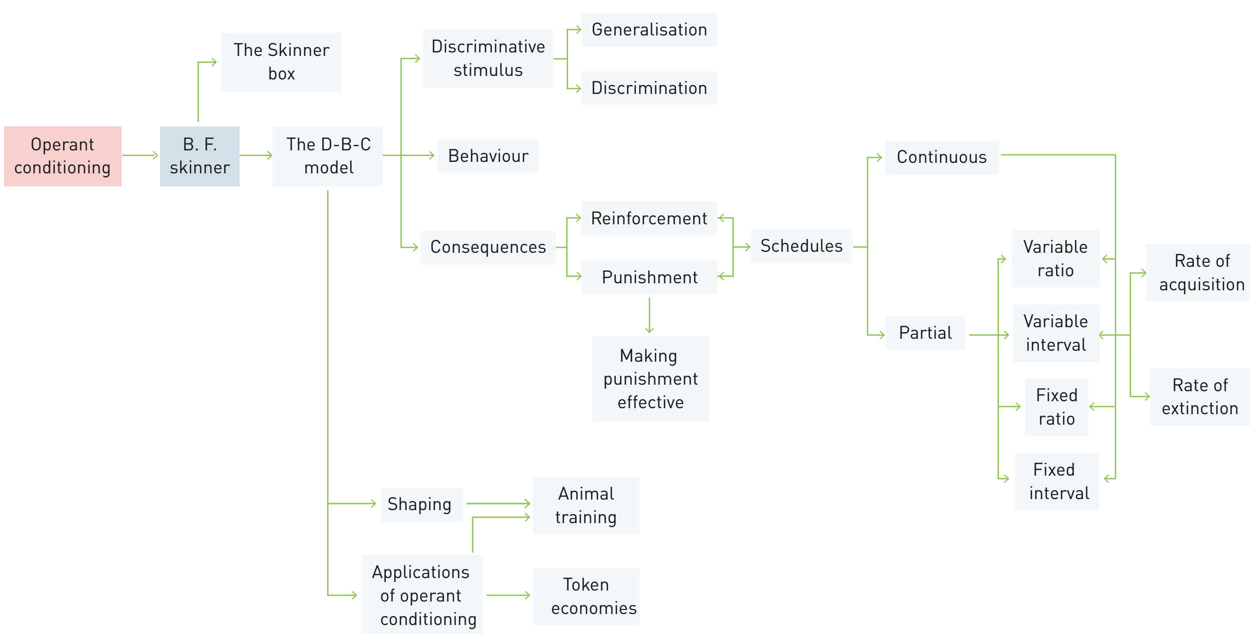
→ CHAPTER SUMMARY 14:

- Operant conditioning is a form of learning in which behaviour becomes controlled by its consequences.
- Skinner developed the system of teaching and learning referred to as operant conditioning. He referred to the three-phase model as involving:
  - the discriminative stimulus (or antecedent condition-)
  - the behaviour
  - the consequences.
- This is known as the D-B-C or (A-B-C) of operant conditioning.
- Skinner trained animals to perform voluntary behaviours by rewarding the response with food; after only a few training trials, the animals would perform the behaviour every time.
- Skinner invented a device called the Skinner box, which has:
  - a means of giving a signal (a light or buzzer)
  - a means of recording a response (a bar, button, lever or touch-pad)
  - a means of providing a reward (food) or punisher (mild electric shock)
  - a means of automatically recording that the response had been made (a cumulative recorder).
- With the Skinner box, results of research can be very robust and generalisation of the results is appropriate.
- Reinforcers and punishers are elements of operant conditioning.
- A reinforcer is a stimulus that strengthens or increases the likelihood of a response (behaviour). There are two types of reinforcers:
  - positive reinforcers: rewards that strengthen a response by providing a pleasant or satisfying consequence

    - negative reinforcers: rewards which strengthen a response by removing an unpleasant consequence.
- A punisher is a stimulus that weakens or decreases the likelihood of a response (behaviour). There are two types of punishers:
    - punishment (sometimes called positive punishment), which occurs when a behaviour is weakened because it is followed by a negative experience
    - response cost, which occurs when a behaviour is weakened because something desirable is removed.
- Side effects of punishment include frustration, aggression, feelings of helplessness, displacement of anger onto the person doing the punishing.
- Effective punishment needs to be brief, immediate and linked to the undesired behaviour in the mind of the person (or animal) being punished. It is only effective if a positive behaviour can be developed to replace the 'bad' behaviour.
- Schedules of reinforcement are variations in the frequency and manner in which a response is reinforced.
- Continuous reinforcement is when a correct response is reinforced every time it is given.
- Partial reinforcement is when only some correct responses are reinforced. Responses conditioned under partial reinforcement usually take longer to extinguish than those conditioned under continuous reinforcement. Different schedules of partial reinforcement are:
    - fixed interval schedule
    - fixed ratio schedule
    - variable interval schedule
    - variable ratio schedule
- Shaping is a procedure in which reinforcement is given for responses that get closer and closer to the target behaviour (the method of successive approximations):
    - identify the 'target' or desired behaviour
    - identify steps that lead from the present behaviour to the target
    - reinforce the first step – then do not reinforce until the second is performed, and so on.
- Extinction is when the conditioned response disappears over time after reinforcement has ceased.
- Spontaneous recovery is the reappearance of an extinguished response after a rest period.
- In operant conditioning, the terms 'generalisation' and 'discrimination' refer to the discriminative stimulus (activating event):
    - generalisation is where a behaviour occurs as a result of a discriminative stimulus that is similar (but not identical) to the original
    - discrimination is where the organism learns to avoid responding to a discriminative stimulus that is similar (but not identical) to the original.
- A token economy is a form of behaviour modification in which tokens are earned for performing desirable behaviours and later exchanged for some reinforcer (reward) that is valued by the learner.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

continuous reinforcement
D-B-C of operant conditioning
discriminative stimulus (or antecedent conditions)
effective punishment
extinction
fixed interval schedule
fixed ratio schedule
negative reinforcers
operant conditioning
partial reinforcement
positive reinforcers
punisher
punishment (positive or applied punishment)
reinforcer
response cost
schedule of reinforcement
shaping
side effects of punishment
Skinner box
spontaneous recovery
stimulus discrimination
stimulus generalisation
three-phase model
token economy
variable interval schedule
variable ratio schedule
voluntary behaviours

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of:

- Skinner box
- operant conditioning
- the D-B-C (A-B-C) of operant conditioning
reinforcers and punishers
- schedules of reinforcement
- extinction and spontaneous recovery
- generalisation and discrimination
- shaping
- token economies.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of operant conditioning to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study.

TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Essential features of the Skinner box include:
  a a means of automatically recording a response and a means of automatically providing reinforcement or punishment.
  b electrical recording of the frequency of response and a means of providing positive reinforcement or negative reinforcement.
  c a string that enables a cat to escape from the puzzle-box.
  d automatic provision of food pellets when an animal pushes a lever and a means of automatically recording responses.

2 After a response has been extinguished, so that the conditioned stimulus no longer causes it to occur, it is possible that it may reappear when the stimulus is repeated after a few days. This is referred to as:
  a stimulus recovery.
  b spontaneous recovery.
  c stimulus relearning.
  d spontaneous relearning.

3 Which schedule of reinforcement in operant conditioning would be least resistant to extinction?
  a fixed ratio
  b fixed interval
  c variable interval
  d continuous reinforcement

4 Chloe has just got a job at a car dealership. She is paid a low weekly wage but gets an extra $100 for each car she sells. If she sells 10 cars in a month, she receives a bonus of $500 as well. What reinforcement schedules are Chloe's employers using?
  a fixed interval schedule and variable ratio schedule
  b fixed ratio schedule and variable ratio schedule
  c fixed interval schedule and fixed ratio schedule
  d continuous reinforcement and fixed ratio schedule

5 In operant conditioning, the learner must:
  a intend to learn.
  b be active.
  c know that learning is taking place.
  d want to learn.

Questions 6 – 9 refer to the following information:

Jimmy is two years old and when his mother took him to the supermarket one day he saw some chocolate frogs and started screaming 'Want frog! Want frog!' After five minutes trying to ignore him, his mother went to the check-out and bought a chocolate frog which she gave to Jimmy. He sat quietly in the trolley and ate the chocolate.

6 Jimmy receiving the chocolate frog is likely to lead to:
  a Jimmy screaming out the next time they go to a supermarket.
  b Jimmy screaming out the next time he sees a chocolate frog.
  c Jimmy's mother feeling stressed the next time she has to go shopping.
  d Jimmy being better behaved on the next visit to a supermarket, hoping to be rewarded with a chocolate frog.

7 In terms of operant conditioning, what has Jimmy's mother experienced?
  a punishment for the action of taking Jimmy to the supermarket
  b positive reinforcement for the action of giving Jimmy the chocolate frog
  c negative reinforcement for the action of giving Jimmy the chocolate frog
  d reinforcement for the action of taking Jimmy to the supermarket

8 The next week, Jimmy and his mother go shopping at a hardware store. As soon as he is put in the child seat in the trolley, Jimmy starts screaming 'Want frog! Want frog!' In terms of operant conditioning, Jimmy is exhibiting:
  a response generalisation.
  b stimulus discrimination.
  c response discrimination.
  d stimulus generalisation.

9 When Jimmy and his mother went shopping at the hardware store, the entrance to the shop and being put in a trolley acted as a:
  a generalised response.
  b discriminative stimulus.
  c behavioural consequence.
  d predictive stimulus.

10 An unreasonable level of fear of an object is called a phobia. Phobias can be learnt through fear being linked to the object as a result of experience. Phobias are very difficult to treat because every time a person encounters the phobic object, they become anxious and avoid it, which makes them feel relief. This means that people with phobias are:
  a negatively reinforced for avoiding the phobia object.
  b positively reinforced for avoiding the phobia object.
  c maintained by classical conditioning.
  d acquired by operant conditioning.

11 John is training his dog, Deefer, to sit on command. At first John says 'sit' and when Deefer sits, he rewards him with a dog treat every time. When Deefer seems to have learned what is required, John rewards him every fifth time he sits. The schedules of reinforcement John used were:
  a continuous followed by fixed ratio
  b fixed ratio followed by fixed interval
  c fixed interval followed by fixed ratio
  d continuous folowed by fixed interval.

12 After a few weeks, Deefer is sitting very well on command. John now gives him a treat on average every 20th time he sits. John is now using a __________ schedule.
  a continuous
  b variable interval
  c variable ratio
  d fixed ratio

13 A Grade 2 teacher has set up a star chart for her whole class. There is a long list of behaviours for which children can earn a star and, at the end of each day, children can exchange their stars for treats. This system is referred to as a ____________ which is a form of ____________.

- a token economy; behaviour therapy
- b behaviour therapy; token economy
- c behaviour modification; token economy
- d token economy; behaviour modification

14 Shaping is also referred to as:

- a the method of loci.
- b the method of successive approximations.
- c animal training.
- d trial-and-error learning.

15 In order to train an animal to perform a complex series of behaviours, it is necessary to use:

- a the method of successive approximations.
- b trial-and-error learning.
- c chaining.
- d the method of loci.

16 James was given a Friday detention because he fell asleep in History on Tuesday afternoon. The Psychology teacher at James' school said that the detention would probably not influence James' behaviour in future. The most likely reason for this is:

- a the punishment is not linked to the behavour in James' mind.
- b the punishment is irrelevant to the behaviour the teacher wants to eliminate.
- c it is likely that James' dislike for his History teacher will increase
- d all of the above reasons are correct.

SHORT ANSWER

17 Negative reinforcement and punishment are often confused with each other.

- a Identify two ways in which negative reinforcement and punishment are different.

2 marks

- b Show these differences by giving an example of negative reinforcement and an example of punishment.

2 marks

18 Dorothy is teaching her dog Toto to sit. Every time Toto sits when he is told to do so, Dorothy gives him a treat.

- a What form of conditioning is being used?

1 mark

- b What schedule of reinforcement is being used?

1 mark

- c How might Dorothy change her procedures to try to make the 'sit' response longer-lasting?

1 mark

19 What is meant by variable ratio reinforcement? Explain using an example.

2 marks

20 What is meant by extinction in operant conditioning? Explain using an example.

2 marks

21 Describe how shaping may be used to teach a child to tie her shoe-laces.

2 marks

COMPARISONS OF CLASSICAL AND OPERANT CONDITIONING

KEY KNOWLEDGE

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).

(VCE Study Design 2013)

TABLE 1 Comparisons of classical and operant conditioning

TYPE OF CONDITIONING	ACQUISITION	EXTINCTION	STIMULUS GENERALISATION
Classical conditioning	By pairing of neutral stimulus (NS) with unconditioned stimulus (UCS)	By continued presentation of the conditioned stimulus (CS) alone	Conditioned response (CR) occurs when a stimulus similar to CS is presented
Operant conditioning	By reinforcing a behavioural response	Occurs when the behaviour occurs but reinforcement is never given	Refers to discriminative stimulus (antecedent condition). Occurs when the behaviour occurs in an environment similar to that which led to reinforcement.

The consequence occurs after the response and consists of a reinforcing event or an aversive event.
Voluntary – the learner is in control of the behaviour

TABLE 2 Observational learning

TYPE OF LEARNING	ACQUISITION	EXTINCTION	STIMULUS GENERALISATION
	Observational learning	(modelling)	By attention; retention and reproduction

Discriminative stimulus occurs before the behaviour (response).
Consequence occurs after the response and consists of a reinforcing stimulus or an aversive stimulus.
Voluntary – the learner is in control of the behaviour

STIMULUS DISCRIMINATION	SPONTANEOUS RECOVERY	ROLE OF THE LEARNER	TIMING OF STIMULUS/ RESPONSE	NATURE OF RESPONSE
After several trials when a stimulus similar to CS is presented but never associated with the UCS – CR only occurs with CS	When CR has been extinguished – after a time delay, CS is presented and again elicits CR	Passive – the (reflexive) behaviour occurs without any deliberate action from the learner	Stimulus before response (reflexive behaviour is in response to a stimulus)	Reflexive – the learner has no control over the behaviour
When the behaviour is never reinforced in environments that are similar to the discriminative stimulus. Eventually, the behaviour occurs only when discriminative stimulus is present.	After the response has not been reinforced for several trials, the discriminative stimulus will not elicit the response. After a time delay, if discriminative stimulus occurs, behaviour will again be shown.	Active – the behaviour must be initiated by the learner		Discriminative stimulus is the environment that provokes the behaviour – occurs before the behaviour (response).

STIMULUS DISCRIMINATION	SPONTANEOUS RECOVERY	ROLE OF THE LEARNER	TIMING OF STIMULUS/ RESPONSE	NATURE OF RESPONSE
As with operant conditioning		As with operant conditioning	With no reinforcement and no further modelling for several trials, the environment will not elicit (motivate) the response. After a time delay, the behaviour will again be shown in the right environment.	Active – the behaviour must be initiated by the learner

CHAPTER 15: OBSERVATIONAL LEARNING

Is it possible to learn without direct participation in the process? Do classical and operant conditioning theories explain all forms of learning? How do people learn to use machinery or even simple items such as cutlery? Would it be wise for a learner driver to simply hop in a car and learn how to drive by trial-and-error? Would it be wise for children to use power tools such as electric drills or electric knives by trial-and-error?

KEY KNOWLEDGE

Observational learning (modelling) processes in terms of the role of attention, retention, reproduction, motivation, reinforcement as informed by Albert Bandura's social learning theory.

(VCE Study Design 2013)

FIGURE 15.1 How do people using powerful machinery or motor vehicles first learn to operate them?

Learning: An introduction

CHAPTER OVERVIEW

Learning: An introduction	Social learning Observational learning (modeling)
Process of observational learning	Attention Retention Reproduction Motivation Reinforcement
Comparison of learning theories	Observational learning and operant conditioning > Differences > Similarities
Bandura's social learning theory	The role of models > The nature of the observer > Bandura's classic 1965 study > Lessons from the Bobo doll experiments
Application of observational learning	Children and television violence Comment on observational learning

Most people learn to use cutlery and learn to drive by observing other experienced people operate the equipment. Similarly, it is common for children to spend many years as a passenger in a motor vehicle observing their parents' driving.

As these examples suggest, learning does not always happen in the absence of other people. Some learning theories propose that we learn through social learning, where people learn from those around them, with or without reinforcement.

Social learning

In the 1960s, psychologist Albert Bandura and his colleagues conducted a series of experiments on learning by children who watched the behaviour of others. The results of these studies led him to develop social learning theory (Bandura 1977). These experiments have become classic studies and are known as 'the Bobo doll experiments' because they involved a large, inflatable plastic doll named 'Bobo' that

FIGURE 15.2 Bobo dolls have been used in studies about social learning.

was about 1.5 metres high and designed to spring back upright when knocked over. In the experiments, the children were shown an adult (model) behaving aggressively to a Bobo doll – hitting it, throwing it, sitting on it, etc. The children were then placed in a room alone with a Bobo doll and their behaviour was observed. There was evidence that learning had occurred when the children behaved aggressively to the Bobo dolls just as they had observed the models doing previously.

Observational learning

According to Bandura, social learning occurs within a social context: you observe another person's actions, and the consequences of their actions and use this to guide your own future actions, through imitation of the model's behaviour. A form of social learning is **observational learning**, where a person learns by watching the behaviour demonstrated by another. When the observer demonstrates the learnt behaviour by imitating it, it is referred to as **modelling** (Bandura 1967).

There are four principles of observational learning:

1. learning occurs by observing the behaviour of others and the consequences of those behaviours
2. learning can occur without there being an immediate change in behaviour – it can remain *latent*.
3. cognition plays a role in observational learning because the learner has awareness and expectations of future reinforcements or punishments, and these can influence whether the learnt behaviour will be demonstrated
4. observational learning is a link between behaviourist theory of learning (operant conditioning) and cognitive learning theories (latent learning and insight learning).

FIGURE 15.3 Children learn by modelling.

THE PROCESS OF OBSERVATIONAL LEARNING

In observational learning, as in operant conditioning, the learner plays an active role in the learning. There are several key processes that are necessary for observational learning:

- attention
- retention
- reproduction
- motivation
- reinforcement.

Attention

Attention must be paid to the model's behaviour and its consequences. This is a *cognitive* aspect of observational learning. For example, a child might concentrate on a parent (model) making pancakes for breakfast. Attention can be influenced by characteristics of the observer such as perceptual and cognitive capabilities, and arousal level. It can also be influenced by characteristics of the event.

Retention (in memory)

The learnt behaviour must be stored in memory as a *mental representation* (understanding of what to do in the mind of the learner) so that the observed learning can be utilised at a later time. This is a *cognitive* aspect of observational learning because the memory must be stored and later retrieved to reproduce the behaviour. For example, the child might remember the ingredients and procedure for making pancakes.

Reproduction (of the behaviour)

The learner must have the physical and intellectual ability to convert these mental representations into actions. For example, the child must be old enough to be able to use the kitchen equipment for making pancakes.

Motivation

The learner must *want* to imitate the learnt behaviour. This will depend on whether the learner believes that there will be a desirable consequence (reinforcement) for reproducing the learnt behaviour.

Reinforcement

When there is the prospect of a positive result for imitating the behaviour (i.e. a reward for the learner), it is likely that the learner will do so. In contrast, if there is a prospect of punishment for reproducing the learnt behaviour, it is less likely that the behaviour will be imitated. For example, the child must perceive that praise will be given for making the pancakes or that there will be personal pleasure in eating the pancakes.

Reinforcement influences the likelihood that a learner will imitate an observed model's behaviour. The *expectation* of reinforcement or punishment influences the cognitive processes of the observer and this affects how well the learner pays attention to and retains the memory of the model's behaviour.

Reinforcement for imitating the model's behaviour can come from several sources:

- the model – for example, a parent praises the child for imitating their behaviour
- a third person – the observer might have imitated the behaviour of another person, such as a television personality or leader, but receives praise for the behaviour from a parent or teacher
- personal – the imitator receives satisfying consequences as a result of imitating the model's behaviour
- vicariously – positive consequences received by the model increase the likelihood of the observer imitating the model's behaviour, whereas negative consequences for the model's behaviour will decrease the likelihood of the observer imitating the model's behaviour.

FIGURE 15.4 Observational learning process (a) Attention: the child actively watches the model's behaviour. (b) Retention: the child must store a mental representation of the learnt behaviour. (c) Reproduction: the child must be physically and mentally capable of reproducing the learnt behaviour. (d) Motivation and reinforcement: the child must perceive that there will be a reward for reproducing the learnt behaviour. After producing the behaviour, a positive outcome will cause it to be repeated (reinforcement).

REVIEW 15.1

1 Define 'observational learning'.
2 Outline the four principles of observational learning.
3 Explain what is meant by 'social learning'.
4 Who are the main sources of models for observational learning?
5 Create one of the following to illustrate your understanding of the steps involved in the observational learning process. You must use your own example:
   - directional flow chart with text and pictures
   - PowerPoint presentation with text and pictures
   - animation with figures and captions/bubbles.

Comparison of learning theories

Observational learning has characteristics of operant conditioning and also cognitive factors.

Differences

DIRECT VERSUS INDIRECT LEARNING

While operant conditioning emphasises the importance of the organism's *direct* experience when learning, observational learning suggests that learning can occur *indirectly* through observation. For example, an employee who sees a colleague receive a promotion for hard work might also begin to work harder to receive a promotion.

OBSERVABLE VERSUS UNOBSERVABLE EVIDENCE OF LEARNING

Unlike operant conditioning, in observational learning there is a distinction between *learning* and *performance*. Learning can occur but is not necessarily demonstrated or observed unless there is a motivation for the organism to demonstrate the learnt behaviour. There are many examples where people have learnt through observation but never actually perform the learnt behaviour. Therefore, a distinction is made between the *acquisition* and *performance* of a behaviour that has been learnt through observation.

THE ROLE OF COGNITION IN LEARNING

Unlike operant conditioning, observational learning includes the role of *cognition* (thinking and memory) in the learning process. This is because the organism is required to pay attention to and remember the model's behaviour. In observational learning, the learner must attend to a model's behaviour and its consequences, and then store a mental representation of it.

Similarities

ACTIVE LEARNING: THE ROLE OF THE LEARNER

Observational learning is similar to operant conditioning in that the learner is active in both of these learning processes. For example, the employee who observes a colleague being rewarded with a promotion for hard work will deliberately work hard so that they might also be rewarded with a job promotion.

REINFORCEMENT

As with operant conditioning, in observational learning it is *reinforcement* rather than the learning itself that influences the likelihood of the observed behaviour being imitated by the observer. If the learner observes the model receiving a favourable consequence for the behaviour, the learner will be more likely to imitate the model's behaviour. This is known as *vicarious conditioning* where an observer learns the consequences of a behaviour by observing its consequences for another.

However, what is more important to the likelihood of the behaviour being imitated is the learner's perception that imitation will result in a positive reinforcer. In other words, the likelihood of the learnt behaviour being imitated depends on whether the learner thinks they will receive a reinforcer for demonstrating the learnt behaviour. For example, the employee who observes a hard-working colleague receiving a promotion would be more likely to reproduce the same hard-working behaviour as the colleague if they thought there was a chance of also receiving a promotion.

TABLE 15.1 Observational learning and operant conditioning: similarities and differences

	OBSERVATIONAL LEARNING	OPERANT CONDITIONING
Direct versus indirect learning	Indirect	Direct
Observable versus unobservable evidence of learning	Not observable unless the organism is motivated by a stimulus to display the learning that has occurred via observation and retention	Observable
The role of cognition in learning	Cognition is necessary	Cognition not always necessary
Active learning: the role of the learner	Active	Active
Reinforcement of the learner	Increases likelihood of the learner repeating the learnt behaviour to obtain a positive outcome	Increases likelihood of the learner repeating the learnt behaviour to obtain a positive outcome

REVIEW 15.2

1 Explain the relationship between operant conditioning and observational learning.
2 Refer to Table 15.1 and provide a real-life example for each of the following forms of conditioning:
   a direct and indirect learning
   b observable and unobservable evidence of learning
   c the role of cognition in learning
   d active learning: role of the learner
   e reinforcement of the learner.

The role of models in observational learning

Different types of models may be involved in observational learning. Models can be:
- live – an actual person demonstrating the behaviour
- symbolic – a person portrayed in television, video games and computer programs.

The likelihood that a learner will pay attention, retain and reproduce a behaviour is influenced by the characteristics of the model. Factors that increase the likelihood include similarity of the model to the observer and the relevance, likeability, credibility, attentiveness and prestige of the model.

FIGURE 15.5 Former tennis star Pat Rafter and cricketer Michael Clarke are relevant models for sports fans, and their images in an advertising campaign will ensure desired attention and retention for advertisers.

THE NATURE OF THE OBSERVER

The extent to which the learner will imitate the model's behaviour will also depend upon the nature of the observer. Learners who lack self-esteem and confidence are more likely to imitate the model.

INVESTIGATE 15.1

1. Choose three different individuals whom you would consider models (in terms of observational learning) and explain why you chose them according to the characteristics of models. (Suggestions: famous sportsperson, actor, dancer, singer, producer, politician, parent, teacher, friend.)
2. Why might self-esteem influence a person's likelihood to imitate a model's behaviour?
3. Consider some of our sporting celebrities (e.g. football players). How does their behaviour/misbehaviour potentially affect young people? Explain.

SUPPORTING UNDERSTANDING

Bandura's research

Albert Bandura and his colleagues, Dorrie and Sheila Ross extensively studied observational learning in their work with children (Bandura 1977; Bandura, Ross & Ross 1961, 1963a, 1963b).

Social learning theory, aggression and the Bobo doll

Bandura and colleagues conducted a series of experiments at Stanford University that revolutionised the field of research in learning and aggression. He hypothesised that children learn from the behaviour of trusted adults. One of these experiments is outlined below.

Bandura's classic 1965 study

This experiment involved a similar experimental design and procedure to the earlier Bobo doll studies. In this study, the conditions were that each group of children was shown one of three films. Each film showed an adult punching, kicking and verbally abusing the Bobo doll.

- group 1: aggressive model was rewarded with lollies, soft drink and praise from another adult.
- group 2: aggressive model was punished by spankings and verbal criticism from another adult.
- group 3: aggressive model received no consequences whatsoever.

After viewing their film, each child was placed alone in a room with a one-way mirror and observed by the researcher. Some children were offered rewards as incentive for imitating the aggressive behaviour while others were offered no reward or incentive.

Results

The children who watched the aggressive model either being reinforced (group 1) or experiencing no consequences (group 3) imitated the model's aggressive behaviour more than the children who had watched the aggressive model being punished (group 2). However, when a reward was offered to the children as incentive, even those who saw the model punished tended to imitate the model's behaviour.

REVIEW 15.3

1 Create a table to summarise the 1965 experiment. You will need to provide detailed information in each box. Dot points are recommended.

NUMBER OF EXPERIMENTAL GROUPS	EXPERIMENTAL CONDITIONS	OUTCOME/RESULTS

INVESTIGATE 15.2

EVALUATION OF RESEARCH

1. What was the aim of Bandura's 1965 experiment?
2. Write an experimental hypothesis for this experiment.
3. Identify the independent and dependent variables in this study.
4. What experimental design was used by the researchers?
5. What was concluded by the researchers?
6. Identify two ethical issues that may have been breached in this experiment and explain how/why.

Lessons from Bandura's Bobo doll experiments

There are a number of lessons to be learnt from Bandura's Bobo doll experiments:

- Learning can occur through observation of the behaviour of models.
- Vicarious learning can occur when models are seen to be reinforced for their behaviour. Learning can be cognitive; the children who observed the models learnt how to hit a Bobo doll but did not necessarily demonstrate their learning.
- Learning through observation can occur but remain latent unless an appropriate incentive or reward is offered to the observer to reproduce the learnt behaviour. It is not necessary for a learner to be active or to have reinforcement for learning to occur.

FIGURE 15.6 Children exposed to an aggressive role model are more likely to show aggressive behaviour.

- Learning to control behaviour such as aggression can also be learnt through observation of an appropriate model, such as boys observing male models. This suggests that prosocial behaviour can also be learnt through observation of appropriate models.
- Although the Bobo doll experiments did not absolutely prove that children learn to behave aggressively by modelling adult behaviour, it did suggest that it is *likely* that children observing an adult model behaving aggressively might believe that this type of behaviour is normal. They may, therefore, be more likely to use this type of action themselves when confronted by similar situations. Girls were less likely to be physically aggressive but were equally as prone to verbal aggression as boys. (This is something often encountered in society, where bullying at school by boys is more often of a physical nature while girls tend to bully in more verbal and social ways).

INVESTIGATE 15.3

Conduct an Internet search to find a recording of Albert Bandura describing the Bobo doll experiments. You may also be able to find a video clip.

Did you know?

Research has indicated that, for observational learners, some of the same neurons are active when observing the learning of others as when the observer is conducting the same behaviour themselves. When a model receives conditioned reinforcers for a behaviour, similar neurons in the observer's brain also strengthen.

(Carlson et al. 2007)

Application of observational learning

Observational learning means that role models (both fictional and real) are powerful sources of influence on the behaviour of others, especially impressionable people and children. This helps to explain why physical punishment might lead to aggressive behaviour on the part of those who were punished – for example, parents who physically punish their children may unintentionally be modelling aggressive behaviour which their children will imitate. Other examples where models can influence positive behaviour of observers include parents reading to their children, demonstrations of problem solving, moral thought and behaviour and prosocial behaviour.

Children and television violence

Bandura's work had important implications for the debate about the influence of television violence on young children. Children are more likely to pay attention to advertisements where relevant models are present in them. Bandura explored the idea that televised aggression may have adverse effects on children's behaviour. He found, for example, that children are more likely to copy another's behaviour if the model is similar to them in age and sex or if the model has desirable characteristics and is seen as attractive (Bandura 1977). This is particularly important when considering the number of hours children spend watching visual media each week.

The good news is that if a child's development is influenced through observational learning and by their media viewing, then it also has the potential to act as a positive influence.

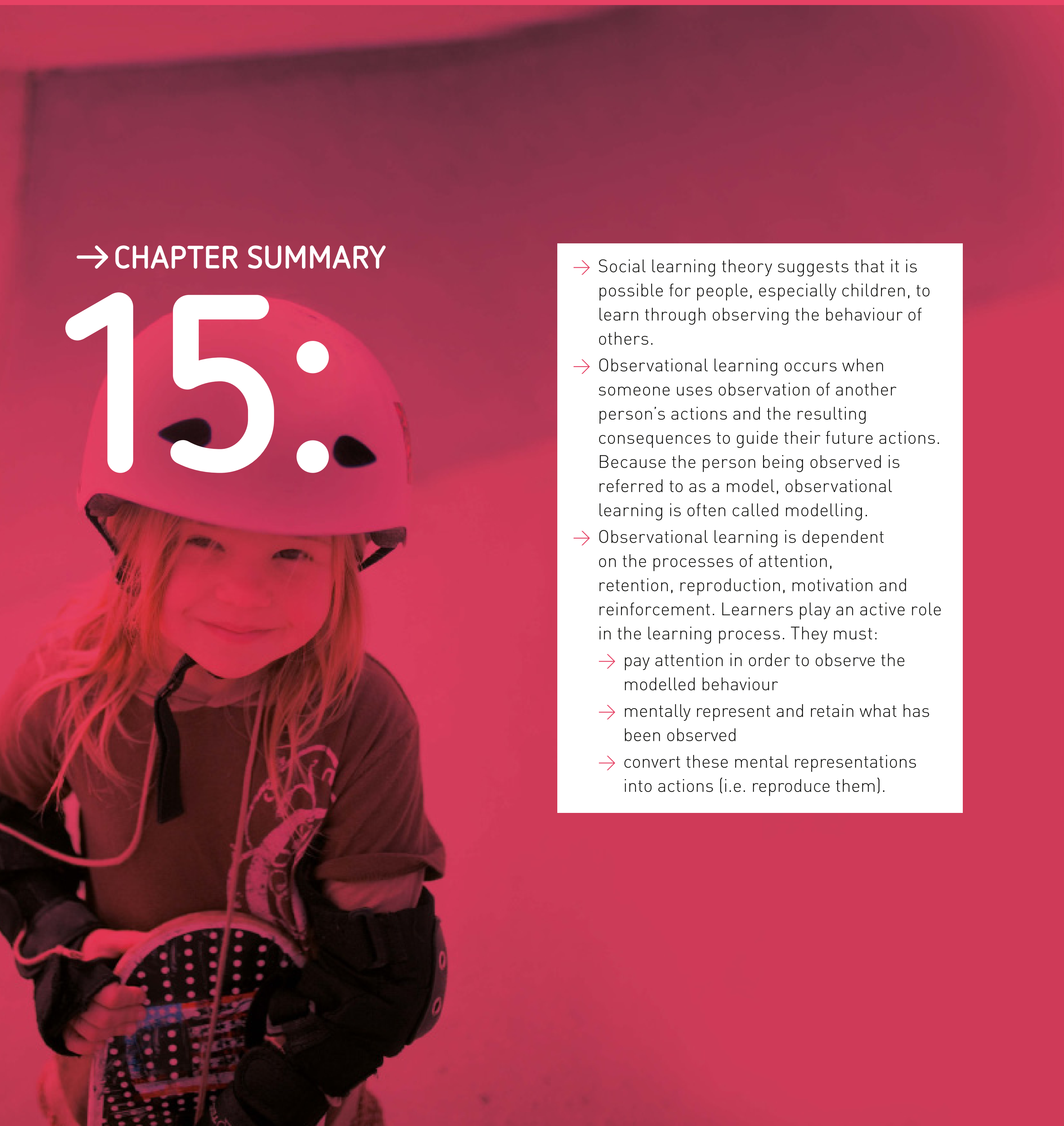
FIGURE 15.7 Children are more likely to copy another's behaviour if the model is similar to them in age and gender.

INVESTIGATE 15.4

1 Explain why Bandura's experiments were criticised.
2 How has observational learning contributed to our knowledge (refer to application of observational learning)?

Comment on observational learning

Observational learning introduces the role of cognition to the theories of the learning process. Unlike operant conditioning, Bandura's work has shown that people are active in their learning, and that observational learning is not just simple mimicry alone. Instead, the learner retains in memory the general principles of what they have observed. However, observational learning does not provide us with information about the nature of these cognitive processes. Instead, it tends to emphasise the role of the environment and factors external to the learner.



→ CHAPTER SUMMARY 15:

- Social learning theory suggests that it is possible for people, especially children, to learn through observing the behaviour of others.
- Observational learning occurs when someone uses observation of another person's actions and the resulting consequences to guide their future actions. Because the person being observed is referred to as a model, observational learning is often called modelling.
- Observational learning is dependent on the processes of attention, retention, reproduction, motivation and reinforcement. Learners play an active role in the learning process. They must:
  - pay attention in order to observe the modelled behaviour
  - mentally represent and retain what has been observed
  - convert these mental representations into actions (i.e. reproduce them).

- Reinforcement influences the learner's motivation to perform the learnt behaviour.
- Observational learning has a cognitive component evident in the attention and retention processes. However, social learning theory does not attempt to explain the nature of children's cognitive processing when learning is taking place.
- Operant conditioning can occur through observational learning but the likelihood of the learnt behaviour being reproduced by the observer will be greater if there is a prospect of a reward or favourable reinforcer for doing so.
- Bandura's Bobo doll experiments with children demonstrated that it is not always necessary for a learner to engage in behaviour for learning to occur, and that this learning can be latent until there is sufficient motivation (reinforcement) to demonstrate the behaviour. These experiments demonstrated that children would copy aggressive behaviour modelled by another person, especially if the model was similar to them in some way (for example age and in terms of gender) and not punished for the antisocial behaviour.
- Bandura's Bobo Doll experiments informed debate on the effect of both live role models and television role models on the learning of children.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP

Observational learning–modelling → Social learning theory (Bandura) → Sequential elements

- Stage 1 — Attention: learner actively watching model
- Stage 2 — Retention: learner stores the mental representation of the behaviour
- Stage 3 — Reproduction: learner has the mental and physical ability to perform the behaviour
- Stage 4 — Motivation: environmental stimuli make the learner wish to perform the behaviour
- Stage 5 — Reinforcement: positive outcome means the learner will repeat the behaviour when again motivated to do so
- Through stages 1–4 the learning is latent
  This is the point when behaviour is shown

KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

attention
modelling
motivation
observational learning
reinforcement
reproduction
retention
social learning theory

KEY KNOWLEDGE

For the exam, you must be able to show your understanding and apply your knowledge of:

- observational learning – principles and processes
- the distinction between observational learning and other theories of learning
- the application of observational learning, including examples.

RESEARCH METHODS

For the exam, you must be able to:

- use your knowledge of research methods to evaluate a research study
- use your knowledge and understanding from this chapter to apply to a related research study.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Who was the psychologist who pioneered the research on observational learning?
  a Thorndike
  b Skinner
  c Pavlov
  d Bandura

2 Observational learning suggests that people imitate a model because of __________ and __________: those received by the model as well as by the imitators.
  a reflexes; punishments
  b aggression; rewards
  c rewards; punishments
  d reinforcers; aggression

3 Observational learning might help explain why __________ parents might have __________ children.
  a abusive/passive
  b passive/abusive
  c abusive/aggressive
  d aggressive/abusive

4 Models are most effective when they are perceived as __________ or __________ by the observer. Models are also most effective when their words and actions are __________.
  a similar; successful; consistent
  b similar; male; flattering
  c male; successful; consistent
  d similar; successful; flattering

5 Observational learning differs to classical conditioning because it includes a __________ process.
  a cognitive
  b passive
  c respondent
  d reinforcement

6 Which is the correct sequence for learning by observational learning?
  a attention, retention, reproduction, motivation, reinforcement
  b attention, retention, motivation, reproduction, reinforcement
  c attention, retention, reinforcement, reproduction, motivation
  d attention, retention, reproduction, reinforcement, motivation

7 Why did Bandura describe observational learning as social learning?
  a Modelling only occurs in groups of people.
  b This is the way in which children learn the skills needed to join adult society.
  c Children learn behaviours by watching other children.
  d Adults need to shape the social skills of children by reinforcement.

8 Which of the following might be a definition of modelling?
  a A form of learning in which the learner watches another person perform a task and then imitates their action when the occasion is right.
  b A form of learning in which the learner watches another person perform a task and forms a mental image of the action.
  c A form of learning in which the learner is a passive participant observing an action being performed.
  d A form of learning in which the learner watches another person perform a task and gets reinforced for it.

SHORT ANSWER

9 Marg wants to use observational learning to teach her five-year-old daughter Gemma how to tie her shoelaces. Name stages 2 and 4 of observational learning and, for each of these, show how Marg could teach the skill of tying shoelaces.

2 marks

10 Gary wants to use observational learning to teach his four-year-old son Jake how to make his bed in the morning. Name stages 1 and 5 of observational learning and, for each of these, show how Gary could teach the skill of bed-making.

2 marks

11 Using examples, explain the following processes involved in observational learning:

a retention

1 mark

b reproduction

1 mark

12 In observational learning, there is a stage where learning has occurred but the behaviour has not yet been shown.

a Which processes involved in observational learning must occur immediately before the behaviour is shown?

1 mark

b Which of the processes involved in observational learning must occur if the behaviour is to be shown more than once?

1 mark

c Explain exactly what is meant by what is necessarily the first of the observational learning processes.

1 mark

13 In Bandura's experiments, how did the outcome for the model influence the likelihood of children imitating the behaviours?

2 marks

RESEARCH METHODS AND ETHICS IN THE STUDY OF LEARNING

KEY KNOWLEDGE

Research methodologies and ethical principles associated with the study of learning, as outlined in the introduction to Unit 3 on page 3.

(VCE Study Design 2013)

Evaluation of research

CASE STUDY 1

Baby Albert (9 months old), a placid child, selected on the grounds that he had never been seen to cry, was 'borrowed' from a child-care facility at Johns Hopkins University in 1920. Baby Albert, on the floor in Watson's laboratory, showed no fear of a white rat and did not respond negatively to other animals and objects; he did show fear, however, when a steel bar was struck with a hammer, making a loud noise just behind him. Two months later, Watson paired the rat with a loud noise by striking an iron bar with a hammer just behind Albert's head. This caused Albert to jump in fear but at first he did not cry. After seven pairings of the rat and the noise (over two sessions, one week apart), Albert did cry. Soon afterwards, when the rat was presented but there was no noise, Albert cried and tried to crawl away from it.

He also showed fear when presented with a dog, a rabbit, a fur coat and a Santa Claus mask (though the fear response was much reduced when he was in a different and much larger laboratory).

Although Watson and Rayner were apparently aware that Albert's mother was taking him away, they did not extinguish the fear response that he had learnt. (Watson, J., 1930)

This research was a case study. As with all case studies, a great deal of in-depth information is kept about the single participant: Watson and Rayner kept immensely detailed notes of what was happening.

The value of a case study is that, from all the detailed observations of one participant, it is possible to develop hypotheses that can then be tested by more rigorous experimental procedures.

Questions

1 Which experimental design was used?
   a What was the 'control' condition?
   b What was the 'experimental' condition?
2 What was the independent variable?
3 What was the dependent variable?
4 Watson did not operationalise the dependent variable. State how this could have been done.

5 If such an investigation was carried out today, what procedures should be followed:
   a before the investigation takes place
   b after the 'research' was complete?
6 If Little Albert's mother had been told what would be involved and the risks to Albert, and had been given the right to withdraw Albert from the research at any time, and she had signed a form indicating that she voluntarily and knowingly consented for Albert to take part, would this research have conformed to current ethical standards? Explain your answer.
7 What conclusion did Watson draw from this research?

CASE STUDY 2

Estes (1970) looked at the question of whether punishment *extinguished* behaviour or merely *suppressed* it.

Two groups of rats (A and B) were placed in Skinner boxes. When they pressed a lever, they received food.

When placed in the box (discriminative stimulus/antecedent condition) they quickly learnt to press the lever (behaviour) whenever they desired the food (consequence).

Estes then withheld food for a period of time, even though the rats pressed the lever. In addition, Group A received an electric shock when they pressed the lever, while Group B had no consequence for pressing the lever. The lever-pressing behaviour was quickly extinguished in the rats in Group A while the rate of lever pressing dropped for the rats in Group B.

After a short time the shocks stopped and the lever-pressing behaviour of Group A rapidly increased to be the same as Group B.

Estes concluded that punishment (the electric shocks) temporarily suppressed the behaviour but did not cause it to be 'unlearnt' or extinguished. (Estes, W.K., 1970)

Questions

1 Which experimental design was used?
2 What was the independent variable?
3 What was the dependent variable?
4 Give a possible operational definition of Estes' dependent variable.
5 State a possible experimental hypothesis.
6 To what population can these results be generalised?
7 Design an experiment that could examine whether the same results as Estes' would occur with primary school children. Be careful to state the procedures that must be followed to comply with ethical requirements.
8 Although rats are not humans, there are still ethical considerations that must be followed in research with animals. What are these?

CASE STUDY 3

Galef (1988) experimented with observational learning in rats. He had a demonstrator rat eat food that was flavoured, for example, with cocoa.

All food was then taken away and a second rat (test rat) was placed in the cage for 30 minutes. The test rat was then allowed a choice of food—unflavoured or cocoa-flavoured.

Test rats consistently chose food of the flavour that the demonstrator rat had previously eaten, even when several hours had elapsed before the two rats were placed together and when up to 12 hours had passed before the test rat was allowed to choose the food.

Galef concluded that interacting with a rat that had been exposed to a particular food created a temporary preference for that food. (Galef, B.G. Jnr. 1988)

Questions

1 How could a control group have been used in this research?
2 Can you think of any variables that may have confounded Galef's results?
3 State a possible experimental hypothesis.
4 To what population can these results be generalised?
5 Suggest some further procedures in this research that may have made the results more robust.

ASSESSMENT ACTIVITIES

OUTCOME

On completion of this unit, the student should be able to explain the neural basis of learning, and compare and contrast different theories of learning and their applications. (VCE Study Design, 2013)

This outcome requires a folio of at least five practical activities, with at least three of these activities to be annotated to ilustrate aspects of learning.

The assessment rubric on page 444 is designed to help guide your response.

Annotated folio of practical activities

The activities do notnecessarily need to be presented as formal written reports but must be presented as per instructions within the text and/or from your teacher. For example, a folio may include:

- one research investigation per chapter
- responses to the test items at the end of one or more chapters
- written responses to the Review items in one or more chapters within this area of study
- **any of the following activities**

Discussion

- Is 'maturation' genuinely a type of unlearnt behaviour?
- Design a behaviour modification program to assist a friend to stop eating chocolate biscuits - using a program of operant conditioning.

- Is observational learning merely a particular type of operant conditioning?
- Evaluate the relative contributions of Pavlov, Skinner and Bandura to our understanding of learning theory.

Visual presentation (e.g. poster)

- Distinguish among any three of the following: classical conditioning, one-trial learning, operant conditioning and observational learning in terms of:
  - timing of stimuli, behaviours and consequences
  - role of the learner
  - nature of behaviours being learnt.
- Using the language of learning theories, describe a routine for training an animal such as a seeing-eye dog.
- Describe how various types of conditioning are used in everyday life.

Research investigation and/or evaluation of research

You will need:

- a source of sound for the whole class (buzzer, bell)
- a means of changing the light conditions in the room (e.g. blacking-out the room and switching off the light).

1. Sit opposite your partner, watching their pupils.
2. The buzzer starts 0.5 seconds before the light is dimmed.
3. Record how many seconds it takes for the pupils to noticeably dilate. (There will be two results for each pair.)
4. Buzzer stops and the light is turned on.
5. Repeat five times at 2-minute intervals (allow pupils time to readjust to light).
6. Pool the data for the class.
7. Repeat the buzzer sounds at 1-minute intervals, with the light left on.
8. After each 3 trials, E-group experiences another pairing of UCS (dimmed lights) and CS (buzzer) while C-group experiences no further pairing.
9. All times for pupil dilation are recorded.

Evaluation

1. What was the aim of the research?
2. What was the research hypothesis?
3. Who were the participants?
4. What were the independent and dependent variables?
5. How was the dependent variable operationalised?
6. What were the results?
7. What conclusion(s) can be drawn from this study?
8. What weaknesses/strengths did you identify in the study?
9. What suggestions to improve this design can be made for future research?

Data analysis

	GENDER	WORD SCORE /100		GENDER	WORD SCORE/100
1	F	75	11	F	84
2	F	43	12	M	55
3	F	98	13	M	39
4	M	47	14	M	85
	GENDER	WORD SCORE /100		GENDER	WORD SCORE/100
5	M	33	15	F	44
6	M	55	16	M	90
7	M	46	17	F	89
8	F	72	18	F	57
9	M	38	19	F	33
10	F	62	20	M	34

1 Calculate the mean word scores for:
   - a all participants
   - b males
   - c females.
2 Compare the mean word scores for males and females. Is there a difference?
3 Draw a line graph of total scores.
4 Draw a line graph showing the difference in scores between males and females.
5 What can be concluded from these results?

Media response

A media clip could be sourced from a movie, television show, cartoon, newspaper article, book, website, painting, photograph, song, documentary, advertisement, magazine or podcast.

Critique the media clip in terms of its portrayal of learning (i.e. is it appropriate and correct?).

1 Give a brief description of the media clip.
2 Which topics of learning are covered in the media clip?
3 Which theories, issues and studies are related to the media clip?
4 Do you think the media clip portrays the learning topic accurately? Explain with reference to the relevant knowledge and understanding.
5 Do you think the media clip may contribute to any misconceptions? Explain your answer.
6 How has this media clip contributed/not contributed to your knowledge and understanding of this area of study?

Oral presentation

→ Distinguish among any three of the following: classical conditioning, one-trial learning, operant conditioning and observational learning in terms of:
   - timing of stimuli, behaviours and consequences
   - role of the learner
   - nature of behaviours being learnt.

→ Using the language of learning theories, describe a routine for training an animal such as a seeing-eye dog.

→ Describe how various types of conditioning are used in everyday life.

ASSESSMENT RUBRIC

CRITERION	0 TO 1
1 Psychological knowledge and understanding The work demonstrates an accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices.	Limited knowledge and correct use of psychological terminology, concepts and practices.
2 Evidence-based arguments Employs higher order thinking (analysis, synthesis, evaluation and application) to complete task. Constructs evidence-based arguments that draw on psychological research findings and theoretical models to justify the student's explanations, evaluations and applications.	Limited display of higher order thinking and/or incorrect or inappropriate application of psychological knowledge to draw relevant conclusions.
3 Location and use of psychological information Locates and draws on a range of appropriate and legitimate (valid and reliable) psychological sources to complete the assessment task.	Limited or inappropriate use of legitimate psychology sources of information have been draw upon to complete this task.
4 Strategies to complete the task Displays initiative, independence, critical reflection and cooperation while completing the task. Develops monitors and executes effective strategies to successfully complete the task.	Little or ineffective planning and monitoring of appropriate strategies to complete the task.
5 Communicating Communicate psychological ideas and information in a concise, focussed and logical manner to meet the demands of the assessment task.	Assignment lacks logical structure and/or relevant psychological information to communicate ideas.
6 Referencing Cite and reference sources of information within body of text and reference list according to APA format (if relevant).	Sources of information are inaccurately referenced or not shown.

* Teachers must indicate to their students which aspects of each criterion are applicable to the relevant assessment task that has been set for their class.

2 TO 3	4 TO 5	6 TO 7
Correct use of psychological terminology appropriate to the assessment task.	Correct and appropriate use and understanding of the psychological terms, concepts and practices in a manner that directly relates to meeting the demands of the assessment task.	Accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices to clearly meet the demands of the assessment task.
Demonstrates understanding of the task and summarises information to state conclusion. Relies on source material rather than transform psychological information to demonstrate higher order thinking.	Able to differentiate the key elements of the task and psychological understandings and draw logical conclusions. Uses evidence-based arguments to support student's point of view.	Able to analyse and evaluate psychological information to draw insightful, appropriate and meaningful conclusions. Constructs evidence-based arguments to explain, analyse and justify the student's point of view including explanations, evaluations and applications.
Legitimate psychological sources have been located and used to address the requirements of the task.	A comprehensive range of relevant and legitimate psychological sources have been located and used effectively to address the requirements of the task.	
Development of strategies to complete the task.	Develops, monitors and executes of strategies to successfully complete the task. Displays initiative, independence, critical reflection and cooperation while completing the task.	Displays initiative, independence, critical reflection and cooperation throughout the process of completing the task. Develops, monitors and executes effective and efficient strategies to successfully complete the task.
Logical structure is used to communicate psychological ideas in an appropriate manner suitable for the intended audience.	Focused and logical structure is used to communicate psychological ideas and information in a clear and concise manner suitable for the intended audience.	
Sources of information are correctly referenced and cited using APA format.		

UNIT 4 AOS 2

MENTAL HEALTH

'Mental health' is a goal for the individual and for society as a whole. The more it is studied and the more it is understood, the clearer it becomes that prevention is better than cure and prevention is the ultimate goal.

Understanding of the biopsychosocial model is vital if we are to recognise, diagnose and treat mental illness and develop community values and behaviours that will promote mental health.

In this area of study, we dispel some of the myths and mystery surrounding mental health. Mental disorders are not incurable, they do not prevent a person from functioning successfully in society and most people who are violent do not suffer from mental illnesses.

All students will study the background to mental health and understand the biopsychosocial framework in terms of identifying and treating stress. In addition, one of the following optional areas will be studied: anxiety disorder – specific phobia; mood disorder – major depression; addictive disorder – gambling or psychotic disorder – schizophrenia.

OUTCOME

On completion of this unit the student should be able to differentiate between mental health and mental illness, and use a biopsychosocial framework to explain the causes and management of stress and a selected mental disorder.

(VCE Study Design 2013)

MENTAL HEALTH — WHAT IS 'NORMAL'?

KEY KNOWLEDGE

Concepts of normality and differentiation of mental health from mental illness.

(VCE Study Design 2013)

MENTAL HEALTH

According to the World Health Organization (WHO) (1998), mental health is a state of emotional and social well-being in which individuals realise their own abilities, can cope with the normal stresses of life, can work productively and can contribute to their community.

There are degrees of mental health. We may experience mental health problems when we have extra stress in our lives, such as if our family situation changes, we break up with a girlfriend or boyfriend, lose money or have examinations. Adjusting to these situations may lead to mental health problems that bring emotional and social difficulties.

MENTAL ILLNESS

A mental illness is a mental disorder that affects one or more functions of the mind, and can interfere with a person's thoughts, emotions, perceptions and behaviours. It is a serious departure from normal functioning and can cause considerable stress and suffering for the person and their close friends and family. A mental disorder implies the existence of a clinically recognisable set of symptoms and behaviours that usually need treatment to be alleviated (WHO, 1992). Mental illness is more severe and ongoing than a mental health problem.

Approximately 20–30 per cent of people in Australia will experience a mental illness at some time in their lives. Mental illnesses can manifest at any time throughout the lifespan. Some mental health problems have symptoms that are evident very early on, while others arise later in life.

The nature and severity of a mental illness may vary from person to person. Many only have one short-lived episode and fully recover; others may have a lifetime battle with mental illness. With psychological support and (often) medication, the majority of people living with a mental illness can lead full, active and successful lives.

WHAT IS NORMAL?

A behaviour is generally considered to be normal when it helps a person to assimilate appropriately into their society and culture and to function independently as expected for their age. Mental illness is one aspect of life that can make people behave in ways that are not normal, because the behaviours interfere with the person's daily living. This means that we regard mental illness as contributing to abnormality according to the functional and medical definitions.

If you studied Units 1 & 2 Psychology, you will remember that there are many ways of describing 'normality' – including Functional; Historical; Medical; Situational; Societal and cultural and Statistical.

Because we are concerned with the Biopsychosocial model, we consider here the two approaches to describing normality that are most relevant to mental illness – the Functional approach and the Medical approach.

FUNCTIONAL APPROACH TO NORMALITY

We have probably all had a time when we have shown behaviours which, if taken to extremes, would be considered 'abnormal'.

Have you ever avoided going to a party because you were afraid that you would not know many of the other guests? In itself, that would be 'normal' behaviour but, when such thoughts, feelings and behaviours are so widespread that they cause a person to avoid all social contact, then a mental illness – social phobia – may exist.

MEDICAL APPROACH TO NORMALITY

The medical approach to normality states that a person's state of mental health is determined by a set of symptoms. If a mental illness is diagnosed, then treatment is required – psychological, pharmaceutical or both.

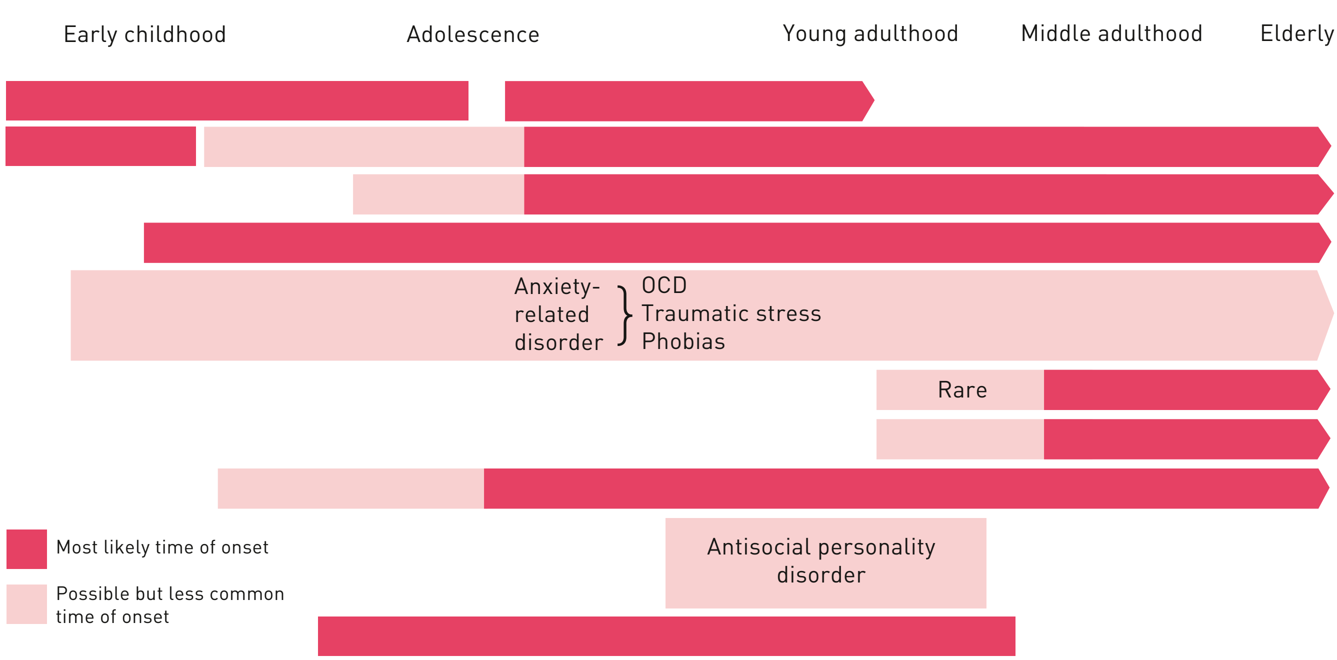


FIGURE 1 Age of onset of common mental health problems

REVIEW 1

1 What is the essential difference between mental health problems and mental illness?
2 How can you maintain good mental health?
3 How should you seek help if you or a friend shows symptoms that may reflect a mental health problem?

MHCA — BE ACTIVE FOR YOUR MENTAL HEALTH

Check out the Mental Health Council of Australia website for fact sheets on good mental health.

Good mental health helps us to more fully enjoy the people and environment around us and to be successful in our daily lives.

To build and maintain your mental health there are three things you can do:

Act — Strive to keep yourself as active as possible, physically, socially and mentally—walk, swim, read ...

Belong — Connect to your community — join a group, chat to a neighbour, meet a friend ...

Commit — Look to the future and have a go — take a challenge, get involved, volunteer ...

INVESTIGATE 1

MYTHS, MISUNDERSTANDING AND FACTS ABOUT MENTAL ILLNESS

There are many myths and misunderstandings about mental illness. Education plays a key role in overcoming negative stereotypes and helping to support people suffering from mental illness.Using the internet, research the following questions:

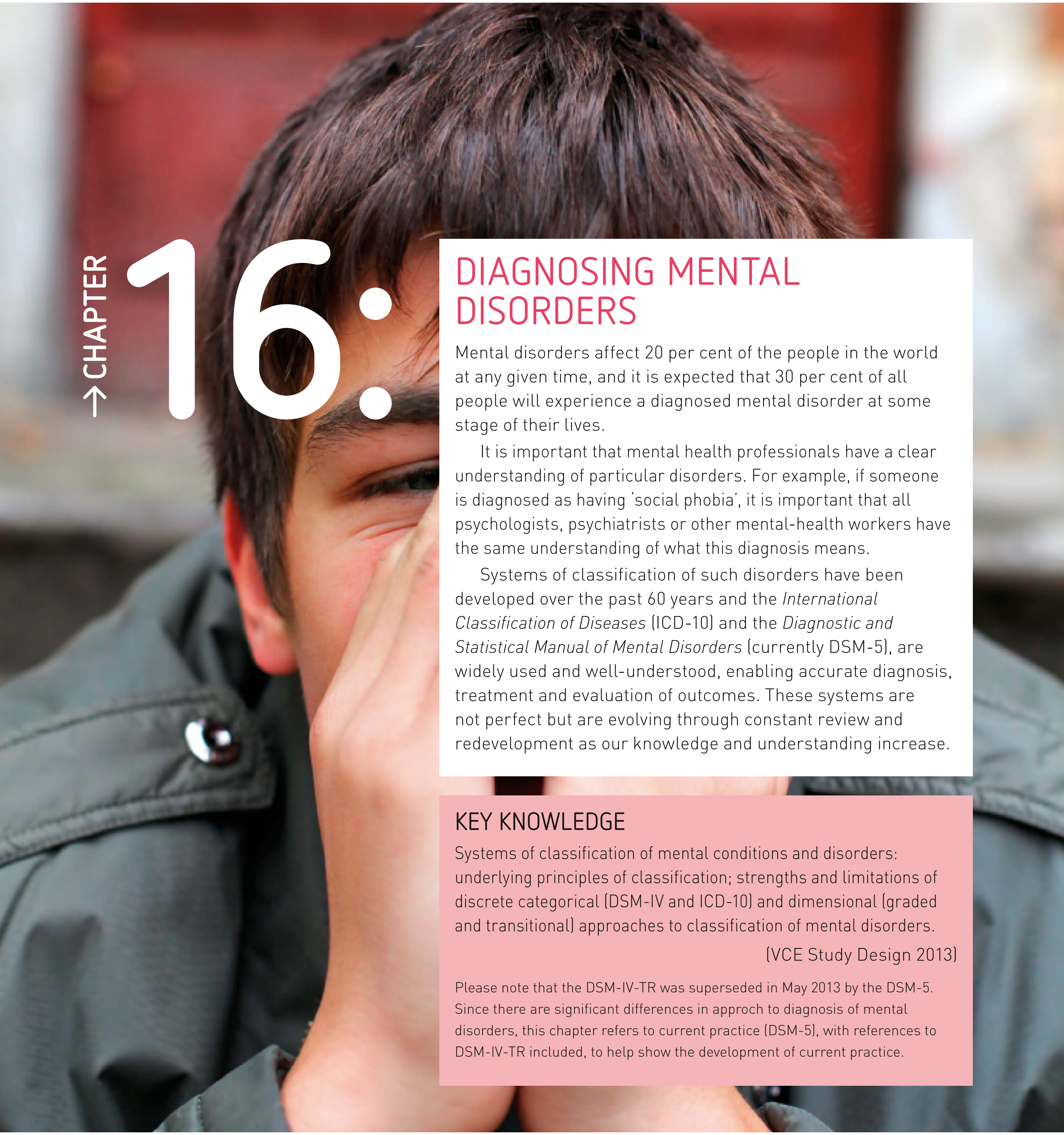
- Are mental illnesses a form of intellectual disability or brain damage?
- Are mental illnesses incurable and life-long?
- Are people born with a mental illness?
- Can anyone develop a mental illness?
- Are people with a mental illness usually dangerous?
- Should people with a mental illness be isolated from the community?

TAKE CARE!

Most mental disorders are exaggerated forms of normal thoughts, feelings and behaviours. You need to be careful, therefore, not to diagnose symptoms, within yourself or others, as being a mental illness.

SEEK HELP! KIDS' HELP LINE 1800 551 800

If you feel that you have symptoms that are intense and that interfere with the way you function in life, please seek professional help. Your school psychologist or a medical doctor would be a good person to consult in the first place—your GP can refer you to a psychologist.



CHAPTER 16:

DIAGNOSING MENTAL DISORDERS

Mental disorders affect 20 per cent of the people in the world at any given time, and it is expected that 30 per cent of all people will experience a diagnosed mental disorder at some stage of their lives.

It is important that mental health professionals have a clear understanding of particular disorders. For example, if someone is diagnosed as having 'social phobia', it is important that all psychologists, psychiatrists or other mental-health workers have the same understanding of what this diagnosis means.

Systems of classification of such disorders have been developed over the past 60 years and the *International Classification of Diseases* (ICD-10) and the *Diagnostic and Statistical Manual of Mental Disorders* (currently DSM-5), are widely used and well-understood, enabling accurate diagnosis, treatment and evaluation of outcomes. These systems are not perfect but are evolving through constant review and redevelopment as our knowledge and understanding increase.

KEY KNOWLEDGE

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.

(VCE Study Design 2013)

Please note that the DSM-IV-TR was superseded in May 2013 by the DSM-5. Since there are significant differences in approch to diagnosis of mental disorders, this chapter refers to current practice (DSM-5), with references to DSM-IV-TR included, to help show the development of current practice.

Mental disorders

CHAPTER OVERVIEW

MENTAL DISORDERS	
Communication and control	Use of DSM and ICD systems Importance of the diagnostic system Criticisms of these systems of diagnosis > Cultural variation > Validity of the categories > Writing by committee > Subjectivity > Health insurance Categories or dimensions? Dimensional diagnosis in action

> A mental disorder is a clinically significant behavioural or psychological syndrome or pattern that occurs in an individual and that is associated with present distress (e.g. a painful symptom) or disability (i.e. impairment in one or more aspects of functioning) or with a significantly increased risk of suffering, death, pain, disability or an important loss of freedom.
>
> (American Psychiatric Association 2000).

The term **disorder** was introduced by the American Psychiatric Association in its *Diagnostic and Statistical Manual of Mental Disorders* (DSM) in 1952. The term is sometimes wrongly used as synonymous with disease or syndrome, but the three terms have important differences in meaning.

SUPPORTING UNDERSTANDING

TABLE 16.1 Differences between disorder, syndrome and disease

TERM	MEANING	EXAMPLE
Disorder	A set of symptoms that interfere with daily functioning. Symptoms are reasonably consistent between patients but origins/ causes may differ	Post-traumatic stress disorder Major depression
Syndrome	A particular profile of symptoms. The origins and clinical severity may vary	Dyslexia
Disease	A condition with a known cause, predictable course and standard protocols for treatment	Malaria; Alzheimer's dementia

Communication and control

One of the roles of a psychologist is to diagnose mental illness. A classification system is used to identify symptoms and make a diagnosis. Naming a mental disorder allows better communication between psychologists, psychiatrists, other health-care workers and educators, and also helps to clarify and define variables in research in the area. A correct diagnosis is extremely important as it can assist with the course of treatment and control of the disorder and symptoms.

FIGURE 16.1 One of the roles of a psychologist is to diagnose mental illness.

The two main systems of classifying and diagnosing mental health disorders are the ***Diagnostic and Statistical Manual of Mental Disorders* (DSM)** and the ***International Classification of Diseases* (ICD)**.

The DSM, published by the American Psychiatric Association, is a handbook that is used to identify and classify symptoms of mental disorders. Diagnosis is based on a number of factors, including the person's medical condition, psychosocial stressors and the extent to which the person's mental state is interfering with everyday life. The DSM is *descriptive* – it does not specify the *causes* of the mental disorder nor does it direct the *treatment*, though it also includes the onset, course and persistence of symptoms.

There has been a series of revisions made to the DSM since it was first published in 1952. The DSM - currently the fifth edition, DSM-5 – is the most widely used classification system in Australia.

The ICD is produced by the World Health Organization. Like the DSM, it is descriptive and largely based on the symptoms reported by the patient and criteria ranked as important by professionals. It does not consider causes or possible treatment. It has undergone many revisions and is currently up to its tenth (ICD-10). ICD-11 is expected to be published in 2015.

The ICD has become the international tool for diagnosing most health problems, including both physical and mental illness. It therefore covers a wider range of illnesses than the DSM, which is more commonly used to diagnose mental health conditions. Interestingly, mental disorders were not included in the ICD until its sixth revision in 1952 – the same year that the first edition of the DSM (DSM-I) was published. The number of disorders has increased as the different revisions have been published (see Table 16.2).

There is extensive overlap between the ICD and DSM, with many, but not all, mental disorders having virtually identical criteria. There are, however, many categories used in the DSM that are grouped into a single category in the ICD. For instance, *neurotic, stress-related* and *somatoform disorders* appear under one category in the ICD, while the DSM divides these into four different categories (*anxiety disorders*, *somatoform disorders*, *dissociation disorders* and *adjustment disorders*).

Because over 200 countries are involved in the construction of the ICD, it is less dynamic and less responsive to new ways of thinking about mental health issues than the DSM.

TABLE 16.2 Number of disorders in different DSM revisions

PUBLICATION	YEAR	NUMBER OF IDENTIFIED DISORDERS
DSM-I	1952	106
DSM-II	1968	182
DSM-III	1980	265
DSM-IIIR	1987	292
DSM-IV	1994	365
DSM-IV-TR	2000	365
DSM-5	2013	Approx. 365

16.1 REVIEW

1. Define 'mental disorder' using your own words.
2. Why is it important for psychologists and other mental health professionals to label and identify different mental disorders?
3. Name the two main systems available for identifying mental disorders. How do they differ?

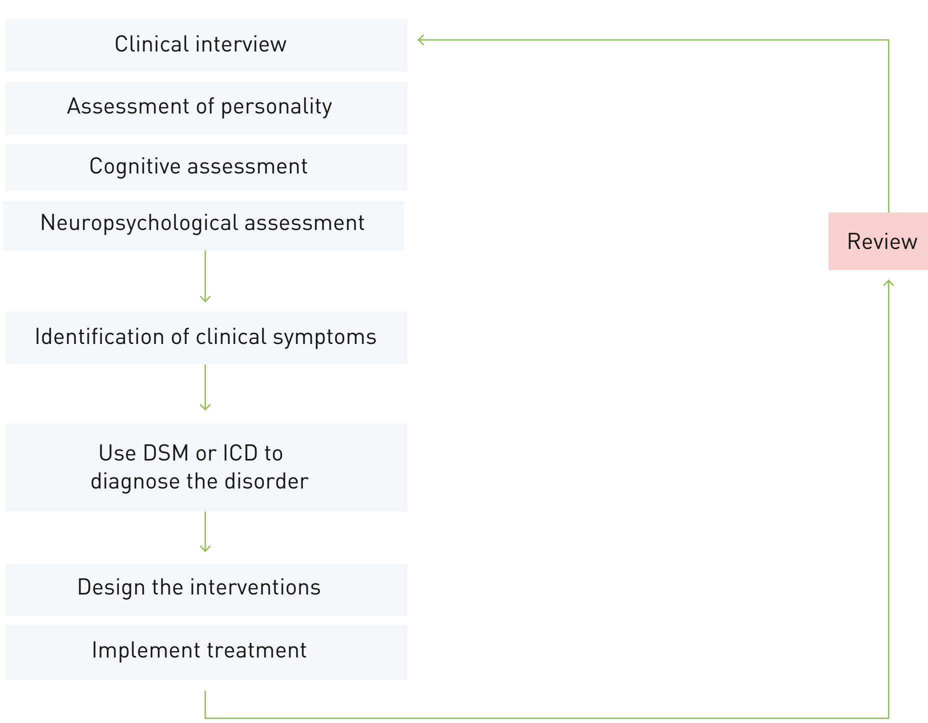


FIGURE 16.2 The steps in intervention when a person presents to a psychologist with a mental health problem, showing the role of the DSM or ICD in this process

SUPPORTING UNDERSTANDING

Use of DSM and ICD systems

The DSM-IV-TR system of 5-axis diagnosis was an attempt to standardise diagnoses. It was considered to be too restrictive and the DSM-5 has now increased the importance of dimensional descriptions of disorders.

TABLE 16.3 Axes used in identifying presenting issues

AXIS I *CLINICAL DISORDERS: ANY MAJOR PSYCHOLOGICAL DISORDER*	
Disorder	Example
Disorders usually first evident in infancy, childhood or adolescence	ADHD Stuttering
Substance-related disorders	Substance (alcohol/drug) abuse
Schizophrenia	Paranoid schizophrenia
Mood disorders	Major depressive disorder Bipolar disorder
Anxiety disorders	Simple phobias Generalised anxiety disorder

AXIS II *MENTAL RETARDATION AND PERSONALITY DISORDERS* **1. MENTAL RETARDATION: INTELLECTUALLY WELL-BELOW AVERAGE (LOWEST 5 PER CENT OF POPULATION)** **2. PERSONALITY DISORDERS**	
Disorder	Example
Paranoid personality disorder	Suspicious of others, constantly perceiving other people as threatening
Antisocial personality disorder	Lacking affection for others; hurt others without remorse
Borderline personality disorder	Lack of sense of identity; mood swings; manipulation of others; impulsive behaviours
Obsessive-compulsive personality disorder	Preoccupation with order/cleanliness/routines

AXIS III *GENERAL MEDICAL CONDITIONS*	
Disorder	Example
Any physical disorder	Diabetes, cancer, hypertension (high blood pressure), heart disease

AXIS IV *PSYCHOSOCIAL AND ENVIRONMENTAL PROBLEMS*	
Problems	Example
The psychologist makes references to social and environmental stressors experienced by the person over the past year	Isolation; family break-up; unemployment

AXIS V *GLOBAL ASSESSMENT OF FUNCTIONING (GAF) (A 'SCORE' ASSIGNED BY PSYCHOLOGIST)*	
Sample score	**Symptoms**
90	Minimal symptoms, good functioning in all areas
70	Some mild symptoms or some difficulty in social, occupational or school functioning but generally functioning quite well
40	Some impairment in reality testing or communication or major impairment in family relations, judgement, thinking or mood
20	Some danger of hurting self or others, occasional failure to maintain minimal personal hygiene or gross impairment in communication

A person will often have diagnoses on both Axis I and Axis II. Consider, for example, the DSM multiaxial evaluation of 'Julia', age 38:

- Axis I: major depressive disorder
- Axis II: dependent personality disorder
- Axis III: type 1 (insulin-dependent) diabetes
- Axis IV: psychosocial stressors include husband being made redundant, teenage son facing Children's Court for vandalism
- Axis V: current GAF is 55.

Did you know?

The results of Rosenhan's 1973 study caused a sensation among those who treat the mentally ill and led to an additional study in which Rosenhan told a particular psychiatric hospital that he was going to send a number of 'fake' patients in a certain three-month period. At the end of the three months, staff at this hospital reported that of the 193 patients that had been admitted, 41 were suspected of being 'fakes' by at least one staff member. In actual fact, Rosenhan had not sent any 'fakes' at all – each was a genuine patient!

Importance of the diagnostic system

If a proper diagnostic system such as DSM or ICD had been used, the following famous study by Rosenhan (1973) may have had completely different results.

Eight psychologically 'normal' people visited eight different psychiatric hospitals in the United States, complaining that they had heard voices saying 'empty', 'hollow' and 'thud'. In addition to these false symptoms, the participants gave false names and occupations.

All eight were admitted to the psychiatric hospitals. Seven of them were immediately diagnosed with schizophrenia and the eighth with 'manic depression' (now called bipolar disorder). Once admitted to hospital, the participants stopped complaining of hearing voices. On average, they stayed for 19 days (the range being 7–52 days).

At the end of their hospitalisation, each participant was discharged with a note on their medical record stating that their condition was 'in remission', meaning that they were showing no signs of the disorder – but not one of them was told that they no longer suffered from a mental illness. Interestingly, some of the other patients at the hospitals suspected Rosenhan's participants of being 'fakes'.

Note that because none of the fake 'patients' received any form of treatment, there was really no need to label them with a diagnosis at all – they should more appropriately have been taken in for observation.

Rosenhan's studies highlighted the issues surrounding diagnosis. Misdiagnosis raises issues surrounding the justification of treatments. It also indicates the importance of recognising that a person may have completely recovered from a mental illness.

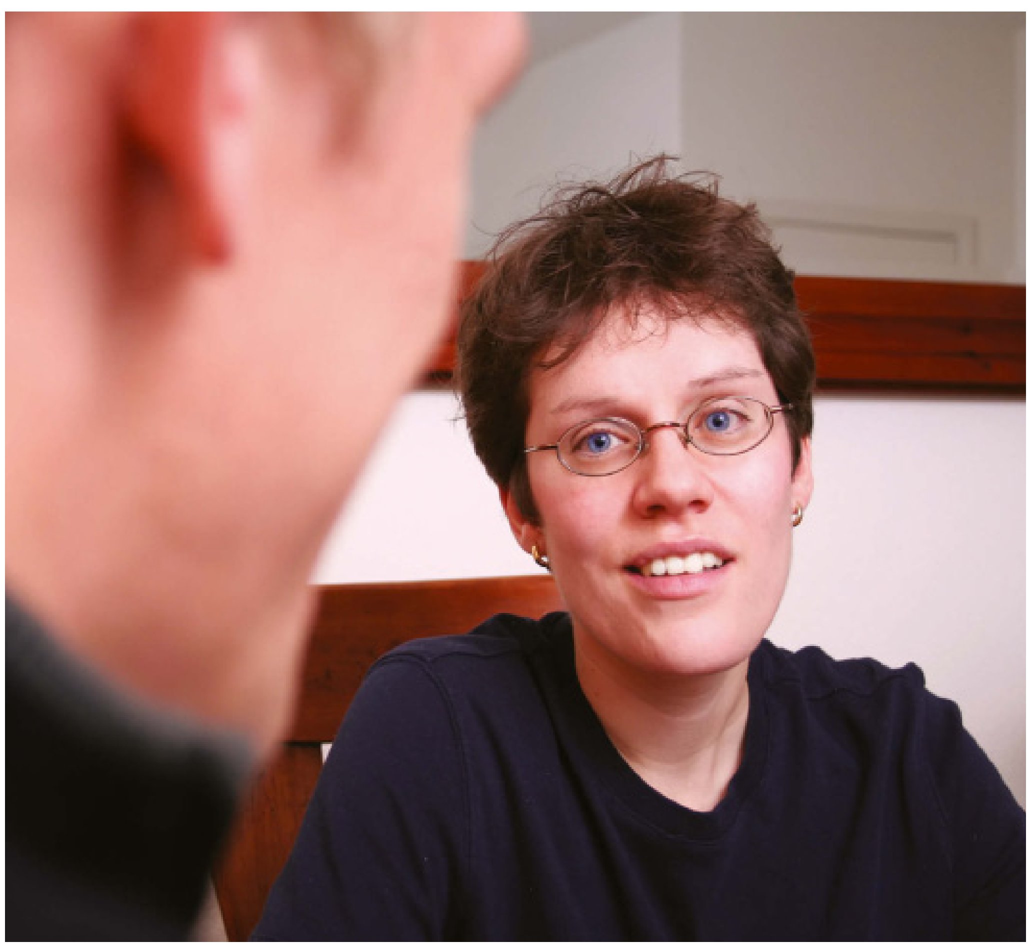


FIGURE 16.3 It is important to recognise that a person may have completely recovered from a mental illness.

16.1 INVESTIGATE

EVALUATION OF RESEARCH

1 Suggest an aim for Rosenhan's 1973 study.
2 Write an experimental hypothesis for this study.
3 Identify the independent and dependent variables.
4 What conclusion can be drawn from the outcome of this experiment? Explain your answer in terms of the participants and in a possible real-life situation.
5 Why do you think that Rosenhan decided to set up the 1973 study in the first place?

FIGURE 16.4
Homosexuality was considered a mental illness prior to 15 December 1973.

Criticisms of these systems of diagnosis

CULTURAL VARIATION

The DSM is created based on American culture, tradition and mores. As illustrated by the example of Prea (see the Prea case study on page 458) this may not always be appropriate.

Appendix I of the DSM gives instructions for diagnosing people within their cultural context.

VALIDITY OF THE CATEGORIES

The goal of the system has been to enable and increase the consistency of diagnosis but it can be argued that this means that the validity of the categories may be overlooked. It is possible that a very precise and specific description may not truly reflect a disorder – for example, on 15 December 1973, homosexuality was removed from being classified as a mental illness. On this day, millions of gay people across the world were 'cured' of what had previously been considered to be a mental disorder!

CASE STUDY

PREA

If you studied Psychology in Year 10 and used the companion book to this text, you may remember the story of Prea, a 25-year-old woman:

> At times, I am controlled by a spirit. I can never predict when it will take hold of me. It is very powerful and makes me say and do all sorts of things – some of them I can't even remember. The spirit has been with me since I was 15 years old.

When you read such a statement, you may immediately be inclined to think that Prea was suffering from a mental illness such as schizophrenia or dissociative identity disorder (DID), which used to be called multiple personality disorder (MPD). But you need to be careful – there is more to Prea's story!

Prea comes from a small village in Northern Sudan. In this society, it is common for females to report spiritual possession – in fact, about 45 per cent of females over 15 years of age report this phenomenon (Boddy 1988). From a societal and cultural view, Prea is normal!

FIGURE 16.5 Prea, who comes from North Sudan

WRITING BY COMMITTEE

The fact that the DSM criteria are created in discussion by multidisciplinary committees can be both a strength and a weakness.

Eloquent and persuasive committee members may have a disproportionate influence on the committee listing the diagnostic criteria for a particular disorder; this could lead to new conditions being added as disorders – or to others being removed – despite lack of empirical evidence to support these decisions.

SUBJECTIVITY

Classification is based on symptoms reported by the person or behaviours they are subjectively observed to exhibit in the judgment of others. People may not disclose subjective feelings, such as intense anxiety, unhappiness or distress. People may also be indifferent to or unaware of their condition. This is especially true of a psychotic illness such as schizophrenia – where thought processes are, by definition, irrational, yet the patient believes they are thinking clearly. All these factors can make diagnosis difficult.

FIGURE 16.6 People suffering from schizophrenia may be unaware of their condition.

HEALTH INSURANCE

Although used worldwide, the DSM is created by the American Psychiatric Association with a view to its use in the United States. The health insurance industry in the USA is very commercial and often will only pay for treatment for mental disorders that are listed in the DSM. As a result, there is a great tendency for conditions such as *alcohol addiction* or *pathological gambling disorder* to appear as diagnosable conditions in their own right, rather than (possibly) being symptomatic of other conditions.

REVIEW 16.2

1 List five criticisms that have been made of the DSM system.
2 Write a one-sentence summary of each of these criticisms.

INVESTIGATE 16.2

GENDER DYSPHORIA (FORMERLY GENDER IDENTITY DISORDER)

Gender dysphoria, commonly presenting as transsexualism, is a condition in which a person identifies with the opposite sex and desires to live as a member of that sex. Gender dysphoria is classified as a mental disorder in the DSM-5. Films such as *Boys Don't Cry* portray the lives of those who are transsexual.

Do you think Gender dysphoria should be classified as a mental disorder? Give reasons for your answer.

FIGURE 16.7 Hilary Swank (right) portrayed Brandon Teena, a transsexual man, in *Boys Don't Cry*.

Categories or dimensions?

If you go to your doctor with a cough and high temperature, the doctor will probably take a blood test to determine exactly what the illness is so that appropriate treatment decisions can be made.

Psychological illnesses do not always fit into such neat categories and very often a person with one diagnosed disorder will have symptoms of one or more others (Kessler *et al.* 2005). These are referred to as 'comorbidities'. If the categories really are separate and discrete disorders, then there should be no greater percentage of people who have generalised anxiety disorder (GAD) being diagnosed as depressed than the percentage in the general population; however, this is simply not the case. People diagnosed with GAD are many times more likely to be depressed than people with no other psychological condition and the most common presentation of mood disorder is actually a comorbidity of the conditions of anxiety and depression.

A problem with categorical classifications is the tendency for stereotyping and labelling with a lack of flexibility in diagnosis – patients being seen as either having the disorder or not, with no difference among individuals.

The DSM-5 and proposed ICD-11 have moved towards a less categorical structure by introducing dimensional classifications, especially of personality disorders. This would mean that mental health professionals would rate an individual on the extent to which they show personality characteristics such as the following:

- **neuroticism** (with emotional stability as its opposite), which means a person is anxious, stressed, depressed and self-conscious
- **agreeableness** (with self-interest and suspicion as its opposite), which means a person is compassionate and trusting
- **conscientiousness** (laziness and carelessness as its opposite), which means that a person is self-disciplined and reliable.
- other possible dimensions would be **compulsiveness**, **antisocial responses** and **social withdrawal**.

Dimensional diagnosis in action

To apply the full biopsychosocial model, it is necessary to move away from the practice of simply slotting patients into convenient categories and to relate the diagnoses more directly to the individual.

The DSM-5 makes the following statements:

> Although the DSM-5 remains a categorical classification of separate disorders, we recognize that mental disorders do not always fit completely within the boundaries of a single disorder. Some symptom domains, such as depression and anxiety, involve multiple diagnostic categories and may reflect common underlying vulnerabilities for a larger group of disorders. (p. xii).

This corresponds with the new arrangement for the ICD-11 planned for release in 2015.

Did you know?

If autism consists of 80 pieces selected at random from 100 pieces, how many different combinations are possible?

It's easy to work out: 100 x 99 x 98 x 97 x 96 ... all the way down to x 81 x 80. This would be a number very close to 81 followed by 21 zeros – approximately 12 trillion times as many as there are people in the world. Doesn't this show why labeling all autistic people as if they were identical is totally inappropriate?

> 'DSM-5 has moved to a nonaxial documentation of diagnosis (formerly Axes I, II and III), with separate notations for important psychosocial and contextual factors (formerly Axis IV) and disability (formerly Axis V).' (p. 16)

You can see that this is how DSM and ICD aim to include the full biopsychosocial model.

Professor Tony Attwood from the University of Queensland is arguably one of the world's greatest experts in this area. In 2009 he held a workshop in Melbourne at which Attwood made a memorable statement:

> Asperger's syndrome (high-functioning autism) is like a 100-piece jigsaw puzzle. You find one piece, then another and another and begin to build up the picture; when you get to 80 pieces, you diagnose the condition … There's probably no one in the world with all 100 pieces – and all of us have at least 10. There are also many individuals who have 50, 60 or 70 pieces.

This shows the dimensional nature of this type of condition and the need for dimensions in its diagnosis.

SUPPORTING UNDERSTANDING

The following statements from DSM-5 help to explain the change in emphasis from the DSM-IV.

'On the basis of the published findings of … ICD-11 and DSM-5 … it was demonstrated that clustering of disorders according to what has been termed *internalizing* and *externalizing* factors represents an empirically supported framework.' (p. 13) This means that they are differentiating, for example, depressive, somatic or anxiety symptoms from conditions with significant impulsivity, conduct disorders, addictions and antisocial behaviours.

The aim has been to '… keep the DSM-5 central to the development of dimensional approaches to diagnosis that will likely supplement or supersede current categorical approaches in coming years.' (p. 13)

'To improve clinical utility, DSM-5 is organized on developmental and lifespan considerations.' (p. 13). This demonstrates a significant change in organisation from DSM-IV-TR.

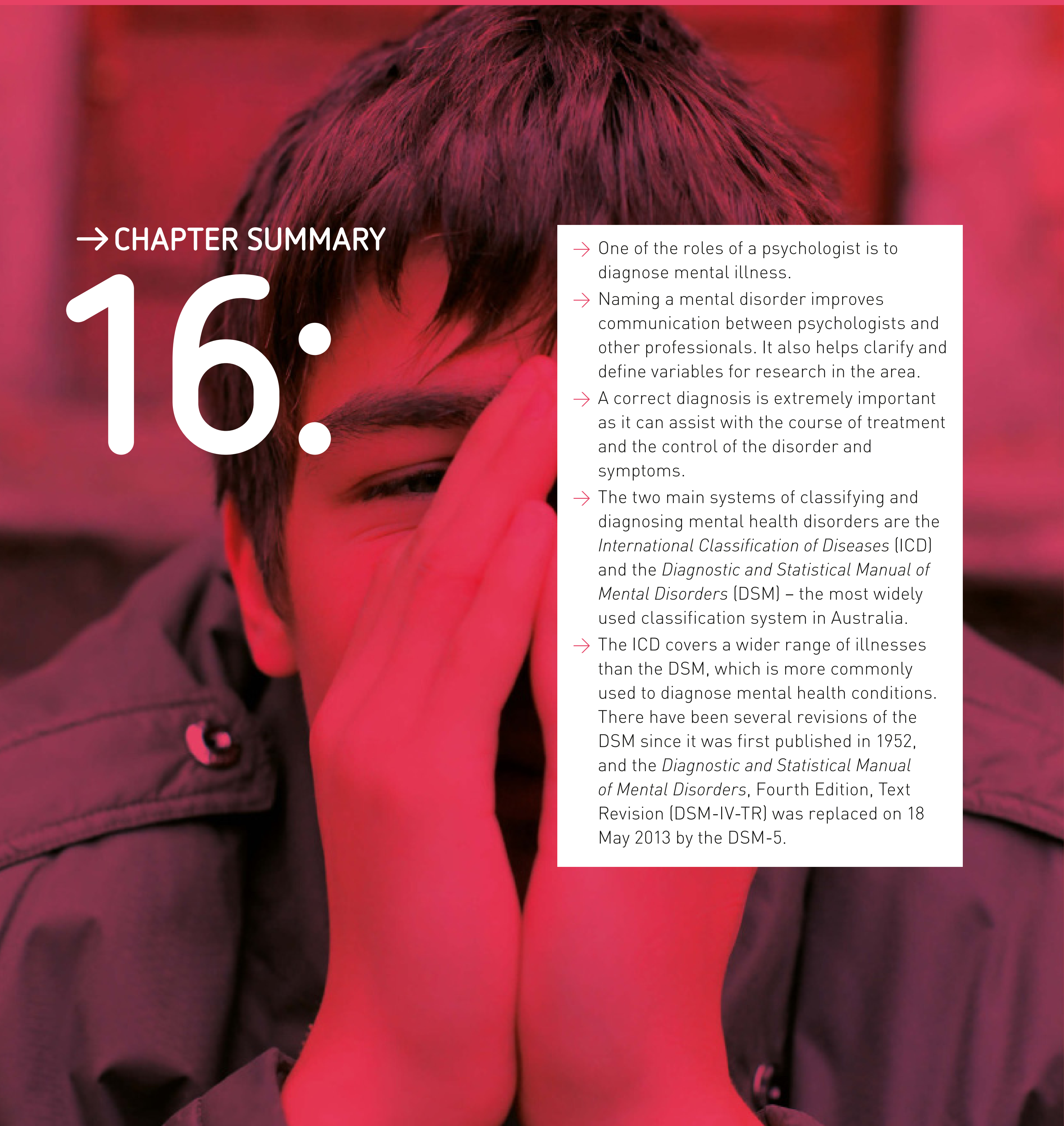
VISUAL PRESENTATION

INVESTIGATE 16.3

Create a visual representation in the form of a flow chart or table outlining the criticisms of the DSM systems.

The Mind Disorders website has some valuable information to assist in the completion of this task.

If you have a smartphone or tablet, you can also download the (free) app 'Mental Illness'.



→ CHAPTER SUMMARY

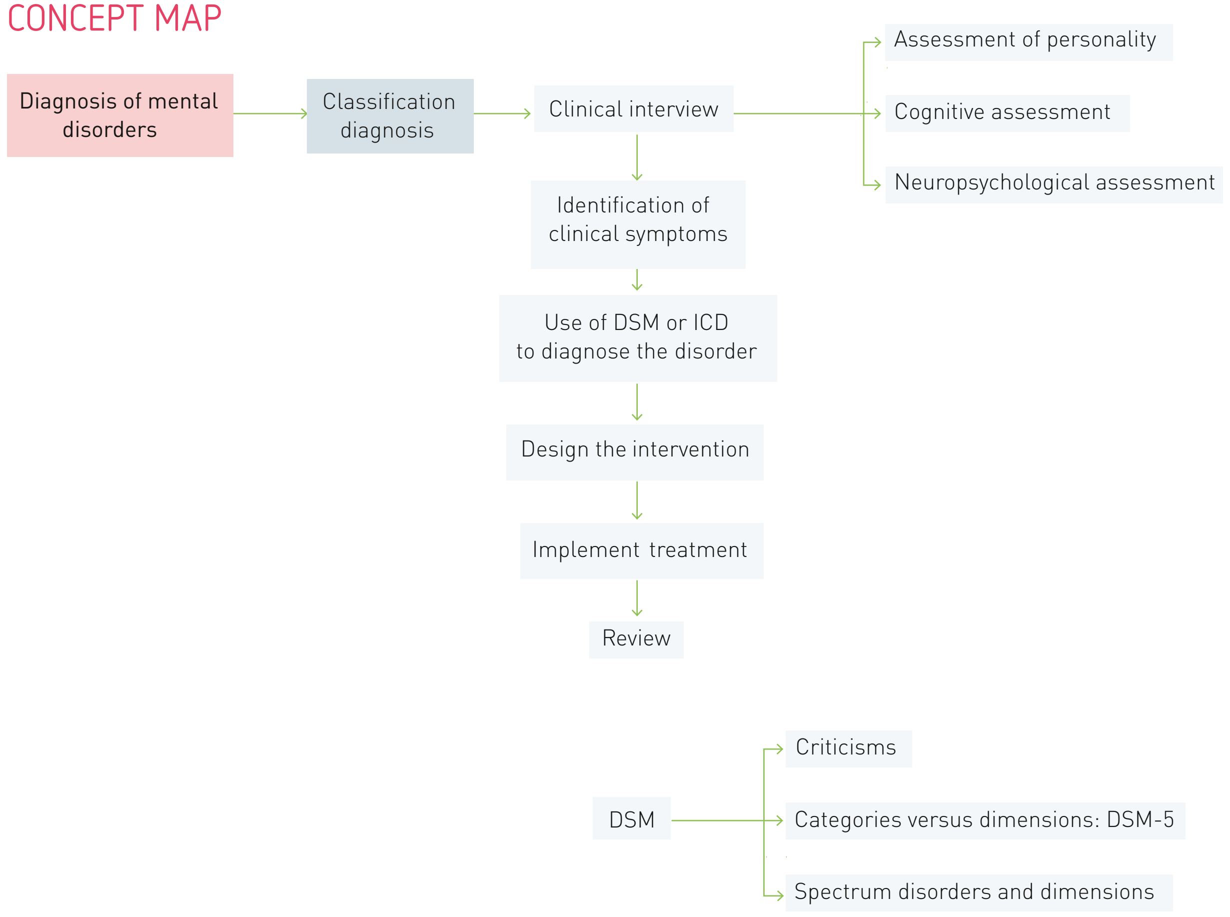
16:

- One of the roles of a psychologist is to diagnose mental illness.
- Naming a mental disorder improves communication between psychologists and other professionals. It also helps clarify and define variables for research in the area.
- A correct diagnosis is extremely important as it can assist with the course of treatment and the control of the disorder and symptoms.
- The two main systems of classifying and diagnosing mental health disorders are the *International Classification of Diseases* (ICD) and the *Diagnostic and Statistical Manual of Mental Disorders* (DSM) – the most widely used classification system in Australia.
- The ICD covers a wider range of illnesses than the DSM, which is more commonly used to diagnose mental health conditions. There have been several revisions of the DSM since it was first published in 1952, and the *Diagnostic and Statistical Manual of Mental Disorders*, Fourth Edition, Text Revision (DSM-IV-TR) was replaced on 18 May 2013 by the DSM-5.

- The number of disorders has increased as the different revisions have been published and now stands at approximately 365.
- When a person presents to a psychologist with a mental health problem, the steps in intervention are as follows:
  - clinical interview
  - assessment of personality, cognitive or behavioural traits
  - neuropsychological assessment
  - identification of clinical symptoms
  - use DSM or ICD to diagnose the disorder
  - design the interventions
  - implement treatment
  - review intervention.
- Criticisms of the DSM system include issues to do with:
  - cultural variation
  - validity of the categories
  - writing by committee
  - subjectivity
  - health insurance.
- Psychological illnesses do not fit into neat categories as most medical conditions do, and very often people with one diagnosed disorder have symptoms of one or more other disorders. The latest version of DSM and the proposed new ICD take this into consideration.
- The fifth edition of the DSM (DSM-5) was moved towards a less categorical structure by introducing dimensional classifications, particularly of personality disorders.
- Autistic disorder and high-functioning autism are referred to as 'spectrum disorders', where autism grades into high-functioning autism.
- The condition previously known as 'Asperger's disorder' has now been absorbed into 'Autism Spectrum Disorders'.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

categorical diagnosis
dimensional diagnosis
disease
disorder
DSM
global assessment of functioning (GAF)
ICD
multiaxial diagnosis
neurosis
psychosis
Rosenhan
syndrome

KEY IDEAS

For the exam, you must know:

- the two main systems of classifying and diagnosing mental health disorders: the *International Classification of Diseases* (ICD) and the *Diagnostic and Statistical Manual of Mental Disorders* (DSM), which is published by the American Psychiatric Association
- the fourth edition text revision of the DSM (DSM-IV-TR) was the most widely used classification system in Australia; it was superseded in May 2013 by the DSM-5.
- the steps in intervention when a person presents to a psychologist with a mental health problem, showing the role of the DSM or ICD
- criticisms of the DSM system
- the use of categories or dimensions in diagnosis, particularly of personality disorders.

RESEARCH METHODS

The diagnosis of mental illness is an in-depth investigation of an individual. Each is therefore a *case study*. You should be familiar with the strengths and weaknesses of this form of research.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Which of the following statements is correct?
   a The ICD and DSM are produced by the American Psychiatric Association.
   b The ICD and DSM are produced by the World Health Organization.
   c The ICD is produced by the World Health Organization and the DSM is produced by the American Psychiatric Association.
   d The DSM is produced by the World Health Organization and the ICD is produced by the American Psychiatric Association.

2 Which statement is true for both ICD and DSM?
   a These systems of classification of mental conditions and disorders are both mainly dimensional systems.
   b These systems of classification of mental conditions and disorders are both mainly categorical systems.
   c The ICD system of classification of mental conditions and disorders is mainly categorical while the DSM is mainly dimensional.
   d The DSM system of classification of mental conditions and disorders is mainly categorical while the ICD is mainly dimensional.

3 The DSM is now in its fifth edition. This is referred to as:
a DSM-VII.
b DSM-VI.
c DSM-5.
d DSM-IV-TR2.

4 DSM and ICD are moving to a more dimensional system of diagnosis. This is a progressive move fromthe formerly ________ system.
a classified
b categorical
c critical
d classical

5 A problem with a categorical system of diagnosis of mental health conditions is that:
a it can lead to labelling.
b it can lead to stereotyping.
c it limits flexibility in diagnosis.
d all of the above are true.

6 Approximately how many mental health conditions are identified by the DSM-5?
a 465
b 365
c 265
d 165

7 Professor Rosenhan's study in 1973 showed the inadequacy of the diagnostic procedures at the time. Which version of the DSM would have been in use at the time and approximately how many mental health conditions had been described at that stage?
a DSM-I; almost 100
b DSM-II; almost 200
c DSM-III: almost 400
d DSM-IV; almost 500

8 Each of Rosenhan's participants was discharged with their diagnosed mental disorder 'in remission'. What does this mean?
a The participants still have the condition but there are no active symptoms.
b The participants have been cured of the condition.
c The participants never had the condition – a misdiagnosis had been made.
d The participants still have symptoms but they are not serious enough to require hospitalisation.

9 What is a criticism of the DSM?
a Mental health conditions do not fall easily into categories and comorbidities are common.
b Some conditions may be added or removed due to opinions rather than research.
c The classifications are based on United States norms and beliefs and may not apply to a range of cultures.
d All of the above.

10 What are the type of mental disorders considered most appropriate for the use of dimensional diagnoses?
a mood disorders
b anxiety disorders
c schizophrenic disorders
d personality disorders

11 One difficulty in forming a diagnostic system for mental disorders is that:
a mental disorders fall cleanly into categories but there are too many of them.
b mental disorders do not fall cleanly into categories.
c mental disorders can be tested by examining a patient's genetic structure.
d mental disorders are known to be created by specific preconditions.

12 One particular strength of the DSM system is that:

a members of the committees are all medical doctors who have a good understanding of the medical model of disease.

b members of the committees are all psychiatrists and psychologists who have a good understanding of mental health issues.

c members of the committees are from a variety of health professions so that there is a broad understanding of mental health issues.

d the committee members represent over 200 countries so there is a broad cross-cultural view of mental health issues.

SHORT ANSWER

13 Distinguish 'disease' from 'disorder' and give one example of each.

4 marks

14 Explain what is meant by the following sentence: 'The DSM is descriptive – it does not specify the causes of the mental disorder nor does it direct the treatment.'

3 marks

15 What are some problems with categorical diagnostic tools such as ICD and DSM?

3 marks

THE BIOPSYCHOSOCIAL MODEL

KEY KNOWLEDGE

Use of a biopsychosocial framework (the interaction and integration of biological, psychological and social factors) as an approach to considering physical and mental health).

(VCE Study Design 2013)

The biopsychosocial model was first developed by George L. Engel in 1977 who believed that to truly understand and treat a person's mental and/or physical illness, it was important to consider their condition in terms of biological, psychological and social influences (Engel 1977; Borrell-Carrio, Suchman & Epstein 2004). His model was a 'holistic' option to the traditional biomedical model that had separated the body and the mind for centuries. The biomedical approach tended to treat the individual from a purely physiological and molecular or cellular level in a distant and impersonal manner that ignored human distress. Engel also believed that the clinician/doctor/psychologist had an important role in influencing the course of both treatment and the person's recovery. If the clinician was perceived to be uncaring and disinterested in the patient, the recovery could be hampered and delayed. His aim was to bring greater 'empathy and compassion' into the patient-practitioner relationship, with the objective of attaining a better recovery outcome.

According to Engel, biological factors include physiological/anatomical, neurotransmitters, genetic factors, gender, age and ethnicity. Psychological factors are the individual's subjective perceptions, personality predisposition and their unique thoughts, feelings and behaviours. Social influences include family, friends, societal expectations and available services, cultural background and environment. The biopsychosocial model became a 'collaborative pathway to health'.

The biopsychosocial model has developed since its first inception and has been applied successfully in both medical and organisational settings. It considers questions such as:

- Is there a family history of physical or mental illness?
- Is this person experiencing psychological distress (sadness, anxiety) because of an underlying physiological condition?
- Does their personality determine how well or how poorly they cope with stress?
- Are there any difficulties at home, school or work?
- Does their cultural background exert any extraordinary pressures or expectations that may be affecting them?
- What social support structures do they have in place?

This path of inquiry underpins the biopsychosocial framework and reflects an all-encompassing approach by the practitioner.

Biological factors
> bodily structures
> biochemical processes
> genetics

Psychological factors
> individual's personality predisposition
> thoughts, feelings and behaviours (e.g. sadness, depression, anxiety)

Social/cultural factors
> home
> school
> friends
> work
> societal expectations
> cultural expectations

Biopyschosocial Model

Biological, psychological and social/cultural influences are considered together in the assessment and treatment of mental and physical health.

A 'holistic' approach that was a collaborative pathway to mental and physical health.

FIGURE 1 This biopsychosocial model considers three broad areas in assessing and managing mental and physical health.

Biological factors

This aspect of the biopsychosocial model considers a person's functioning in terms of bodily structures such as the brain and nervous system, biochemical processes (for example the role of particular neurotransmitters) and genetic predisposition (what has been inherited). It explains behaviour in terms of physiology.

Types of assessment/treatment include:

- neuroimaging—devices such as computerised axial tomography (CAT scan), positron emission tomography (PET scan), electroencephalogram (EEG), magnetic resonance imaging (MRI) or functional magnetic resonance imaging (*f*MRI)
- medication—antidepressants (for depression), psychotropic drugs (to manage delusions and hallucinations), mood stabilising drugs (to assist with anxiety).
- neuropsychological testing—such as questionnaires and intelligence quotient tests
- medical procedures.

Psychological factors

Psychological factors such as the following are taken into account:

- personality—an individual's personality predisposition. For example, are they outgoing (extroverted) or reserved (introverted)? Are they confident or fearful? What coping strategies do they use?
- behaviour—what the individual's behaviour says about them. Is it conscious or unconscious? Are they aware of what they are doing or what consequences their actions might have for themselves or others?
- perception—the individual's awareness of themselves and the universe around them

- cognition—the way in which they process information and their intelligence and decision-making skills
- attention—what incoming information do they focus on and what do they ignore?
- motivation—what drives them to behave or think in a particular way?

Social factors

A range of social and cultural influences can either increase a person's resilience or contribute to their ill health. These influences can include:

- school environment or pressures
- work environment or pressures
- level of education
- availability and access to appropriate medical and support facilities
- socioeconomic factors such as poverty and homelessness.

These factors can be crucial to a person's recovery if they have been ill. Research has found that social support networks are just as important to an individual's recovery as the actual medical attention or diagnosis they receive. There is great emphasis on developing a professional but also caring relationship between clinician/doctor/psychologist and patient/client. Consider the following case study about Anne.

CASE STUDY

ANNE

Anne was 27 years of age when she experienced severe abdominal pain one Sunday afternoon. She called an ambulance and had to crawl to the front door to let the ambulance officers in. She was diagnosed with a twisted bowel—a painful condition that required an operation and several weeks of recovery. Anne's parents were divorced and lived in different states. When informed of the seriousness of her condition, she contacted her mother for assistance. Unfortunately, her mother declined to help her as she was 'too busy'. Anne was devastated by this and found that her time in hospital was more difficult than she expected. When she was finally allowed to go home, her recovery was further complicated by depression. She spent her days crying and lost interest in everything around her. This despair was further intensified by a lack of contact with other people. Neither of her parents visited her that year.

In this situation, Anne's physiological symptoms were treated with an operation and medication to manage her pain. However, her doctor dealt with her using a biomedical approach by treating the body's symptoms but ignoring the state of her mind. He failed to help with her psychological distress and lack of social support.

1 REVIEW

1. Explain what the biopsychosocial model involves.
2. In what ways is the biopsychosocial framework different to the biomedical approach?
3. Name two advantages of using this model compared to looking at health from a single perspective. Explain.
4. Why is the sociocultural aspect of the biopsychosocial model important in dealing with a person with either a physical or mental illness? Explain, giving an example.
5. With reference to the case study on Anne, how could her doctor have dealt with her illness differently? Explain using the biopsychosocial framework.

SUPPORTING UNDERSTANDING

Historically, it was believed that physical and mental illness resulted from 'evil spirits' entering the body. Archaeologists have found skulls with evidence of 'trephination' (crudely drilled holes in the skulls of diseased individuals) so that evil spirits could leave the body—a very early form of neurosurgery using Stone Age tools!

The ancient Greeks moved away from the idea of evil spirits and proposed that physical and mental illness was as a result of an imbalance of biological fluids (or humours): blood, phlegm, black bile and yellow bile. Hippocrates (460–377 BCE) was responsible for this humoural theory of illness. Treatment took the form of dietary changes, exercise and/or blood-letting (using leeches or a sharp instrument to release 'bad' blood) to rebalance the four humours/fluids for both psychological and physiological problems. Some time later, Galen (129–199 CE) adapted the humoural theory of illness and proposed four personality types could be identified according to the proportions of the four fluids.

In the Middle Ages (c. 476–1450), a period in history where religion dominated day-to-day life and disease was God's punishment, treatment took the form of torture so that the sinner could repent to save their soul. Dissection of the human body was forbidden and this period also saw millions of people die from the bubonic plague (Black Death).

It was not until the fifteenth century, during the Renaissance period, that medical knowledge was gained through biological and physiological experiments. In Descartes' (1596–1650) theory of 'Cartesian dualism', the 'body' and 'mind' were treated as separate entities. This in turn led to the 'body' taking prominence, with technological advances such as the invention of the microscope enabling researchers to identify abnormality at a cellular level (Westen 2009). This dualistic approach lasted for centuries and was the basis for the biomedical model of health.

During the late 1800s, Sigmund Freud, a trained physician, found that some illnesses could not be attributed to a biological cause and believed that these inexplicable physical problems/symptoms originated from 'unconscious conflicts'. Consequently, psychological conflict/stressors could lead to real physiological changes with actual symptoms. This was a significant change to how physical and mental health was explained as it finally reflected a strong link between the mind and body.

The strong relationship between psychology and physiology also led to an exploration of the effect of social and cultural factors. George L. Engel (1977) was the first to develop a framework referred to as the 'biopsychosocial' model that incorporated all three factors—biological, psychological and social—in understanding mental and physical health.

FIGURE 2 The ancient Incas of Peru believed that cutting a hole into a person's skull would release evil spirits. This procedure was known as trephination and was used in other cultures in the ancient world.

There are many potential areas in a person's life that can contribute to both mental and physical health. The more pressure a person experiences from more than one area, the greater the potential for distress and potentially illness.

CASE STUDY

JUAN

Juan is an Australian-born Brazilian. He is a Year 12 student who is under intense pressure from his family to maintain an 'A' grade average and he is constantly fighting with his parents. In addition, he has just broken up with his Japanese girlfriend Mitsuko, primarily because of parental interference and cultural expectations and demands from both sides.

Even though Juan is upset and depressed about everything going on in his life, he agrees to go with a mate to a party. While there, he is offered a 'joint' (marijuana). Contrary to his values and beliefs, and due to all the pressure he's under, Juan smokes the entire thing. However, Juan is unaware that he has a strong family history of schizophrenia. Unfortunately for Juan, this single exposure to the drug results in him hearing voices (auditory hallucination) and feeling like someone or something is watching him. As his behaviour becomes increasingly more bizarre, his friend calls for an ambulance. Juan is one of the unlucky ones. Not only is he feeling sad, anxious and stressed from a range of personal issues, he has now experienced the first of many psychotic episodes characteristic of schizophrenia.

Juan's story is one that reflects the value of taking the biopsychosocial approach. He will be assessed and treated from a biological perspective with medication to alleviate his psychotic symptoms and undergo a range of tests to determine his brain function and structure; he will also require assistance/counselling for his psychological distress that stems from family, school, relationship and cultural expectations. Juan's ability to cope with his mental disorder and other life stressors will be better managed using the biopsychosocial framework as it considers the many potential sources of a person's symptoms.

How can the biopsychosocial model be applied to a real life situation? The following table gives an insight into how this framework can be adapted to someone like Juan who was diagnosed with schizophrenia.

FIGURE 3 Marijuana can act as a trigger for psychotic episodes in some people.

TABLE 1 Application of biopsychosocial model

	ONSET OF ILLNESS	MANAGEMENT OF ILLNESS	LONG-TERM STRATEGIES
Biological support	Sedating medication for initial episode Appropriate testing to determine diagnosis Appropriate psychotropic medication to control delusions and hallucinations Antidepressant medication Nutrition and safety	Psychotropic medication Appropriate antidepressant medication Mood stabiliser Ongoing monitoring of symptoms and adjustment of treatment	Psychotropic medication Appropriate antidepressant medication Mood stabiliser Ongoing monitoring of symptoms on a less frequent basis and adjustment of treatment
Psychological support	Reduced stimulation and calming down of patient/client Sit beside patient/client rather than facing them Acknowledge their delusions and hallucinations without challenging them Support the taking of appropriate medication Refer family members to appropriate support program(s) Provide information regarding mental illness and the availability of support organisations Provide emotional support Work towards strategies of self-care and relationships with family	Increase levels of external stimulation Enable greater independence and responsibility for self Provide information about the illness Develop a wellness recovery plan and implement with patient/client Refer family members to ongoing support programs Ensure that links with support networks are made Discuss in detail their experiences and allow them to develop a greater awareness of their mental and physical state	Continued counselling support for the patient/client that allows them to debrief about their experiences Consider how this experience can enable a wellness recovery plan Provide ongoing information about the illness Ensure that important relationships are maintained Integrate a wellness recovery plan in daily life Possibly reduce frequency of appointments Continued referral of family to appropriate supports
Social support	Organise hospitalisation or intensive clinical support at home Provide support and information for family and friends Establish whether there are any cultural issues that may either impede or support recovery/ effective management	Organise psychosocial rehabilitation services and respite programs to support patient/client and family Provide access to education to assist in facilitating and reinforcing relationships with family and friends Monitor whether cultural beliefs may interfere with taking medication working towards independence	Encourage increased independence Psychosocial rehabilitation may begin to decrease which may allow student to return to school Continue to monitor whether cultural beliefs have interfered with taking medication and working towards independence

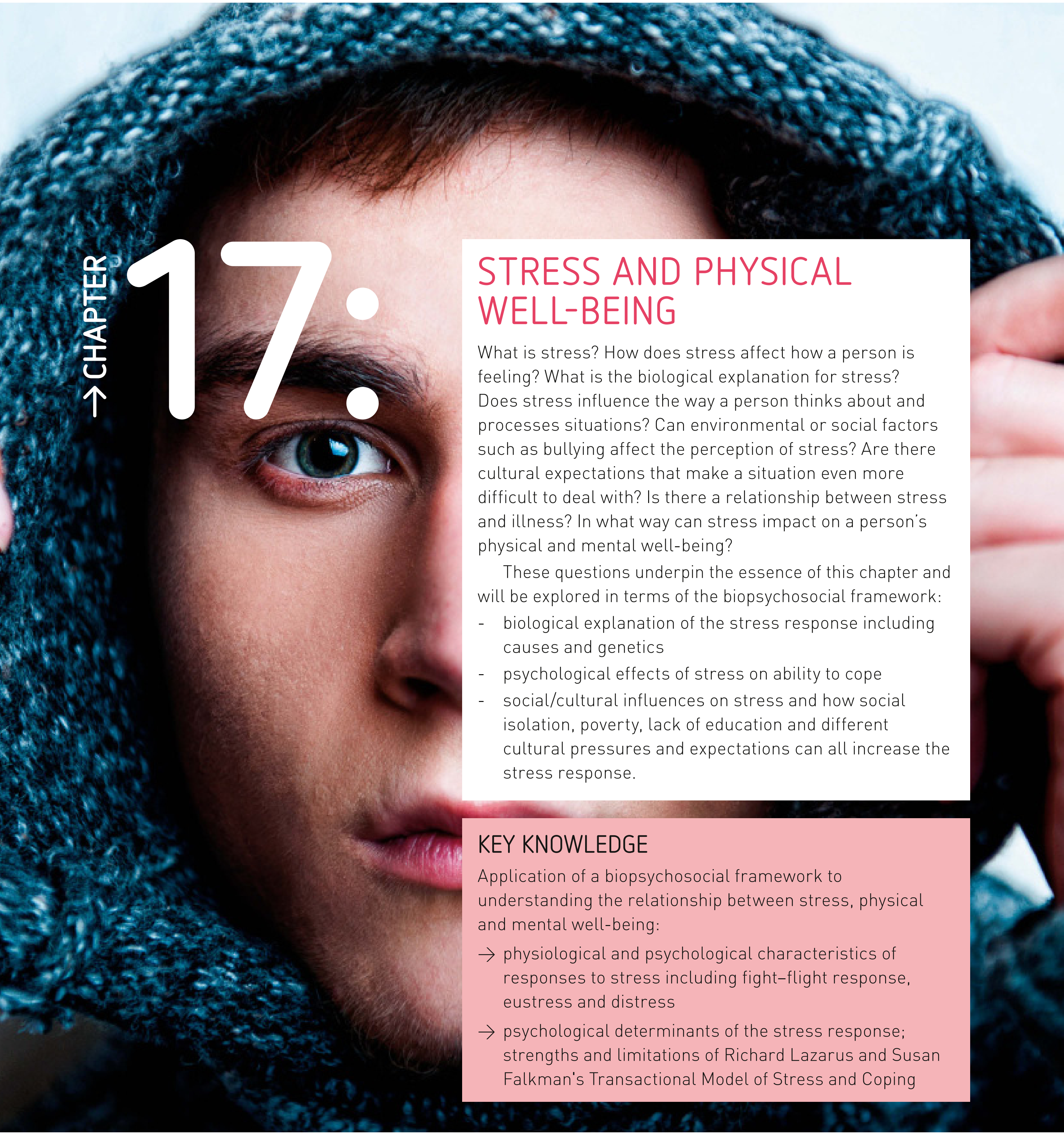
INVESTIGATE 1

1 Research has found that marijuana can trigger schizophrenia. Go to the schizophrenia.com website to find out more.

2 Create your own biopsychosocial model. Set up a table similar to Table 1 and show how this could be applied to one of the following mental or physical issues. Conduct further research on the problem you choose, using the Internet.

   a sporting injury for an elite athlete (e.g. professional football/tennis player)
   b diabetes
   c eating disorder
   d depression

FIGURE4 The biopsychosocial model takes into account the young man's biological, psychological and social factors in how he functions on a day-to-day basis. Factors include genetics, the role of neurotransmitters, the use of neuroimaging techniques, how a person is feeling, how those feelings are reflected in how they think and behave, the influence of home, school and friends as well as cultural expectations.



CHAPTER 17:

STRESS AND PHYSICAL WELL-BEING

What is stress? How does stress affect how a person is feeling? What is the biological explanation for stress? Does stress influence the way a person thinks about and processes situations? Can environmental or social factors such as bullying affect the perception of stress? Are there cultural expectations that make a situation even more difficult to deal with? Is there a relationship between stress and illness? In what way can stress impact on a person's physical and mental well-being?

These questions underpin the essence of this chapter and will be explored in terms of the biopsychosocial framework:

- biological explanation of the stress response including causes and genetics
- psychological effects of stress on ability to cope
- social/cultural influences on stress and how social isolation, poverty, lack of education and different cultural pressures and expectations can all increase the stress response.

KEY KNOWLEDGE

Application of a biopsychosocial framework to understanding the relationship between stress, physical and mental well-being:

→ physiological and psychological characteristics of responses to stress including fight–flight response, eustress and distress

→ psychological determinants of the stress response; strengths and limitations of Richard Lazarus and Susan Falkman'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.

(VCE Study Design 2013)

Understanding stress and well-being

CHAPTER OVERVIEW

Physiological and psychological characteristics of responses to stress	Fight-or-flight response Autonomic arousal Eustress and distress
Psychological determinants of the stress response	Lazarus and Falkman's transactional model of stress and coping > Primary appraisal > Secondary appraisal > Problem-focused coping > Emotion-focused coping > Strengths and limitations
Social, cultural and environmental factors in the stress response	Social Cultural Environmental
New approach to explaining the stress response	Allostasis model > Allostatic load > Allostatic overload Using the biopsychosocial model to deal with stress
Strategies for coping with stress	Biofeedback Meditation and relaxation Physical exercise Social support

'I'm so stressed!'

How often do we hear our friends, family or even ourselves say these words? But what does this actually mean? What is stress? What are we experiencing physiologically or mentally for us to use this term?

Hans Selye (1936) defines stress as 'a psychological and physical response of the body that occurs whenever we must adapt to changing conditions, whether those conditions be real or perceived'. Thus stress is a psychological and physiological response to internal or external sources of tension (**stressors**) that challenge a person's ability to cope. These stressors can be positive or negative, environmental, psychological or social/cultural in nature.

The stressor can also be viewed in terms of type: whether it is physical or psychological, the duration, how long it has been present and its strength or intensity. For example, a student who doesn't get enough sleep while they struggle to balance homework and involvement in the school play, may experience physical and psychological symptoms such as droopy eyelids and difficulty concentrating. The duration of this extraordinary workload is limited to a couple of months while the intensity of the situation is fairly low as it is not a serious situation like a chronic illness. Despite the fatigue and anxiety, once the play is finished, the student will feel better following a couple of good nights' sleep and more time to relax. Hence, a person's physiological and psychological response to a stressor can vary depending on the situation.

FIGURE 17.1 Stress impacts on a person's physical and mental well-being.

TABLE 17.1 Characteristics of some stressors

NATURE OF THE STRESSOR	DURATION	STRENGTH/INTENSITY
Physical > Sleep deprivation > Hunger > Hot/cold > Thirst > Pain/illness **Psychological** > Anxiety from failing a test > Grief from losing a loved one > Sadness from the loss of a pet > Happiness at winning the lottery	**Short-term** > Sitting for an examination > Job interview > Skydiving > First date > Public speaking > Being chased by a vicious animal **Long-term** > Chronic illness > Balancing work and school > Financial difficulties > Family problems	**Low intensity** > Attending a school formal > Competing in a debate > Starting a new school year > Disagreement with a friend **High intensity** > Loss of a child or parent > Terminal illness > Being chased by a vicious animal

When a person is stressed, they usually experience physiological arousal (the fight–flight response) and emotional tension that causes changes in their thinking processes and behaviours (Selye, 1936). Last century, researchers like Hans Selye focused on the biological aspects of stress and proposed an important link between stress and disease. However, this approach was limited as it did not consider the influences of psychological, social and cultural factors. Since then, other researchers such as Lazarus and Folkman (1984) recognised the limitations of taking a purely biological approach and explored the psychological/cognitive aspects of stress. They suggested that the perception of a stressor is a transaction between the individual and their environment, and that a person's coping strategies will depend on their own unique perspective. Although this research provided a strong explanation of the thinking processes involved in the perception of stress, it did not consider the social or cultural influences. Today, psychologists and other medical professionals take a more holistic view of a person's perception and response to stress. This is referred to as the biopsychosocial approach (as discussed in Chapter 6). They consider the 'big picture': factors such genetics, biological processes, personality predisposition, family influences, friendships, support structures and socio–cultural elements, all of which will be discussed later in this chapter.

Physiological and psychological characteristics of responses to stress

Fight-or-flight response

The fight-or-flight response is a term that describes 'autonomic' arousal. (See Chapter 6 for detailed explanation of autonomic arousal.)

Imagine this. It is 11.30 p.m. and you are walking home from the train station. Suddenly, you become aware of a strange man you saw earlier in the train carriage following you. The hair at the back of your neck stands up, your breathing becomes more rapid and you can feel your heart pounding in your chest. As you begin to walk faster, your palms feel clammy with perspiration. The man is getting closer! In a split second, you decide to make a run for it and hope that you're faster than him …

Has something like this ever happened to you (not necessarily the exact same scenario, but the feeling of fear and the desire to run away)? In 1932, physiologist Walter Cannon studied this phenomenon in an experiment using cats and dogs. Cannon carefully monitored the physiological and behavioural responses of each cat after confronting them with a range of dogs. He observed that the cats would elect to either confront the dog (fight) or to run away (flight). Cannon was the first researcher to refer to the reaction of an animal preparing to cope with the threat of a predator as the *fight-or-flight* response and the first to use the term *stress* to refer to a physiological reaction caused by the perception of a threatening situation. This state of physiological arousal experienced in such situations is controlled by the sympathetic branch of the autonomic nervous system.

AUTONOMIC AROUSAL

As we learnt in Chapter 6, the autonomic nervous system is part of the peripheral nervous system and generally operates below the level of conscious awareness. It controls the function of internal organs (viscera) and is divided into two branches: the sympathetic nervous system and the parasympathetic nervous system.

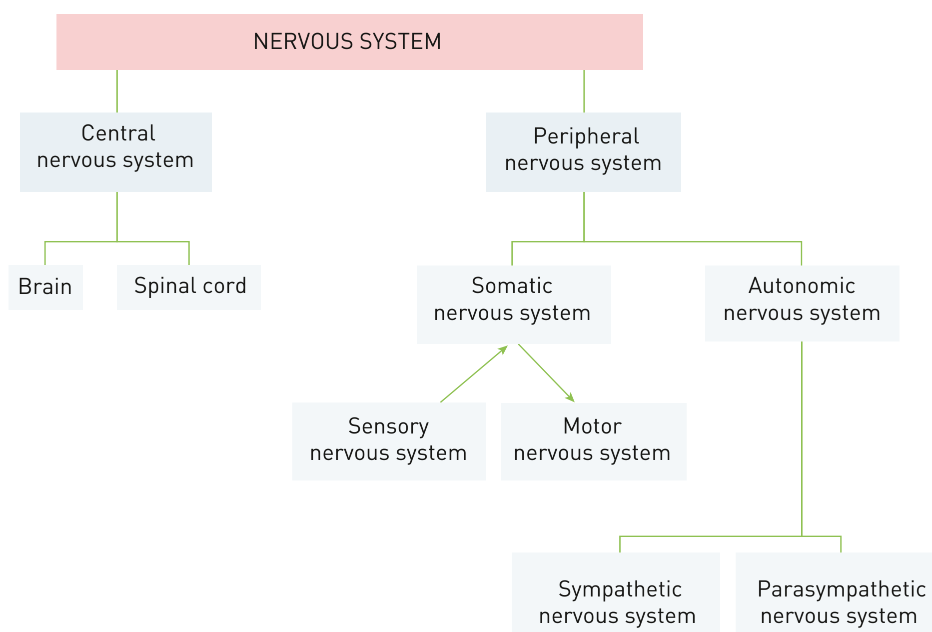


FIGURE 17.2 Structure of the nervous system and the place of the autonomic system.

REVIEW 17.1

1 Define 'stress' in your own words.
2 Explain the difference between a psychological and physical stressor using your own example.
3 What is a stressor? Provide an example.
4 Explain what is meant by the 'intensity or strength' of a stressor.
5 What is involved in the fight-or-flight response?
6 Which branch of the autonomic nervous system is responsible for arousal?

7 Explain the physiological processes involved in autonomic arousal (fight-or-flight response).

8 Draw and label a cartoon or a directional flowchart to show the physiological processes involved once the fight-or-flight response is activated. Think about a situation that causes a person or animal to respond with autonomic arousal.

The fight-or-flight response is an innate and evolutionary phenomenon critical for our survival. It is referred to as an 'adaptive response' because, in the early days of human and animal evolution, those with quick instinctual responses that were activated by the sympathetic nervous system had a greater chance of survival. Today, there are many reasons why we experience the fight-or-flight response that are not necessarily due to impending danger. This response can be triggered by physical activity, illness, winning the lottery or stressful circumstances such as balancing school and family commitments.

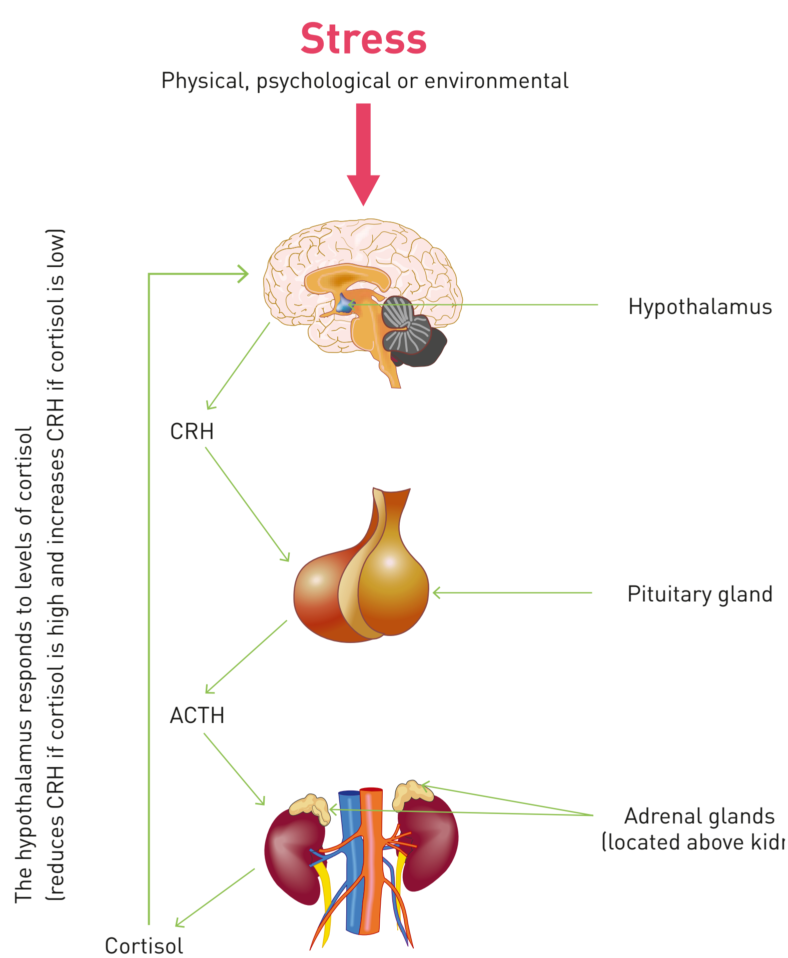


FIGURE 17.3 The HPA axis is activated during times of physical, psychological or environmental stress. These are the structures involved in the activation of the fight-or-flight response.

Did you know?

The perception of a stressor activates a sequence of processes involving the hypothalamus, pituitary and adrenal glands, known as the HPA axis. These structures interact through a feedback system to respond with physiological arousal (fight-or-flight response). The hypothalamus releases corticotrophin (CHR), activating the pituitary gland to release adrenocorticotropic hormone (ACTH). This prompts the adrenal glands to release stress hormones such as adrenaline, noradrenalin and cortisol. Physiological changes such as increased heart-rate, respiration rate and production of glucose enable the person to respond to the stressor.

Did you know?

In 1908 psychologists Robert Yerkes and John Dodson examined the relationship between arousal and performance and developed what is now known as the Yerkes–Dodson law. This law states that a person's performance increases with physiological and psychological arousal – but only to a certain point. When the levels of arousal become too great, the performance of the person decreases. Yerkes and Dodson showed this relationship in a graph in the shape of an upside down 'U' (see Figure 17.4).

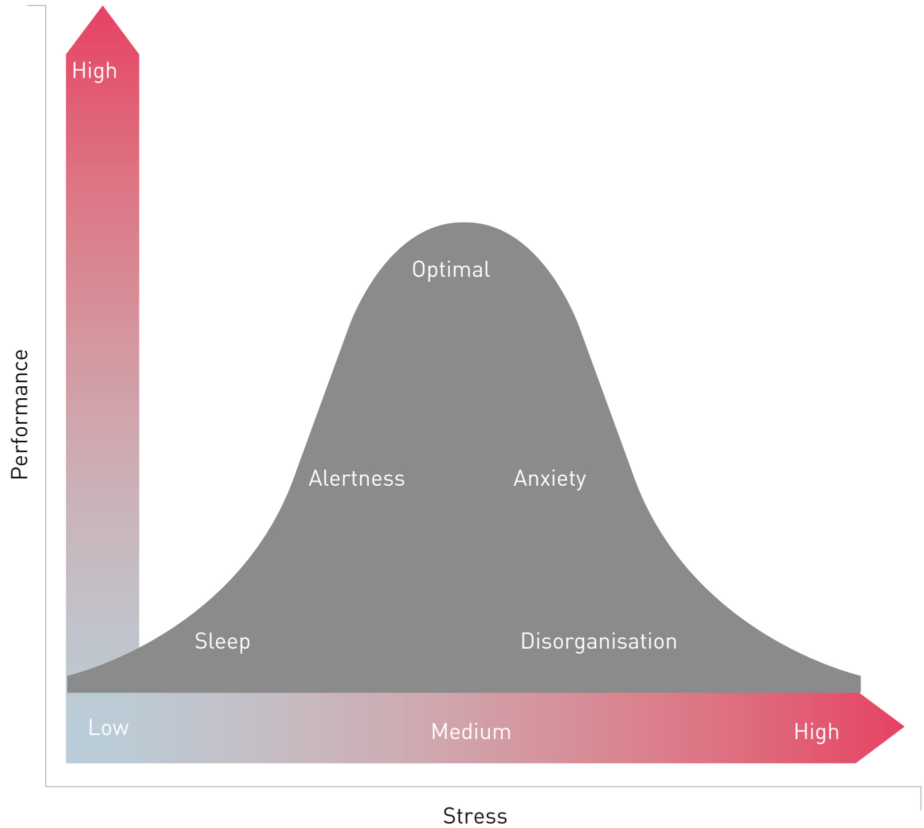


FIGURE 17.4 Yerkes–Dodson curve. If there is too little arousal/stress, we tend to do very little. As the level of stress increases to a moderate level, we experience optimal physiological and psychological arousal and perform at our peak. However, if the level of arousal is sustained and we experience greater levels of stress, we become more anxious and disorganised.

Eustress and distress

You will have heard the term 'distress' but how many people have heard the term 'eustress'?

Scientist Hans Selye (1907–1982), considered 'the father of stress research', was the first to use the term 'eustress' to reflect a stress that is positive in nature. The actual word itself is a combination of two parts: the prefix *eu* derived from Greek meaning 'well' or 'good' and the word 'stress'. Thus, eustress literally means 'good stress'.

The experience of stress is different to other physiological phenomena because bodily arousal, initiated by the sympathetic nervous system's fight-or-flight response, can occur regardless of whether a person receives good or bad news. Selye called stress that is experienced as a result of bad news, such as failing an important exam, negative stress or 'distress', while stress that comes from good news, such as winning a trip overseas, is called positive stress or 'eustress' (Selye 1975). Hence:

- eustress refers to a positive psychological response to a perceived stressor
- distress refers to a negative psychological response to a perceived stressor.

17.2 REVIEW

1 Does the autonomic arousal (fight-or-flight) response always occur during frightening situations? Explain.
2 Why is the stress response considered evolutionary (adaptive)? Explain.
3 Is stress always considered bad for us? Explain.
4 Can you think of a real-life situation where a person needs to feel some stress? Provide an example and indicate how the stress is beneficial.
5 Explain the key difference between eustress and distress.

SUPPORTING UNDERSTANDING

Selye's general adaptation syndrome

FIGURE 17.5 Family arguments are stressful.

Hans Selye contributed to our understanding of how the biological processes involved in the stress response could potentially lead to illness and death. Like many important scientific discoveries, Selye stumbled across this when he was experimenting with a new sex hormone that was injected into rats. Initially, he thought that the effects he saw were due to the hormone itself. However, he soon realised that regardless of whether he exposed the rats to cold, surgical injury, excessive exercise or the injection of a range of different drugs, they all appeared to go through the same physiological processes. He identified a three-phase pattern of physiological responses which he called '**General Adaptation Syndrome' (GAS)**. GAS consisted of alarm, resistance and exhaustion. Selye also found that not everyone goes through all three stages and that the exhaustion stage is only reached if exposure to the stressor is persistent. Ultimately, GAS is the body's way of adapting and dealing with a perceived stressor or stressors.

Alarm

Alarm is the first stage of GAS where the fight-or-flight response is activated to prepare the person to deal with the challenge or stressor. Alarm is experienced in two phases: shock then countershock.

In shock, the body responds as though it is injured. Body temperature and blood pressure momentarily drop as the person or organism becomes aware of the situation. It is during this stage that people who are given bad news are most vulnerable and have been known to faint or, in extreme circumstances, have a heart attack – which is why people are often asked to sit down before receiving the news.

Shock is followed by the countershock phase, where the body increases its resistance to the stressor with the release of adrenalin and cortisol into the bloodstream. This effectively increases heart and respiration rate, and releases more glucose into the bloodstream by diverting it from the gastrointestinal tract to muscles and other parts of the body in preparation for an emergency response.

FIGURE 17.6 People who are given bad news are vulnerable.

Resistance

As the alarm stage cannot last for long, the body eventually enters the second stage of GAS: resistance. This is considered the *adaptive stage* where, even though the parasympathetic nervous system reduces heart rate and respiration rate, blood-glucose levels and some stress-related hormones such as adrenalin and cortisol continue to circulate through the body, keeping it prepared for action. This elevated state of arousal enables the person to adapt to the stressor.

However, the prolonged exposure (to cortisol in particular), can cause damage to organs and depress the immune system, leaving the person vulnerable to illness. The person may show signs of social withdrawal by declining invitations to go out or seeking to be on their own, absenteeism from work or school, difficulty focusing or forgetfulness. They may appear withdrawn, absentminded, tearful or angry. At this point the person may develop a cold or headaches.

For example, Tess is a Year 12 student who has three exams to prepare for in two weeks. She works part-time and she lives in a single-parent home where she is often left to care for her two younger siblings (aged 7 and 11 years) three nights per week. Although she is managing to juggle her responsibilities, she sometimes feels tired. The extra effort of preparing for exams has added to her load and left her feeling stressed. On the day before her first exam, Tess wakes up with a temperature and a sore throat. While Tess's body has given her the much needed resources to deal with the challenges of study, family and work, this has also left her vulnerable to infection. The stage of resistance is where signs of illness begin.

FIGURE 17.7 The stage of resistance is where signs of illness begin.

Exhaustion

If the resistance stage lasts for an extended period of time, the body simply cannot cope with the stressor and its resistance begins to drop as the person enters the stage of **exhaustion**.

Since the body has been dealing with the stressor(s) for such an extended period of time, its resources are severely depleted and the body is susceptible to more serious life-threatening illnesses and, in extreme circumstances, death. Organs such as the heart, that are particularly vulnerable to environmental or genetic factors, often show the first signs of serious illness (for example, heart attack). If a person reaches this stage of GAS, they are physically and psychologically exhausted and may also show signs of helplessness and hopelessness, and symptoms of depression such as sadness.

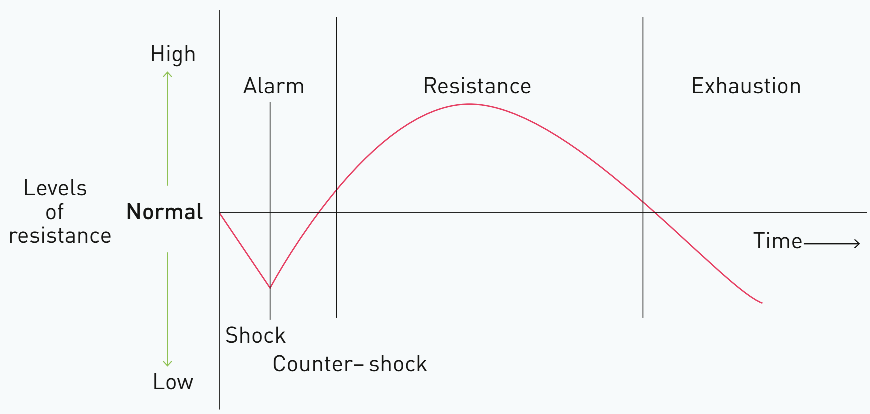


FIGURE 17.8 Hans Selye's general adaptation syndrome follows three stages: stage 1 – alarm reaction, which includes the phases of shock and countershock; stage 2 – resistance; and stage 3 – exhaustion.

Lazarus and Folkman's transactional model of stress and coping

As mentioned earlier, Richard Lazarus and Susan Folkman (1984) shifted from the traditional biological approach to stress and emphasised the importance of the psychological or cognitive processes involved in dealing with a stressful situation. Lazarus and his colleagues also moved away from working with non-human subjects and focused on working with people. It became apparent that it was not just the response to the stressor or the stressor itself that was important but, rather, the individual's perception and assessment of that stressor.

Lazarus and Folkman realised that different people could evaluate a potentially stressful situation in their own unique way. According to this model, stress is regarded as a 'transaction' between the person and the environment (Lazarus 1981; 1993; Lazaraus & Folkman, 1984; cited in Westen 2009) where the person's individual interpretation or **cognitive appraisal** determines how to deal with the situation. This appraisal is also influenced by a person's beliefs, goals, personal circumstances, life experiences and personality. For example, being made redundant from your job can be very stressful, especially for an individual with a family and a mortgage or someone with skills that are difficult to transfer to a different position. For such a person, a redundancy could potentially bring financial ruin and so the level of stress is immense. However, a person who is single and still living at home with their parents may not feel the same level of stress when made redundant – it might be regarded more as an irritation or possibly even as an opportunity to find a new and more interesting job.

Lazarus and Folkman's transactional model of stress and coping emphasised the importance of the interaction between the individual and their environment in assessing whether the stressor is threatening, challenging or potentially dangerous.

> It is the perception of 'potential harm', threats and challenges, together with how confident we are in dealing with these, that determine our ability to cope with stress.
>
> Anthony James Curtis

FIGURE 17.9 Being made redundant can be stressful.

Lazarus and Folkman's model outlines two main stages during the cognitive assessment of a situation: primary appraisal and secondary appraisal. The initial evaluation is usually quick with little reflection as people are usually able to interpret situations efficiently due to their past experiences – so little conscious effort is needed especially during primary appraisal.

Primary appraisal is the initial evaluation process where the person determines whether the event is a threat or a challenge. If the situation has no personal relevance for that individual, then it is viewed as neutral or irrelevant where little or no further thought is needed. Should the situation be perceived as a stressor, the person will then work out what should be done about it during secondary appraisal.

During primary appraisal, the significance of a situation can be classified as:

- **Harm/loss** – as assessment that some type of damage has been done such as an illness or poor test result. For example: 'I just failed a major test.'
- **Threat** – an assessment that there may be a future harm or a loss. For example, 'I might fail the next major test.'
- **Challenge** – an assessment that there is opportunity for personal growth or something might have a positive outcome. For example, 'I didn't do well for the practice test but with a bit of hard work I'll do better.' An upcoming marriage or a change of employment with a pay rise and greater status can also be perceived as a challenge.
- **Neutral/irrelevant/benign** - an assessment that this event is of little or no personal importance or relevance to the person and therefore does not go beyond primary appraisal. For example, 'My neighbour did poorly on his test'

Secondary appraisal is the stage where the person considers what options are available to them and how they will respond. This appraisal is made at a more conscious level and considers the following: Do I have the resources and the energy to deal with the event? What strategies can I use to effectively cope with this situation? For example, a student who fails a major assessment task might consider asking their teacher if they can resubmit the task and accept a penalty for repeating it or perhaps do an alternative task.

Both stages involve **emotional forecasting**. In the primary appraisal phase, the person experiences an emotional response to the given situation . In the secondary appraisal phase, the person predicts the possible emotional impact of each potential response. In the example above, the student might experience great disappointment at failing the assessment task (primary appraisal) followed by relief at being able to resubmit or change subjects (secondary appraisal).

Lazarus and Folkman's transactional model of stress and coping also outlined methods of coping. These were problem-focused and emotion-focused coping strategies.

- **Problem-focused coping** – looks at the causes of the stressor from a practical perspective and works out ways to deal with the problem or stressful situation with the objective of reducing that stress.
- Problem-focused strategies include:
  - Taking control - For example, a student who has performed poorly on an assessment task may decide to spend less time on Facebook and redirect that energy into preparing more comprehensive notes and revising more thoroughly. Or someone who has just lost their job may prepare a new résumé and go online to look for a new position.
  - Information seeking – looking for additional information to know how to deal with the stressor. For example, someone who has just been diagnosed with an illness may seek a second opinion, or see a specialist. They might even look up the symptoms, treatment and prognosis of their illness on the internet. Knowledge can sometimes reduce the level of stress.
  - Evaluating the pros and cons – taking a sheet of paper and dividing it so that on one side, the person writes down the positives about the situation/stressor and the negatives on the other side. For example, a person wanting to leave their job or change a relationship may use this to help reduce their level of stress.

Did you know?

Like Selye, Lazarus and Folkman accepted the notion that stress could be positive and negative. They identified fifteen basic emotions that may contribute to arousal:

- **positive emotions**: happiness, pride, love, relief, love and compassion
- **negative emotions**: anger, anxiety, disgust, envy, fright, guilt, jealousy, sadness and shame.

- **Emotion-focused coping** involves trying to reduce the negative emotional feelings associated with the stressor such as embarrassment, fear, anxiety, depression, excitement or frustration.
  - Emotion-focused strategies include:
    - meditation
    - relaxation
    - talking to friends and family about your problem
    - denial – pretending the event did not occur
    - ignoring the problem in the hope that it will disappear
    - distraction – finding other methods to keep your mind busy and not on the problem. For example, watching TV, playing video games or eating
    - expecting a worse-case scenario so that you are ready for the worst
    - physical exercise – to reduce the feelings of stress.

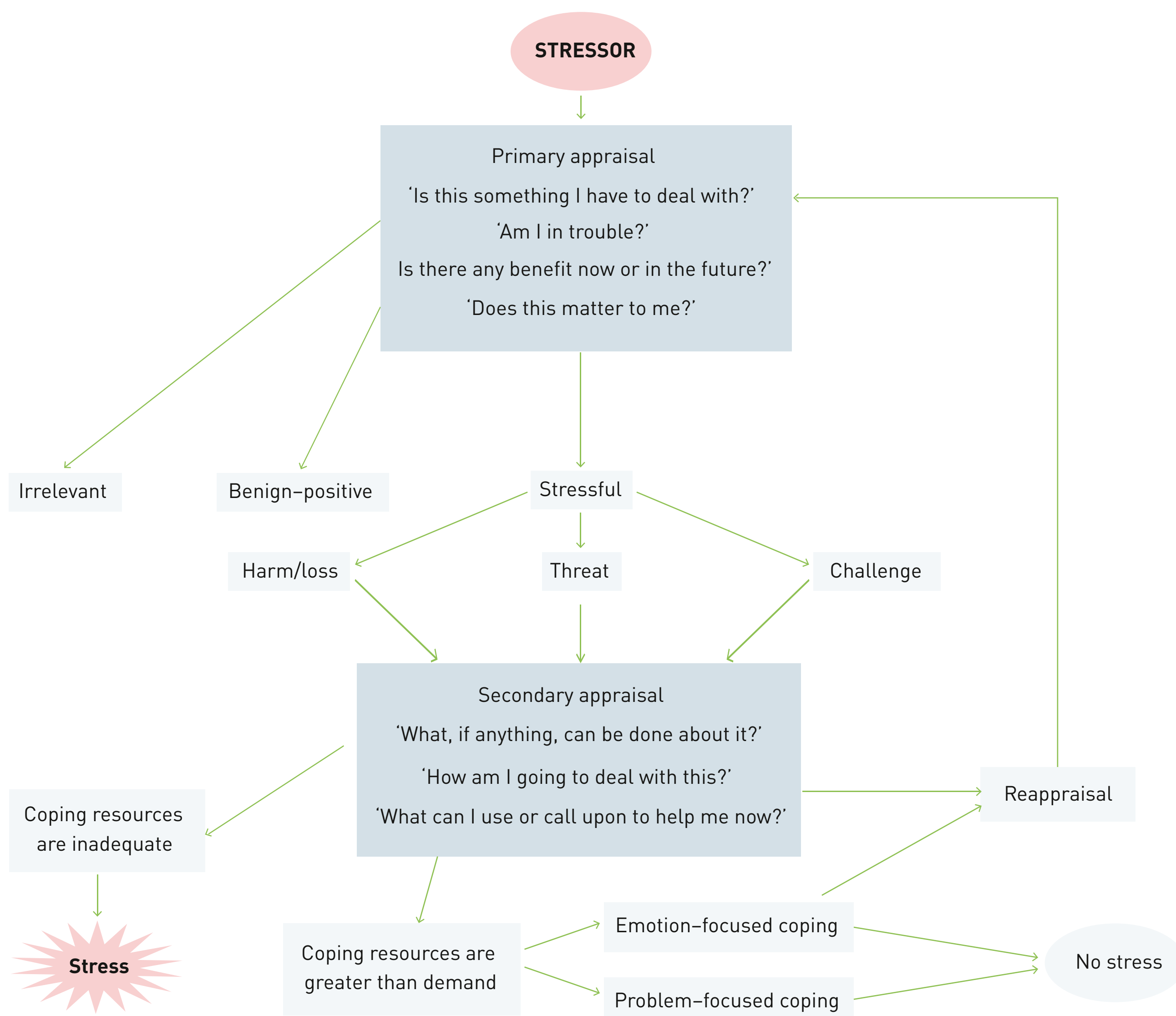


FIGURE 17.10 The transactional model of stress and coping in action.

STRENGTHS AND LIMITATIONS OF LAZARUS AND FOLKMAN'S TRANSACTIONAL MODEL OF STRESS AND COPING

The transactional model of stress and coping accepted Hans Selye's physiological reactions to stress and introduced the cognitive processing and emotional elements that were missing from the generalised adaptation syndrome model. Lazarus and Folkman's theory bridged the gap between the biological and cognitive explanation of stress. It explained the interaction or transaction that occurred between the individual and their environment, giving a greater focus to how the person perceived the situation and whether or not the situation was considered as stressful for that particular person.

The strengths of the transactional model of stress and coping include:

- it used human subjects in developing the model
- it used a cognitive approach to stress with a focus on how people cope with psychological stressors
- it took both mental processes and emotions into account when examining how an individual interprets a situation as stressful or not.

The limitations of the transactional model of stress and coping include:

- the greater focus on psychological factors meant that less emphasis was placed on the physiological elements of the stress response
- it did not include cultural, social or environmental factors in looking at how individuals perceive a stressful event.

17.3 REVIEW

1. What does the 'transaction' element in this model refer to? Explain what it means in this context.
2. Using an example, demonstrate your understanding of the steps involved in Lazarus and Folkman's model. You may use a diagram to assist you.
3. Explain the difference between Lazarus and Folkman's primary and secondary appraisal processes. Use an example for each to demonstrate your understanding.
4. Outline two strengths of the transactional model of stress and coping.
5. Outline the difference between a person perceiving a situation as a harm as opposed to a challenge. Use an example to illustrate your understanding.
6. Scrappy Koko has just lost his part-time job at Coles. If Scrappy saw this as a harm, suggest one problem-focused coping strategy and one emotion-focused strategy he could use.
7. Betty received a call from a well-respected university with a provisional offer for the following year as long as she achieves a very high score. As Betty is a positive person, she perceived this news as a challenge. Using the transactional model of stress and coping, explain the process that Betty would have gone through on hearing the news and what coping strategies she might use. You may present this in the form of a flow chart or as a paragraph.

Social, cultural and environmental factors that can exacerbate or alleviate the stress response

Selye (1936) was instrumental in demonstrating the stress response through a biological or physiological explanation and made a very important link between stress and illness. Lazarus and Folkman's transactional model of stress and coping addressed the cognitive/psychological determinants of a person's perception and appraisal of an event as stressful. However, neither of these approaches considered the important role that social, cultural and environmental factors play in the way a person interprets and responds to stressors.

FIGURE 17.11 For some people, waiting in line can be a source of stress.

Social factors

Have you ever considered how important your relationship with your family is or why you think and behave the way you do? From the time we are born, we are 'socialised' or exposed to rules and expectations. Our life is a sequence of learning experiences that help to shape our identity and enable us to fulfil various roles such as student, friend, mother or father, employee and retiree. These roles enrich a person's experiences and provide a pathway through the journey of life.

Membership to groups is also important to us – perhaps a religious affiliation, charity or football team. These roles require us to work with others and to interact in 'socially acceptable ways'. Ask yourself this: when you are on a tram, do you get up to let an elderly person sit down? If you do, this reflects your social values and confirms that you are a positive member of your society.

Humans are generally social creatures and have a need to feel they 'belong'. They also need to feel that they are safe. Factors such as fear, loneliness, poverty, lack of social support and poor education have been found to increase stress-related disorders. Consequently, if a person is subject to a life of difficulty, they are more likely to perceive and experience stressors in a more negative manner. So, these factors can exacerbate or make the perception and response to the stressor worse. Alternatively, a person who has had a fairly stable life, a good family, a strong friendship network and a good job is more likely to face a stressor with greater resilience. These are known as **protective factors**.

Cultural factors

Australia is a multicultural nation where a number of people have migrated from many different countries for a range of reasons. Some have come because they have family members here, many have come as international students, others have met a special someone they wish to marry, and a growing number of people have been forced to leave because of conflict, war and discrimination. It is not surprising that those who resettle here sometimes have very different beliefs and customs from the majority of Australians.

Those who are forced to leave their country of origin for the safety of their children have had to survive very difficult and dangerous conditions. Sometimes these conditions involved sexual discrimination (women not being allowed to study in some Middle Eastern countries) or racial abuse (caste system India where those of a lower caste are not allowed access to education, good jobs and adequate living conditions). These are stressors based on culture.

Acculturation is also a type of cultural stress where those who have migrated to Australia, for example, can feel isolation and loneliness as they may have different beliefs and customs from the majority of those they encounter. This is also true of our Indigenous population. Those who have been allowed or encouraged to maintain their language, beliefs and customs are less prone to stress-related health risks than those who have been taken away from their families and deprived of their natural heritage (for example, Stolen Generations). In this instance, the maintenance of their cultural connections acts as a protective factor, while cultural isolation can exacerbate or intensify the perception and response to a stressor.

Environmental factors

Environmental factors refer to the circumstances in our environment that can influence our perception and response to stress. These often have social aspects to them and can include family circumstances, school conditions, employment status, work environment, relationship status or peer influences. Negative environmental conditions can exacerbate our perception of the stressor while positive environmental factors can be protective as they foster our resilience and ability to cope more effectively during difficult times

Consider the following scenarios in terms of social, cultural and environmental influences as well as how Lazarus and Folkman's transactional model of stress and coping might be applied.

- **Scenario 1.** A student at Melbourne University discovers that she is pregnant. She is extremely upset by this as she is single and is a new immigrant from a culture where sex before marriage is forbidden and pregnancy out of wedlock brings great dishonour to a family. In this situation, the life event of a pregnancy is highly stressful when cultural, environmental and social factors are considered.
- **Scenario 2**. A student at Melbourne University discovers that she is pregnant. She is single and her family has lived in Australia for generations. Although the pregnancy was unplanned and has left her feeling stressed, her perception of the situation is different. She feels that there is no danger that she will experience parental rejection or social exclusion. In the Australian community, many children are born to single parents. This is a good example of how cultural and social pressures can contribute to the perceived stress of an event.
- **Scenario 3.** A young woman receives news that she is pregnant. She is married and working full-time as a teacher. On receiving the news, she is overwhelmed with joy as she and her husband have wanted to start a family for some time. Her only concern is when should she inform the principal of her school and formally apply for maternity leave. In this situation, the life event of a pregnancy is positive, even though informing her employer and applying for maternity leave is a source of stress.

These three scenarios present different cultural, social and environmental elements that affect the way news of a pregnancy is received, appraised and dealt with by each of the young women. According to Lazarus and Folkman's transactional model of stress and coping, each woman would assess whether they viewed the pregnancy as harmful, threatening or challenging during the primary appraisal stage and experience the accompanying physiological arousal. The initial/primary appraisal will depend on whether they perceived the pregnancy as potentially harmful (the first student's fear of severe disapproval of her by her family), threatening (the second student's disruption of her studies and life) or challenging (teacher's joy at finally falling pregnant). Secondary appraisal (assessment of ability to cope with the pregnancy) will also determine the course of action each one will take. Both may then use problem-focused coping or emotion-focused strategies to reduce their stress.

In terms of the biopsychosocial approach, their perception and response to the pregnancy would also be influenced by their culture (religion/cultural background), environment (university/employment) and their social support network (parents, family, friends, etc.). The combined effect of these influences, coupled with a person's genetics, personality predisposition, belief system will significantly influence their perception and response to the stressor/pregnancy.

SUPPORTING UNDERSTANDING

Positive and negative life events can be a source of stress for people. A person can experience stress simply by lining up to get tickets to a concert or by missing the bus on the way to school. These types of stressors (often referred to as 'daily hassles') seem fairly unimportant in the scheme of things and certainly do not rate highly when you consider life-threatening situations like floods and earthquakes, but their effects can mount up and collectively create a great amount of tension for a person.

The Holmes-Rahe scale (Holmes & Rahe 1967) includes both negative and positive items in the questionnaire. Table 17.2 lists the top 15 stressors on the Holmes-Rahe life events rating scale. By adding up all the life events over the past 12 months, it provides an estimate of stress that a person has or is experiencing. Its value is limited, however, as it does not take into account the amount of stress the individual experiences due to their perception of the event; neither does it take into account the cultural, social and environmental factors that influence the perception of stress in the life event.

TABLE 17.2 Top 15 stressors on the Holmes-Rahe life events rating scale

RANK	LIFE EVENT	MEAN VALUE
1	Death of a spouse	100
2	Divorce	73
3	Marital separation	65
4	Jail term	63
5	Death of a close family member	63
6	Personal injury or illness	63
7	Marriage	50
8	Fired at work	47
9	Marital reconciliation	45
10	Retirement	45
11	Change in health in family member	44
12	Pregnancy	40
13	Sex difficulties	39
14	Gain of new family member	39
15	Business readjustment	39

Source: Holmes and Rahe (1967)

The past 30 years have seen great changes in the field of psychology, particularly in the area of understanding and managing stress. Increasingly, there has been a more holistic approach to understanding the sources and causes of stress.

TABLE 17.3 Recognising stress

COMMON PHYSICAL SIGNS OF STRESS	COMMON COGNITIVE SIGNS OF STRESS	COMMON EMOTIONAL SIGNS OF STRESS	COMMON BEHAVIOURAL SIGNS OF STRESS
> Rapid heart rate/heart palpitations > Increased blood pressure > Headaches > Nausea/vomiting > Dizziness/fainting > Chest pain > Difficulty breathing > Muscle twitching/ erratic movements > Fatigue > Visual difficulties	> Poor concentration > Loss of self-confidence > Memory impairment > Increase/decrease in awareness of surroundings > Difficulty making decisions > Poor abstract thinking > Blaming others > Difficulty identifying familiar objects or people > Racing thoughts > Disturbed thinking	> Apprehension/anxiety > Feeling overwhelmed > Agitation/irritability > Panic > Fear > Anger > Hopelessness > Depression > Denial > Inappropriate emotional response	> Change in physical activity levels > Sleep disturbances > Change in usual style of communication > Loss of interest in previously pleasurable activities > Change in eating habits > Emotional outbursts > Antisocial behaviour > Inappropriate use of humour > Substance use (caffeine, smoking, alcohol, drugs) > Nervous mannerisms (foot tapping, nail biting, teeth grinding, hair pulling, hand wringing, etc.)

REVIEW 17.4

1 Explain the importance of social, cultural and environmental influences in people's experience and perception of stress.

2 Illustrate your understanding by creating your own scenario(s) to show how social, cultural or environmental influences might affect a person's perception of stress and how they might respond depending on their own particular differences/situations.

New approach to explaining the stress response

Allostasis

Most of you have probably heard of the term 'homeostasis', where our automatic bodily functions such as heart rate, digestion and respiration are maintained at a state of equilibrium or balance by the parasympathetic branch of the autonomic nervous system (as outlined in Chapter 7). When we talk about homeostasis, we are referring to a biological model that does not consider the combined effect of psychological and socio-cultural influences on the individual's perception and response to a stressor. As there were clear gaps in the understanding and treatment of stress, an alternative more comprehensive model was developed by Sterling and Eyer (1988) known as allostasis. **Allostasis** is 'where the body maintains stability or homeostasis through change' (Sterling & Eyer, 1988). This framework incorporates the physiological processes of the stress response. However, it views it from a holistic perspective where genetics, personal experiences, behavioural patterns, personality, environmental and socio-cultural influences are taken into account. So, like Lazarus and Folkman, the model of allostasis accepts that each person will perceive and respond to a stressor in their own unique way. When a person interprets an event as being stressful, several internal physiological and behavioural processes are activated so that adaptation to the stressor or *allostasis* can be achieved. Allostasis also provides a theoretical basis for understanding the relationship between stressors and disease (Anderson, McEwen, Nasveld & Palmer, 2012).

TABLE 17.4 Homeostasis versus allostasis

HOMEOSTASIS	ALLOSTASIS
Normal baseline	Changing baseline
Physiological equilibrium/balance	Variable equilibrium/balance
No anticipation of demand	Anticipation of demand
No adjustment based on personal history	Adjustment based on personal history
Adjustment carries no 'price'	Adjustment to stressor carries a 'price'
No illness	Potentially leads to illness

Adapted from *Allostatic Load: A review of literature*, Anderson, McEwen, Nasveld and Palmer (2012), Department of Veteren Affairs, Canberra.

ALLOSTATIC LOAD

Our internal systems were not designed to be repeatedly activated for long periods of time. So, when a person experiences a number of negative or distressing events in their life such as divorce, the death of a loved one or living in a highly abusive home, these stressors trigger the fight-or-flight/stress response where the body is repeatedly forced to adapt to the situation. This leads to cumulative negative effects as the body tries to re-establish allostasis. This summative effect of these stressful events is known as the **allostatic load**. It is 'the price' the body pays for adapting to various psychological and social challenges (McEwan & Stellar 1993). Consequently, the greater the number, duration and intensity of stressful events a person experiences, the greater their allostatic load.

FIGURE 17.12 The frequent activation of the fight-or-flight response has a cumulative effect.

As allostasis takes a biopsychosocial approach to a person's perception and response to a stressor, factors such as genetics, early developmental experiences, learned behaviours that affect lifestyle choices, social support systems and cultural background can influence the ability of the body to effectively adapt to a stressor. For example, Fred is a person who is genetically more anxious, has had little emotional family support growing up, and makes poor lifestyle choices such as smoking, drinking and eating a high-fat diet. These factors can interact to potentially intensify Fred's perception and allostatic reaction to the stressor. It would be expected that someone with Fred's history may develop a greater allostatic load than someone who is not anxious and has had a fairly uneventful family upbringing. The repeated activation of the fight-or-flight response leads to the prolonged presence of various stress hormones, such as cortisol, which can adversely affect a person's organs and can eventually lead to a range of illnesses such as diabetes, high blood pressure and heart disease (IOM of the National Academies, 2008, cited in Anderson, McEwen, Nasveld & Palmer, 2012).

TABLE 17.5 Stress responses

INITIAL STRESS RESPONSE (DURATION: MINUTES TO HOURS)
> Increased heart-rate and blood pressure > Increased respiration > Mobilisation of energy from liver and body fat > Increased attention and thinking > Increased fear conditioning > Decrease in the experience of pain > Decrease in digestive processes
PROLONGED STRESS RESPONSE (DURATION: DAYS TO WEEKS)
> Impaired immune system > Suppression of appetite and digestion > Suppression of growth > Persistence of increased heart rate and blood pressure > Rerelease of stress hormones > Interference with learning and memory

Did you know?

Allostatic overload has also been found to interfere with brain plasticity where learning and memory are affected. There is also evidence to show that it interferes with decision-making.

ALLOSTATIC OVERLOAD

As previously mentioned, the cumulative effects of our body trying to re-establish allostasis in response to frequent and intense stressors is known as allostatic load. We can view this repeated activation-response pattern along a continuum. Hence, when the demands of the stressor exceed the body's ability to repeatedly adapt, we enter into **allostatic overload**. In this stage, the body is depleted of its resources and is unable to make the necessary physiological adjustments to adapt to even the most trivial stressor – such as missing a bus. For example, a student who has been balancing work with school, dealing with family issues, the possible loss of a loved one and partial sleep deprivation will be physically and mentally exhausted towards the end of the year with final end-of-year exams a couple of weeks away. As these environmental pressures have been present over several months, the student gets to the point where they simply cannot deal with any further stressors in their environment.

There appear to be four situations when allostatic overload can occur:

1 Repeated exposure to new stressors in the person's environment
2 Inability to adapt to the stressor (inability to establish allostasis and homeostasis)
3 Once activated, the stress response takes a long time to shut down so that stress hormones remain in circulation for longer.
4 Inadequate activation of the fight-or-flight response leading to other bodily systems trying to compensate.

The major contribution of this theory is that it effectively integrates the biological, psychological and social factors in explaining an individual's response to stress, providing a true biopsychosocial approach to the understanding and management of stress.

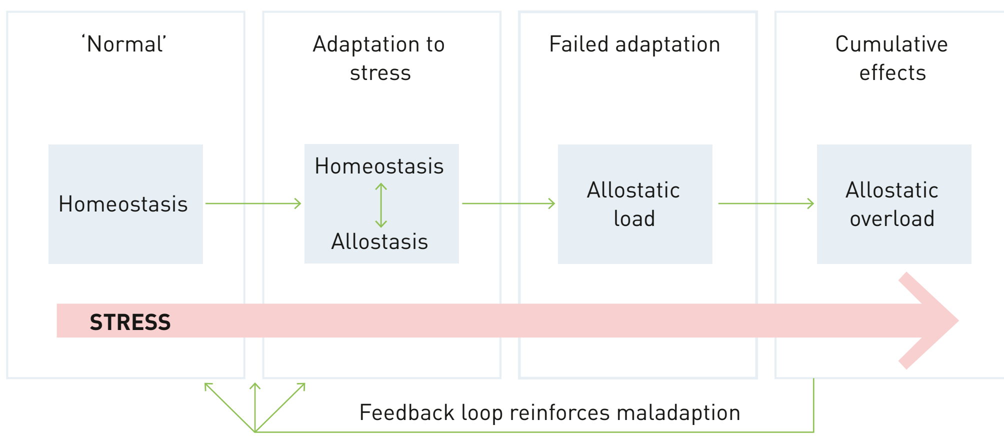


FIGURE 17.13 Consider allostasis along a continuum. When there is no stress, our body maintains homeostasis, a stressor will cause us to try and adapt. If we experience mote that one stressor, this cumulative effect is known as allostatic load. However, if our physiological systems are unable to meet the demands of the stressor, we experience allostatic overload.

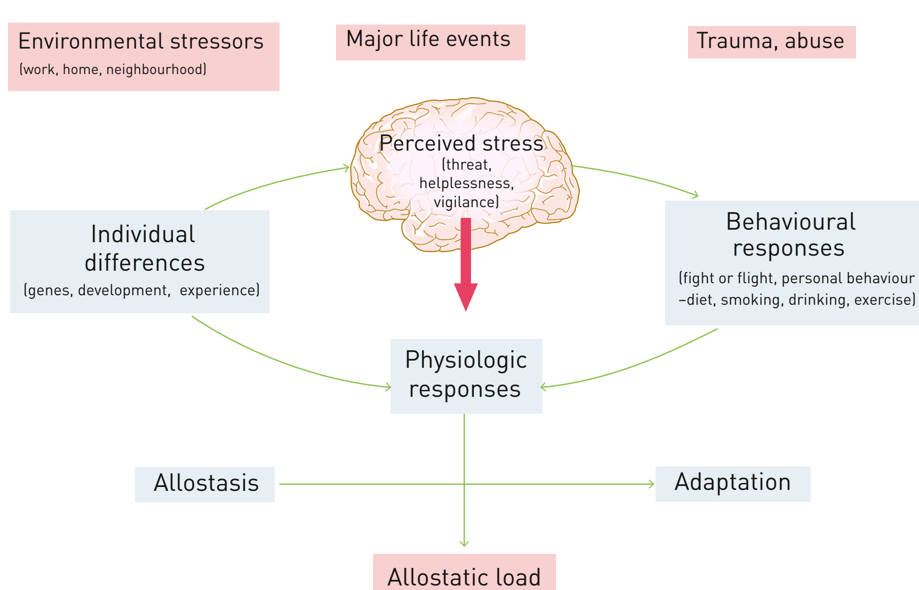


FIGURE 17.14 The frequent activation of the fight-or-flight response has a cumulative effect.

REVIEW 17.5

1. Explain the concept of allostasis.
2. What is the difference between allostasis and allostatic load? Give an example to demonstrate your understanding.
3. Outline the difference between homeostasis and allostasis.
4. Is there a relationship between allostatic load and the development of a serious illness? Explain.
5. Why do people experience 'allostatic overload'? Explain this and give an example to demonstrate your understanding.

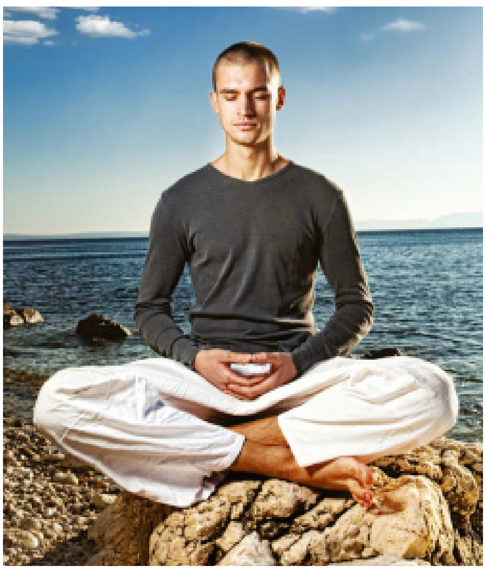


FIGURE 17.15 Meditation is an effective technique for managing stress. Exercise has been referred to as 'moving meditation'.

USING THE BIOPSYCHOSOCIAL MODEL TO DEAL WITH STRESS

People who are exposed to stressful situations over prolonged periods of time are physiologically and psychologically more vulnerable to a range of physical and mental illnesses.

The level of stress depends on:

- the number of stressful events (both positive and negative)
- the individual's appraisal of the stressor or situation
- the influence of environmental, cultural and social factors.

In line with the biopsychosocial approach to dealing with stress, research has found strong evidence to support the use of techniques such as biofeedback, meditation, relaxation and physical exercise in the effective management of stress. Social support has been recognised as playing a significant role in people's ability to deal with challenging situations long-term. Thus, the support from our family, friends, school or work colleagues is important in helping us to deal with long-term stress, along with medical intervention, psycho-education, meditation and exercise.

Strategies for coping with stress

BIOFEEDBACK

Biofeedback is a scientifically based treatment that uses sensitive instruments to monitor and provide feedback/information about a person's heart rate, respiration rate, brainwaves, skin temperature, moisture on the skin and muscle tone in 'real-time' (i.e. as they happen). Through operant conditioning, the person is taught to change the levels of these processes by altering their thoughts, emotions and behaviour. This method is used to feed back physiological information about the autonomic processes that usually occur without conscious awareness.

A biofeedback session generally takes place in a quiet room with a comfortable chair for the client. Baseline readings are taken using the biofeedback equipment – often a polygraph – followed by a review of recent stressors the client may have encountered. As they are led to re-experience the feelings of stress, the therapist teaches the client how to relax and lower breathing rate and heart rate, and consequently lower their stress levels.

STRESS AND BIOFEEDBACK ONLINE VIDEO

INVESTIGATE 17.1

Using the Internet, find an online video documentary that demonstrates the use of biofeedback to deal with stress. Draw a directional flowchart to illustrate what you observed and your understanding of biofeedback.

USING THERMAL BIOFEEDBACK

CASE STUDY

John, a 33-year-old male professional, had experienced anxiety for most of his life. Recently, his therapist recommended biofeedback to help him learn anxiety management techniques. During the beginning phase of his treatment, John learnt that there are usually several signals to alert him that his nervous system is overactive – one key signal being that his feet and hands get cold. Thermal biofeedback training helped him confirm when he was relaxing by measuring an increase in temperature, showing increased blood flow to his extremities.

FIGURE 17.16 During a session of biofeedback, a person is taught how to lower his heart RATE by using relaxation techniques while being attached to an ECG machine.

Biofeedback has been used successfully to help people suffering from a range of illness to alter the physiological processes related to stress.

TABLE 17.6 Biofeedback: Devices used

DEVICE	ABBREVIATION	MEASURES
Electrocardiograph	ECG	Heart rate
Electrodermograph	EDG	Sweat gland activity – level of persiraiton
Electroencephalograph	EEG	Brainwaves
Electromyograph	EMG	Muscle tension
Feedback thermometer	TEMP	Peripheral blood flow
Photoplethysmograph	PPG	Peripheral blood flow, heart rate
Pneumograph	RESP	Abdominal/chest movement, respiration rate

MEDITATION AND RELAXATION

Imagine sitting on the floor, legs crossed, hands extended with thumb and middle finger connected, repeating a meditation mantra such as 'om'. Does this sound familiar? This is what many of us picture when we think about meditation. However, what is meditation exactly? The word 'meditate' – which comes from the Latin word *meditatum*, meaning 'to contemplate' – has been associated with many religions and religious practices dating back to the 12th century. It involves an active mental process that requires focus.

FIGURE 17.17 People can use meditation to reduce stress in many different situations.

Meditation and relaxation are often grouped together as both play an important role in the management of the physiological and psychological symptoms of stress without the need for sophisticated biofeedback equipment. However, there are differences between the two.

How does meditation work to induce a deep state of relaxation? The person needs a quiet place to sit or lie down, where they can then alter their state of consciousness by focusing on a single stimulus such as repeating a word or tone, or by concentrating on physical phenomena that they are usually not aware of such as their breathing. Meditation redirects a person's usual flow of conscious thought to a more focused pathway that leads to a deep state of calmness and relaxation.

Can this state of calmness be measured? The answer is yes. Laboratory experiments have shown that several autonomic physiological and psychological changes occur during meditation and relaxation. This is reflected in phenomena such as brainwave activity, heart rate, respiration rate, blood pressure and temperature. A study by Jangid, Vyas and Shukla (1988) found that, in some forms of meditation, brainwaves usually associated with the first and second stages of sleep (alpha and theta waves) are detected even though the person is not actually asleep. Neurologist Dr James Austin from the University of Colorado discovered that people using Zen meditation showed evidence of changes to the circuitry of the brain, measured using functional magnetic resonance imaging (*f*MRI) (Austin 1998).

INVESTIGATE 17.2

MEDITATION AND RELAXATION

This activity can be undertaken in pairs or as a class activity led by the teacher or one student.

Materials needed:

- stopwatch or watch with second hand
- blood pressure sleeve or pulse-rate monitor (both optional)
- guided meditation CD (optional)
- relaxation music (or a guided meditation CD).

Procedure

- Step 1: Each student takes the other's heart rate and respiration rate and writes them down on a piece of paper. If you are able to obtain a blood pressure sleeve, take each other's blood pressure as well.
- Step 2: Listen to the guided meditation CD or relaxation music. Concentrate on the words and music or, if using a relaxation music CD, concentrate on your breathing. Allow approximately 20 minutes for this.
- Step 3: Take each other's heart rate, respiration rate (and blood pressure if possible) immediately after the meditation session and compare with your initial readings. Collate your data as a class to show each student's 'before and after' results on the board.
- Discuss the results as a class.

FIGURE 17.18 A traditional meditation pose used to clear the mind and relax

Most health professionals acknowledge the benefits of meditation in developing effective stress-management programs. This is because many meditation techniques are able to reduce baseline levels of physiological and psychological arousal and assist people to better deal with the stressors of day-to-day life.

Meditation has also been successfully used in psychotherapy to treat other conditions, especially in the management of phobias and other anxiety-based mental disorders.

What about **relaxation**? Is there a difference between meditation and relaxation? Yes and no! As discussed earlier in the chapter, meditation *actively* alters conscious thoughts by focusing the mind on either a single stimulus or automatic physiological processes such as breathing. Traditionally, meditation was practised for religious purposes to achieve heightened awareness of the self and to connect to a higher level of consciousness, with deep relaxation often being a by-product of some meditative techniques. In contrast, relaxation can be described as a process of releasing one's muscles and thoughts. This is usually done using methods such as visualisation (imagining yourself floating, letting go of things that cause you stress), breathing techniques and graduated muscle tensing and relaxing sequences where each part of the body is systematically tensed and relaxed until the person experiences a release of physical and psychological tension. Interestingly, both meditation and relaxation can induce an alpha brainwave pattern; however, meditation also generates theta waves, normally seen in stages 1 and 2 of NREM sleep (see Chapter 4).

REVIEW 17.6

1 How can meditation be used to relieve stress? Explain.
2 How can relaxation be used to relieve stress? Explain.
3 What is the key difference between meditation and relaxation?
4 Outline the physiological changes that occur when a person either meditates or uses relaxation techniques.

INVESTIGATE 17.3

RELAXATION TECHNIQUES

1 Go to the Mindtools website and look at the different relaxation techniques that can be used to reduce stress. Write a 500-word essay to describe the different relaxation techniques and how their use can reduce the physiological and psychological arousal symptomatic of the stress response.

2 Complete the following table:

TECHNIQUE	DESCRIPTION	PHYSIOLOGICAL/ PSYCHOLOGICAL CHANGES
Meditation		
Relaxation		

3 Using the Internet, research two different types of meditation and two different methods used in relaxation. Present your findings to the class in a PowerPoint presentation.

4 Some meditation techniques have been found to cause psychological problems. One such technique is known as Qigong. Using the Internet, research this form of meditation and answer the following questions:

- What is the history of Qigong?
- Why has Qigong been identified as a meditation technique that can cause psychotic symptoms? Explain.

NB: Make sure you reference the websites you used to research this topic.

PHYSICAL EXERCISE

What is **physical exercise**? Physical exercise refers to an activity that requires exertion with the purpose of improving fitness or health. Improving fitness is important, but can physical exercise help people cope with stress? The answer is yes. When asked how they handle stress, many individuals report that they use physical exercise as a major part of their program (Randolfi 2010).

FIGURE 17.19 Physical exercise helps people cope with stress.

Did you know?

Physical exercise doesn't only act as a buffer that reduces the impact of physiological and psychological effects of stress – it's also good for the brain! Research has found that regular exercise increases neurogenesis, the production of new brain cells, particularly in some areas of the hippocampus that are responsible for learning and memory. This is an important finding since prolonged stress has been shown to suppress neurogenesis and is linked with depression. Many health professionals now incorporate a regular physical exercise regime to assist their clients better manage their stress with the additional benefit of stimulating brain cell production (Tanapat & Gould 2007).

As discussed earlier in the chapter, the biochemical and physiological processes that occur in response to a stressor are essential to help deal with a threatening situation, but most stress experienced by humans is due to psychological or social pressures such as studying for exams, working in a demanding job or experiencing verbal bullying at school, work or at home. In most instances, there is no need for a person to respond physically – to fight the aggressor or to run away (the fight-or-flight response). Unfortunately, prolonged exposure to stress has the potential to decrease the immune system's functioning and lead to physical illness. Studies have shown that regular physical exercise is effective in returning the body to homeostasis more quickly and in reducing the impact of stress.

Physical exercise has been referred to as 'moving meditation', where some forms of exercise such as jogging, swimming and cycling require repetitive motions that can change a person's state of consciousness. Athletes, for example, focus on their breathing or perfecting their freestyle stroke. This intense focus on one stimulus (breathing/stroke) can lead to feelings of calmness and tranquility following exercise that are similar to those reported by people who meditate.

The body's production of endorphins also increases when people exercise for more than 20 minutes per session. As these naturally produced chemicals are similar to morphine, they provide pain relief and a sense of euphoria. This in turn improves a person's mood and helps reduce stress-related tension.

Physical exercise has been found to reduce the strength of a person's physiological reaction to stress (Forcier *et al.* 2006 cited in Westen 2009) and therefore to potentially decrease the damaging physical effects of stress (Plante, Caputo & Chizemar 2000).

FIGURE 17.20 Cycling helps improve one's mood and reduce stress-related tension.

REVIEW 17.7

Using the information in this textbook and your own sources, write a 500-word essay on one of the following topics:

- Physical exercise is an important factor in the management of stress.
- Physical exercise has been referred to as 'moving meditation'. Explain how this assertion can be made.

PHYSICAL EXERCISE AND STRESS REDUCTION

INVESTIGATE 17.4

1 Choose one form of physical exercise and research its physiological and psychological benefits on stress. Your work can be presented in a Word document, PowerPoint presentation or in a brochure.
2 Go to the *Franklin Institute* website to find out the benefits of physical exercise on brain function. Choose one of the studies and present it to the class. You may work with a partner for this activity.

SOCIAL SUPPORT

Can good friends help reduce stress? Again, the answer is yes. There has been mounting evidence to support the idea of the important moderating effects of social relationships (Weiten 2009).

Social support refers to the network of family, friends, neighbours and community members that are available during difficult times to provide emotional, physical and financial assistance. A study of university students found that those who reported high levels of social support showed a greater immune response after being injected with a flu vaccine compared with students who were lonely and socially isolated (Pressman *et al.* 2005). Another study followed the progress of 1477 Australian participants aged 70 years and over for ten years. Not surprisingly, those who had richer friendship and family networks lived longer and had healthier lives (Gilies *et al.* 2005).

Social support is therefore considered a protective factor that is important in maintaining both mental and physical health. A large number of close social relationships is also a predictor of a person's life expectancy (House, Landis & Umberson 1988) while strong social support with the opportunity for emotional disclosure has been found to decrease a person's vulnerability to stress and increase their ability to cope. A solitary person waiting to undergo invasive surgery is likely to experience greater levels of stress and anxiety than another individual who is undergoing the same operation but is surrounded by friends and family. Situations like these are not uncommon and illustrate the importance of social support as a buffer to stress.

FIGURE 17.21 Social support is considered a protective factor that is important in maintaining both mental and physical health.

EVALUATION OF RESEARCH

INVESTIGATE 17.5

Using the Internet, find a recent scholarly article on social support and stress. Write a report that includes the following:
- an outline of the aim of the experiment/study
- a hypothesis for the experiment
- how many people took part in the experiment
- the method and materials used
- the conclusions that the researchers drew from their results.

Discuss your findings with the class.

SUPPORTING UNDERSTANDING

Reducing stress and anxiety: breathing relaxation and progressive muscle relaxation

Breathing relaxation

People hyperventilate, or 'over-breath', under stress and in anxiety-provoking situations. Hyperventilation is both the result *and* cause of panic attacks.

When hyperventilating, a person breathes very quickly, with shoulders and chest pumping fast. Their blood chemistry is changed toward alkalosisin, in which haemoglobin binds more securely to the oxygen (alkalotic O_2 clamping, known as the 'Bohr effect'), so the cells become overloaded with oxygen that can't be released. This means that there is too little carbon dioxide in the system, which causes blood vessels to constrict so that oxygen is not carried freely around the body and brain to where it is needed, restricting logical thought and muscular action.

If a person is hyperventilating, the safest treatment is to deliberately slow down the breathing rate. If a few minutes of this intervention are not effective, the patient should be seen by emergency medical personnel.

Note that this is slow breathing, not deep breathing; the aim is to reduce the amount of air cycling through the lungs.

Try this slow-breathing method:

1 Lying down (at first) or sitting back in a chair, breathe to your diaphragm (so that the air enters your lungs low down). Your abdomen should rise and fall and your chest remain still. Put one hand just above your navel and one on your chest. It should be the lower hand that rises and falls with breathing.

2 Slow down your breathing – usually an adult at rest will breathe 8–10 times per minute, taking 6–7.5 seconds per breath. Try to reduce it to 5–6 breaths per minute.
   - i Breathe in through your nose for a count of 3 seconds.
   - ii Hold for 2 seconds.
   - iii Breathe out through your mouth for 4 seconds.
   - iv Pause for 1 second.
   - v Repeat sequence.

1 Once you are comfortable breathing every 10 seconds (six breaths per minute), add 1 second to the out-breath. This will result in five breaths per minute.

If you can do this for one or two minutes, you will find that your body is relaxing, your thoughts are clearer and you can think more calmly.

Most people benefit from slow breathing twice a day for about five minutes at a time, but it's important to develop the skill when you don't feel anxious and stressed, so you can use it when you do. With practice, you will be able to do this slow breathing when standing or even walking.

Progressive muscle relaxation

Lying down (at first) or sitting back in a chair, get as comfortable as possible. Slow your breathing and you're ready to start.

Start alternately tensing and relaxing specific muscles. After tension, a muscle will be more relaxed than before. Concentrate on feeling the contrast between tension and relaxation. With practice, you will recognise tension in any specific muscle and be able to reduce that tension.

Did you know?

In past times, the remedy used for hyperventilation was to breathe in and out of a brown paper bag. This had the benefit of increasing the carbon dioxide levels, but created a condition of too little free (available) oxygen and so is no longer recommended.

Remember to:

- only work on one muscle or muscle-group at a time
- don't hold your breath, grunt, snarl or grit your teeth
- think only about the tension–relaxation contrast.

Each tension lasts 10 seconds; each relaxation lasts 10 or 15 seconds. Do the entire sequence every day until you can control your muscle tensions. Be careful: if you have any pain, consult your doctor.

The sequence:

1 Hands
> fists tense; relax
> fingers extend; relax

2 Biceps and triceps
> biceps tense (keep hands relaxed); relax
> triceps tense (try to bend your elbows backwards); relax.

3 Shoulders
> pulled back; relax
> pushed forward (hunch); relax

4 Neck
> turn head slowly to the right, as far as you can; relax
> turn head to the left; relax
> push face forwards and lower chin onto chest; relax (don't throw your head back)

5 Mouth
> open mouth as far as possible; relax
> lips tense; relax

6 Tongue
> push tongue as far as possible out of mouth; relax
> squeeze tongue back in throat as far as possible; relax
> push tongue into the roof of mouth; relax
> pull tongue to the bottom of mouth; relax

7 Eyes
> open eyes as wide as possible; relax
> close eyes as tight as possible; relax
> Note: Make sure you completely relax all face muscles after each tension.

8 Back
> arch against bed or back of chair; relax (don't strain)

9 Buttocks
> tense buttocks tightly; relax
> push buttocks into the chair; relax

10 Thighs
> extend legs and raise them just off the floor – use thigh muscles not stomach muscles
> push legs down into the foot-rest or bed; relax

11 Stomach
> pull in stomach (try to make a six-pack); relax
> tense as if you were expecting a punch; relax

12 Calves and feet
> point toes; relax
> pull feet up as far as possible; relax

13 Toes
> curl toes up tight; relax
> extend toes; relax

Relax and continue slow breathing. These exercises don't eliminate tension but, when it arises, you will be able to 'tense–relax' it away.

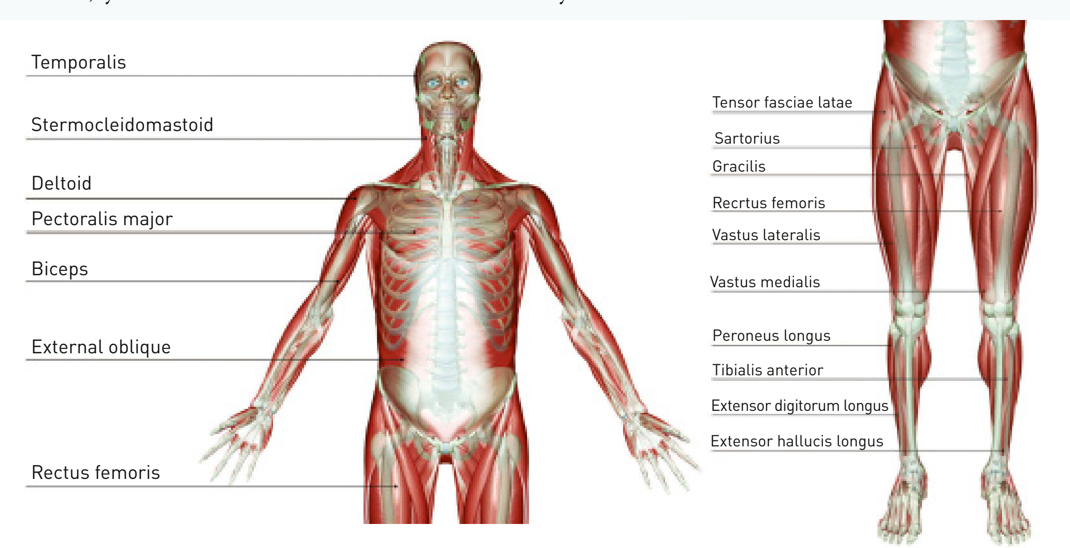


FIGURE 1 Muscles relaxed when following the progressive muscle sequence above

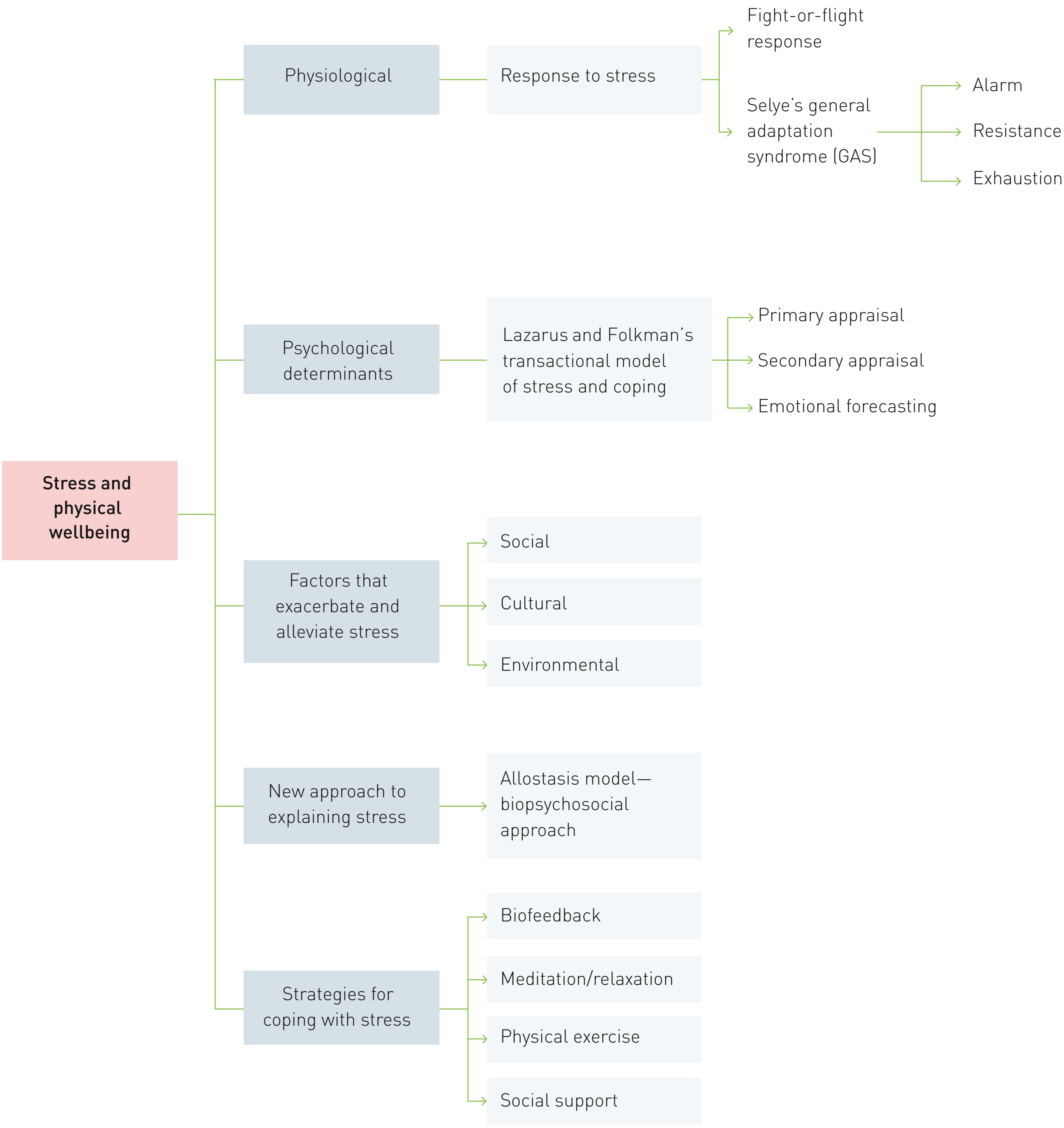
→ CHAPTER SUMMARY 17:

- Stress is a psychological and physical response to internal or external sources of tension (stressors) that challenge a person's ability to cope. These stressors can be positive or negative, and environmental, psychological or social in nature. When a person is stressed, their body experiences autonomic arousal that is known as the fight-or-flight response. This is the physiological reaction of an organism preparing to cope with the threat of a predator and is caused by perceiving a situation as threatening. This state of physiological arousal is controlled by the sympathetic branch of the autonomic nervous system.
- In the fight-or-flight response, adrenalin and noradrenaline are released into the blood stream, thereby increasing the heart rate which in turn increases the respiration rate. Pupils dilate and glucose is released from the liver, allowing greater energy to deal with the stressor. Functions such as digestion are suppressed. When the threat is no longer present or the person is no longer stressed, the parasympathetic nervous system, a branch of the autonomic nervous system (responsible for maintaining balance in day-to-day functioning), returns the body to normal.

- Stress can be the result of either good or bad circumstances. In order to differentiate between the two, the term 'eustress' was coined to refer to the perception of good psychological stress like winning a prize at school or finding out that you and your family are going on a holiday to Paris, while 'distress' was used to refer to the perception of bad psychological stress such as failing an exam.
- Lazarus and Folkman's transactional model of stress and coping incorporated the cognitive component of stress. Stress is regarded as a 'transaction' between the person and the environment, where the person's individual interpretation of the stressor determines how they deal with the situation. The person goes through primary appraisal (initial recognition of the potentially stressful situation) then secondary appraisal (considering one's options). Both stages involve emotional forecasting (predicting what feelings the situation will produce). The person will then use problem-coping strategies such as seeking further information or emotion-focused strategies such as talking to friends and family to reduce their stress. This occurs during the secondary appraisal process.
- Social, cultural and environmental factors can either help to protect the person's resilience to stress or exacerbate it.
- Allostasis reflects a biopsychosocial approach to understanding stress. It is where the body maintains stability or homeostasis through change. This framework incorporates the physiological processes of the stress response. However, it views it from a holistic perspective where genetics, personal experiences, behavioural patterns, personality, environmental and socio-cultural influences are taken into account. Allostatic load refers to the number of stressors a person may experience that lead to the recurrent activation of the body's sympathetic nervous system (arousal).
- Allostatic overload occurs when the demands of the stressor exceed the body's ability to repeatedly adapt, The frequent activation of the fight-or-flight response has a cumulative effect that can result in long-term damage to the body and can lead to serious illnesses such as diabetes, high blood pressure and heart disease.
- As health professionals now take a biopsychosocial approach to understanding and managing stress in their clients, methods such as biofeedback, meditation and physical exercise have proven useful. Another crucial factor that has been recognised to act as a buffer for stress is social support. People with strong and supportive networks of family, friends, neighbours and community members are better able to deal with stress than those who are alone and unsupported.

→ ESSENTIAL EXAM KNOWLEDGE

CONCEPT MAP



KEY TERMS

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

allostasis
allostatic load
autonomic arousal
biofeedback
distress
emotions
eustress
fight-or-flight response
Lazarus and Folkman's transactional model of stress and coping
primary appraisal
secondary appraisal
emotional forecasting
problem-focused coping
emotion-focused coping
meditation
negative emotions
physical exercise
social support
stress
stressor
stress response

KEY IDEAS

For the exam, you must know:

- the physiological and psychological characteristics of responses to stress
- the fight-or-flight response
- the difference between eustress and distress
- the psychological determinants of the stress response:
- Lazarus and Folkman's transactional model of stress and coping – psychological/cognitive approach
- how social, cultural and environmental factors exacerbate and alleviate the stress response
- strategies used to deal with coping and stress
    - biofeedback
    - meditation/relaxation
    - physical exercise
    - social support.

RESEARCH METHODS

For the exam, you must be able to:

- discuss the strengths and limitations of Lazarus and Folkman's model
- understand the allostasis model as the new biopsychosocial approach to explaining the stress response.

→ TEST YOUR UNDERSTANDING

MULTIPLE CHOICE

1 Which of the following best describes stress?
- a a psychological and physical response when we are overloaded with responsibilities
- b a psychological and physiological response to internal and external sources of tension that challenge a person's ability to cope
- c a physical and emotional response to internal and external sources of pressure that stop a person from coping
- d a psychological and physiological response to internal and internal sources of tension that allow a person to cope

Questions 2–4 refer to the following information:
Molly is taking the train to school one morning and notices a man staring at her. Every time she looks his way, she feels a shiver up her spine and her hair stands on end. When Molly arrives at her station, she sees the man get up from his seat to follow her. She panics and runs as soon as the doors open.

2 Which of the following responses has occurred?
- a fight-or-flight response
- b fear response
- c autonomic arousal response
- d sympathetic nervous response

3 Which branch of the autonomic nervous system is activated when Molly first notices the man staring at her and she feels nervous?
- a parasympathetic nervous system
- b peripheral nervous system
- c autonomic nervous system
- d sympathetic nervous system

4 Which branch of the autonomic nervous system is activated when Molly finally gets to school and begins to relax?
- a parasympathetic nervous system
- b peripheral nervous system
- c autonomic nervous system
- d sympathetic nervous system

5 Which of the following is *not* a physiological process of autonomic arousal?
- a dilation of pupils
- b stimulation of digestion
- c release of glucose into the blood stream
- d increased respiration rate

6 Which of the following is an example of a situation that would lead to eustress?
- a receiving a telephone call with news of a much-wanted job
- b failing an important exam
- c being bullied at school
- d skydiving

7 Which of the following best defines distress?
- a stress that is experienced as negative, such as bad news
- b stress that can be positive or negative
- c stress that can lead to crying
- d stress that is also known as good stress

8 Lazarus and Folkman's transactional model of stress and coping was:
- a based on the idea that the perception of stress is a uniquely individual experience.
- b based on the perception that stress is due to a transaction between the environment and the stressor.
- c developed to allow a person to use problem-focused strategies for coping and not emotion-based strategies.
- d developed to better understand the biological processes involved in the stress response.

9 Emotion-focused coping is used by individuals to assist them in managing a stressful event. An example of an emotion-focused strategy would be:
- a working out what to do by writing up a list and looking at the pros and cons of how to deal with it.

b looking for information on the Internet to give further information on how to deal with the stressor.
c talking to family and friends.
d writing a resume and looking for a new job following a redundancy.

10 According to the transactional model of stress and coping, the recognition of a potentially stressful situation where the individual assesses whether or not the circumstances are stressful is known as:
a fight-or-flight response.
b autonomic arousal.
c secondary appraisal.
d primary appraisal.

11 Achieving biological and psychological stability with the ability to provide a variable response to stressors or challenges is known as:
a homeostasis.
b allostatic load.
c allostasis.
d biofeedback.

12 Biofeedback provides information about the following physiological processes to help a person learn to reduce their symptoms of stress:
a heart rate, respiration, temperature, brainwaves.
b muscle tone, respiration, heart rate, eye movement.
c muscle tone, brainwaves, blood flow, respiration.
d skin temperature, muscle tone, sweat, stress response.

SHORT ANSWER

13 Explain the difference between homeostasis and allostasis.

1 mark

14 Outline the physiological processes involved in the fight-or-flight response and explain why this was important for human survival.

4 marks

15 What has research found in relation to stress and health?

2 marks

16 Provide real-life examples of eustress and distress.

2 marks

17 Outline two key strengths and two key limitations of Lazarus and Folkman's transactional model of stress and coping.

4 marks

18 Explain Lazarus' transactional model of stress and coping in your own words, using a real-life example.

2 marks

19 Provide an example of how biofeedback can be used to manage stress.

2 marks

20 If you were a health professional and a client came to see you suffering symptoms associated with prolonged stress, what would your recommendations be? Write a step- by-step process that the person can use to help them manage this stress more effectively.

6 marks

21 Is social support important in how a person perceives and manages stress? Explain.

2 marks

CHAPTER 18:

MENTAL HEALTH

As you are aware by now mental illness is a concern in today's society. One in five people experience a mental illness and one in four experience more than one mental disorder. Mental illness can affect all areas of a person's life from employment, to relationships, to everyday functioning. The more accurate the information that we have about mental illnesses the better equipped we are to deal with it in our lives. Thus it is important that we understand the different types of mental illnesses that exist, recognise their symptoms and dispel any stereotypes and myths about them. In this chapter we will explore phobias, major depressive disorder, addiction in relation to gambling and schizophrenia. We consider the possible causes, symptoms and treatments of each mental illness from a biopsychosocial framework. Further, we will examine the organisations and groups that can help people living with mental illness and their families.

KEY KNOWLEDGE

Application of a biopsychosocial framework to understanding ONE of the following types of mental disorder and its management:

Anxiety disorder: specific phobia

- 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
- sociocultural 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

OR

Mood disorder: major depression

- biological contributing factors: role of genes in contributing to the risk of developing major depression; role of the neurotransmitters serotonin and noradrenalin 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 and psychodynamic psychotherapy
- sociocultural 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 sociocultural factors which contribute to an understanding of the disorder and its management

OR

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
- sociocultural contributing factors; social permission of gambling opportunities; management including social network and recovery groups
- the interaction between biological, psychological and sociocultural factors which contribute to an understanding of the disorder and its management

OR

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
- sociocultural 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 sociocultural factors which contribute to an understanding of the disorder and its management.

(VCE Study Design 2013)

CHAPTER OVERVIEW

Anxiety disorder: Specific phobia	Subcategories of phobic disorder Age of onset Contributing biological factors > Role of the stress response > Role of GABA > Genetic factors Contributing psychological factors > psychodynamic, behavioral and cognitive models > psychotherapies in treatment including CBT, systematic desensitisation and flooding Contributing sociocultural factors > environmental triggers > parental modeling > transmission of threat information Interaction between biological, psychological and sociocultural factors

Mood disorder: Major depression	Symptoms of major depressive disorder Contributing biological factors > Genetic factors > Neurotransmitter functioning > Management through antidepressant medication Contributing psychological factors > Learned helplessness > Stress > Management through psychotherapy Contributing sociocultural factors > Management of sociocultural factors > Interaction between biological, psychological and sociocultural factors
Addictive disorder: Gambling	Contributing biological factors > Serotonin, norepinephrine and dopamine > Management of biological factors Contributing psychological factors > Social learning theory > Schedules of reinforcement > Management of psychological factors Contributing sociocultural factors > Management of sociocultural factors Interaction between biological, psychological and sociocultural factors
Psychotic disorder: Schizophrenia	Contributing biological factors > Genetic predisposition > Drug-induced onset > Changes in brain activity and structure > Management of biological factors Contributing psychological factors > Impaired reasoning and memory > Management of the contributing psychological factors Sociocultural factors contributing to depression > Social disadvantage, trauma and stress > Management of sociocultural factors Interaction between biological, psychological and sociocultural factors

Anxiety disorder: specific phobia

After many years of extensive research into the origins and maintenance of specific phobias, the scientific community came to an important conclusion: there is no simple explanation! There appear to be several complex mechanisms that contribute to the development of specific phobias, including biological factors, genetic tendencies, brain chemistry and psychological, sociocultural and environmental factors. Before discussing specific phobias in detail, it is important to understand the link to anxiety disorders.

All people experience anxiety at some time. It is a normal element of human existence. For some, however, anxiety can become a major problem with disturbing consequences. **Anxiety disorders** (see Chapter 16) are characterised by feelings of extreme apprehension, fear, stress and unease. There are five main types of anxiety disorder: generalised anxiety disorder, **phobic disorder**, panic disorder, obsessive-compulsive disorder and post-traumatic stress disorder. Research has found that genetic, biological and environmental factors play a role in most anxiety disorders. Twin studies have revealed that anxiety disorders such as obsessive-compulsive disorder, panic disorder and specific phobia are particularly heritable, occurring in 85 per cent of identical twins with a family history of these disorders (Nestadt *et al.* 2000, cited in Westen 2009).

FIGURE 18.1 Some people are terrified of spiders.

FIGURE 18.2 Twin studies have shown there are strong genetic links to the development of simple phobias.

Studies have found that anxiety disorders occur in approximately 18 per cent of the population (Drew, Bromet & Switzer 2000, cited in Weiten 2009) and many people can suffer from more than one of these disorders at a time. Women are also more vulnerable to anxiety disorders, especially between 45 and 54 years of age (Australian Bureau of Statistics 1998).

Many people are frightened of spiders or snakes and experience a typical fear response if one crosses their path. This fear response makes sense from an evolutionary perspective because we are genetically wired to fear things that pose a threat to our survival. However, if that fear interferes with a person's social functioning, where they deliberately avoid the distress-causing object, activity or situation to the point where it affects their day-to-day life, it is then diagnosed as a *phobic disorder* or *phobia*. A **phobia** is defined as a persistent, irrational and intense fear of a particular object or event. The individual's fear of the object or event is so intense that they try to avoid the feared stimulus or, if faced with it, experience acute physiological arousal—the fight-or-flight response (see Chapter 5). In extreme cases, just thinking about the source of their phobia can cause the same intense fear and anxiety.

Subcategories of phobic disorder

There are several subcategories of phobic disorder:

- **social phobia** (also known as social anxiety disorder) can involve a fear of other people or social situations. This includes fear of being scrutinised by others while eating, speaking in public or attending a party
- **specific phobia** (also known as *simple phobia*) is fear of a single specific object or event that triggers a panic response (for example, spiders, snakes, heights, catching an illness, or blood)
- **agoraphobia** is a fear of leaving a familiar place such as home. This can be made worse by the accompanying fear of getting a panic attack. Agoraphobia may be caused initially by an existing specific phobia such as fear of open spaces, fear of contamination or fear of social gatherings. This develops into a generalised fear of leaving home or a small, familiar 'safe' area.

FIGURE 18.3 Fear of toads is known as bufonophobia.

There are four main types of specific phobia:

- animal phobias (for example, fear of snakes, spiders, rats or dogs)
- natural environmental phobias (for example, fear of heights, storms, water or darkness)
- situation phobias (for example, fear of enclosed spaces, elevators, flying, dentists, driving, tunnels or bridges)
- blood-injection-injury phobia (for example, fear of medical procedures or of the sight of blood).

Did you know?

Research has found that approximately five per cent of the population experiences at least one phobia at any given time and about 10 per cent of the population will have a phobia at some stage during their lifetime (Graske & Waters 2005). Phobias often begin in early childhood, and twice as many women experience a phobia than men!

18.1 REVIEW

1. Define the term 'specific phobia'.
2. What are the major types of specific phobia?
3. List four phobic responses a person who suffers from a phobia of spiders would experience.
4. Using a labelled diagram, illustrate the relationship between anxiety, phobic disorders and specific phobia.

18.1 INVESTIGATE

A SPECIFIC PHOBIA

Search for a YouTube video that explains the symptoms experienced by someone suffering from a specific, or simple, phobia.

Age of onset

Most anxiety disorders appear early in life. In general, specific phobia appears earlier than social phobia or agoraphobia. For specific phobias, the age of onset depends on the phobia. Most specific phobias develop during childhood and eventually disappear. Those that persist into adulthood rarely go away without treatment. Table 18.1 shows examples of the mean age of onset for selected phobias.

TABLE 18.1 Mean age of onset for selected phobias

PHOBIA	MEAN AGE OF ONSET
Animal	7 years
Blood	9 years
Dental	12 years
Claustrophobia	20 years
Social	Before 20 years
Agoraphobia	Late adolescence to early adulthood

FIGURE 18.4 The onset of dental phobia often occurs at around 12 years of age.

INVESTIGATE 18.2

MIX AND MATCH!

Using the Internet and other sources, match the phobia to its correct definition.

agoraphobia	fear of air drafts, or wind
acarophobia	fear of being alone or of oneself
anemophobia	fear of neglecting duty or responsibility
acrophobia	fear of open spaces or of being in public places
claustrophobia	fear of work or functioning; surgeon's fear of operating
agliophobia	fear of crowds or mobs

aichmophobia	fear of the sea
autophobia	fear of heights
brontophobia	fear of being seen or stared at
ergasiophobia	fear of itching or the insects that cause itching
gephyrophobia	fear of pain
ochlophobia	fear of needles or pointed objects
paralipophobia	fear of crossing bridges
scopophobia	fear of confined spaces, such as lifts
thalassophobia	fear of thunder and lightning

FIGURE 18.5 This young student receiving an injection as part of the cervical cancer (Gardasil) immunisation program does not appear to suffer from aichmophobia.

Contributing biological factors

There are three important biological factors that contribute to the development and maintenance of a phobia. These are:

- stress response
- role of GABA
- genetic factors.

ROLE OF THE STRESS RESPONSE

As discussed in previous chapters, our fight-or-flight response is important to our survival as a species. It provides us with an instant burst of energy to deal with danger in our environment and is controlled by the sympathetic branch of the autonomic nervous system. Once activated, stress hormones such as adrenalin and noradrenaline are released into the bloodstream to increase our heart rate, respiration rate, circulate more glucose through our body for energy, improve focus and temporarily boost our stamina to either fight the impending danger or flee to a safe place. A person with arachnophobia, or fear of spiders, will experience an intense stress response when they see a spider or a milder response by simply looking at a picture of one!

These stress response symptoms can include:

- elevated heart rate
- elevated blood pressure
- tremor (shaking in the hands)
- palpitations (abnormally fast heartbeat that the person is aware of)
- diarrhoea
- sweating
- shortness of breath
- skin sensation of prickling, burning or itching without identifiable physical cause
- dizziness.

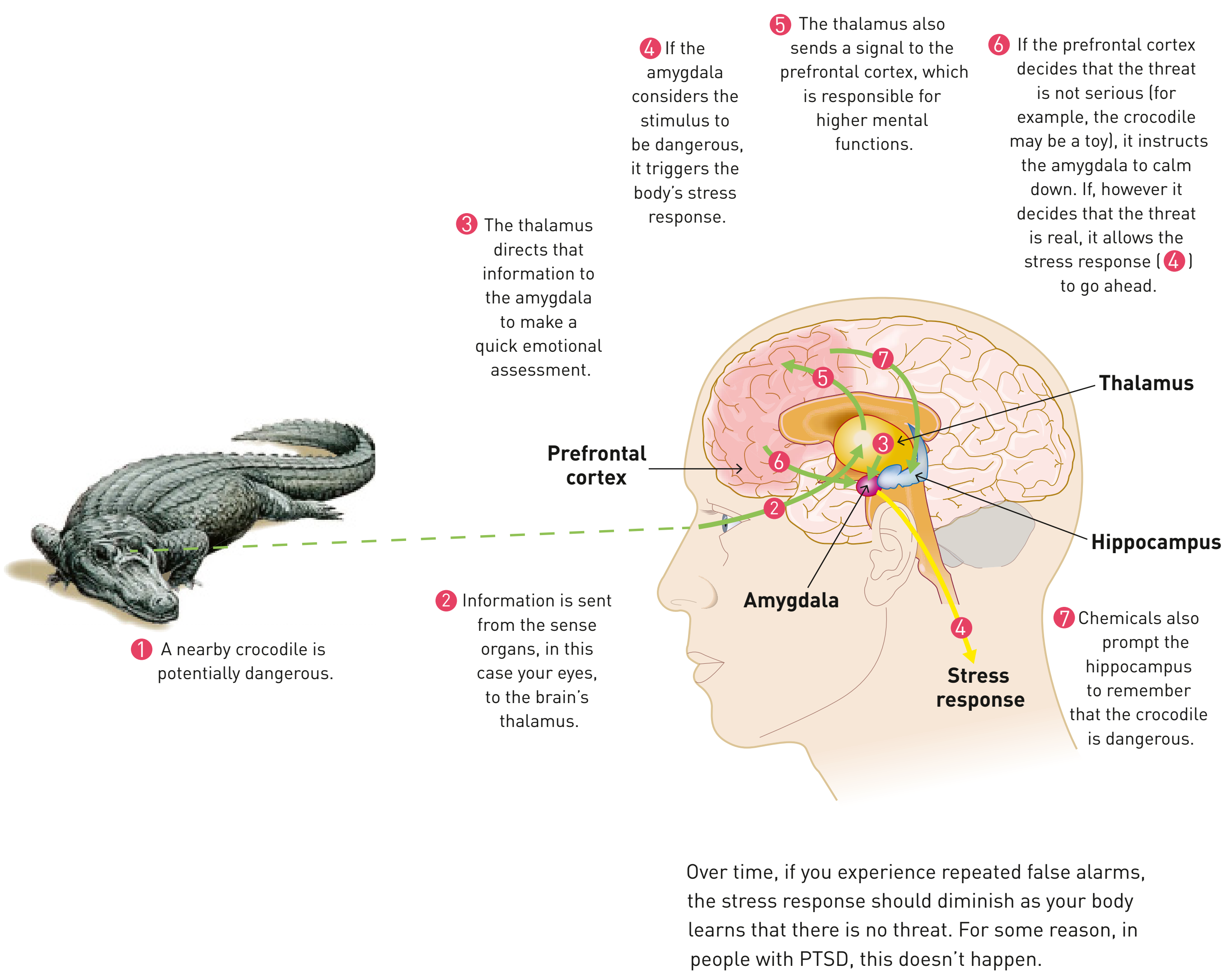


FIGURE 18.6 Biological processes involved that activate the stress response when a person sees a crocodile.

ROLE OF AMYGDALA AND HIPPOCAMPUS IN SPECIFIC PHOBIA FORMATION

The **amygdala** and **hippocampus** are located in the left and right medial temporal lobes. Although there are two of both these structures, it is common to refer to them in the singular: 'amygdala' and 'hippocampus'. The amygdala is part of the limbic system and is vital in initiating and processing emotional responses such as fear and anxiety and in forming emotional memories. As such, it plays a critical role in anxiety disorders such as specific phobias. The hippocampus is involved in the formation of declarative memories such as information about the world, facts, knowledge and autobiographical memories. So when a person experiences a frightening event, information from all the senses is processed by the amygdala as an emotion linked to the memory. The frightening event itself is consolidated by the hippocampus so that the person has a conscious recollection of the frightening event. The more frightening the event, the stronger the memory. Importantly, the amygdala is responsible in the formation and storage of classically conditioned fear. So, if the person is exposed to a similar stimulus, the amygdala triggers the 'emotion' of fear that sets off the fight-or-flight response (Hold, 2008).

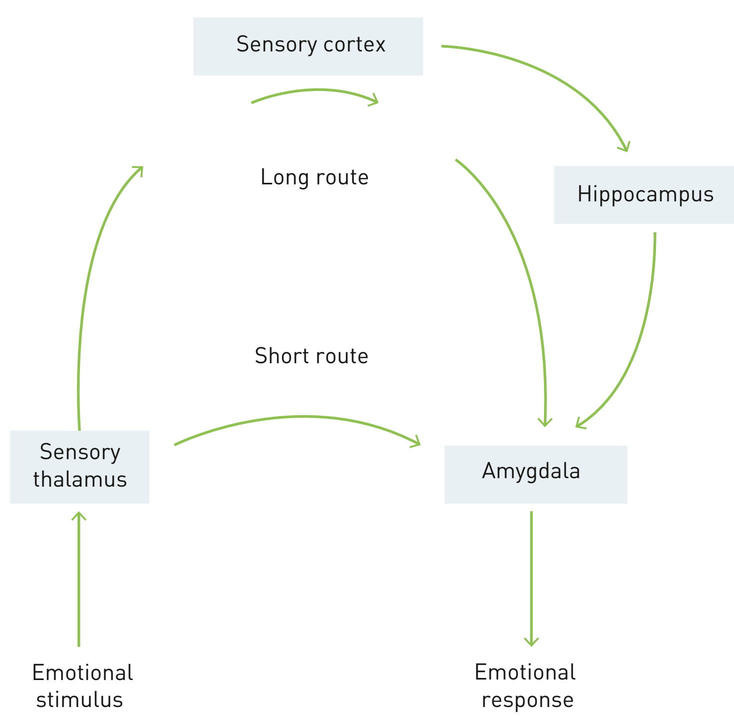


FIGURE 18.7 A spider-like object is detected and sensory information is first registered by the amygdala which initiates the fight-or-flight response. At the same time, a message is sent to the hippocampus via the sensory cortex to determine what the spider-like object is. If it is a big black hairy spider, the person will run or scream. However, if it is just a ball of black fluff, the fight-or-flight response will subside.

Did you know?

Research has shown that the thalamus acts as a gateway to processing fear-inducing stimuli. Recent data from experiments on humans and animals point to a dual processing system for emotion involving the amygdala.

The first pathway is primitive and instinctual, and initiates the fight-or-flight response (fear) without cognitive processing; the second system decides on a course of action. The emotional reaction to a stimulus, therefore, can occur in two stages. The first is quick and driven by evolutionary forces while the second is slower because it involves complex cortical processing. The information is also sent via the sensory cortex to the hippocampus for an assessment of the situation. Information from the amygdala and hippocampus form the memory of the event and the emotion.

ROLE OF GAMMA-AMINO BUTYRIC ACID (GABA)

The stress response experienced by individuals who suffer from an anxiety disorder such as a phobia has been linked to the neurotransmitter gamma-amino butyric acid (GABA) which has an inhibitory role in the regulation of anxiety, arousal and sleep (Siegel 2004, cited in Westen 2009). This is an important finding as GABA-producing synapses are present in approximately 40 per cent of all nerve junctions in the brain. Hence, low levels of GABA lead to higher levels of anxiety because there is not enough GABA to adequately regulate anxiety or arousal levels. These low levels of GABA have been found in highly anxious individuals and this is considered to be a contributing factor in developing a specific phobia.

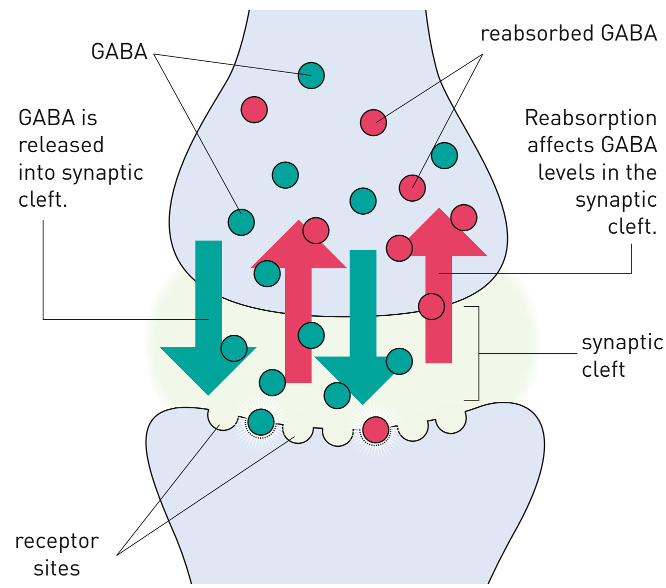


FIGURE 18.8 Diagram of GABA at a synapse. GABA plays a role in inhibiting anxiety. Too little GABA leads to increased levels of anxiety, which make a person more vulnerable to developing a phobia.

Anti-anxiety drugs that mimic GABA's inhibitory effects have been successfully used in conjunction with other treatments to manage phobic anxiety. Lorazepam (Ativan), Clonazepam (Klonopin) and Diazepam (Diastat, Diazemuls, Valium) are medications that are used by health professionals to help manage phobias by inhibiting anxiety.

GENETIC PREDISPOSITION AND INHERITED VULNERABILITIES

Can a specific phobia be inherited? In a way, it can. It is not the phobia itself, however, that is inherited, but several biological elements discussed above that can lead to a genetic vulnerability – such as being born with low levels of GABA like a parent or other relative. This vulnerability is also expressed in a person's personality. Individuals who are nervous and apprehensive about environmental objects and events are more likely to develop anxiety disorders and specific phobias.

This does not mean that an anxious, shy and nervous person will always develop a phobia. Disorders such as phobia can be triggered by psychological, social and environmental influences, so although a person may have the genetic predisposition to develop a phobia, there is no guarantee that they will do so.

18.2 REVIEW

1 Outline the biological factors that contribute to specific phobias.
2 Write a 500-word essay on one of the following:
   a Explain the relationship between the stress response and specific phobia.
   b What is the role of the amygdala in the development of a specific phobia?
   c Explain the role of the hippocampus and amygdala in the development of a phobia. Give an example to illustrate your understanding.
   d Outline the role of GABA in regulating anxiety and what happens to GABA levels in the presence of specific phobias.
   e Suggest one method of treating low levels of GABA and explain how this can help a person with a phobia.
3 Can specific phobias be inherited? Explain.

Contributing psychological factors

How do the different psychological approaches explain the development, reinforcement and management of phobias?

The psychological factors involved in developing a specific phobia refer to 'our thoughts, beliefs and perception about ourselves, our experiences and our environment' (Jacofsky *et al.* 2010). Essentially, we are the sum of our experiences and, depending on genetics and personality, we will interpret environmental events in our own unique way. This allows people to develop mental shortcuts that enable them to function at work, with family and friends, and within the community at large. Those who are more sensitive and anxious and feel less in control are more likely to notice events in their environment and to view them as potentially threatening, even though there may be nothing to fear. These thoughts and perceptions play a key role in developing a specific phobia.

How do different theoretical approaches explain the specific phobia? In the next section, we will examine the psychodynamic, behavioural and cognitive models and see how they differ.

FIGURE 18.9 People who suffer from a phobia have shown a tendency to perceive events as more threatening than those who do not suffer from an anxiety disorder such as a phobia.

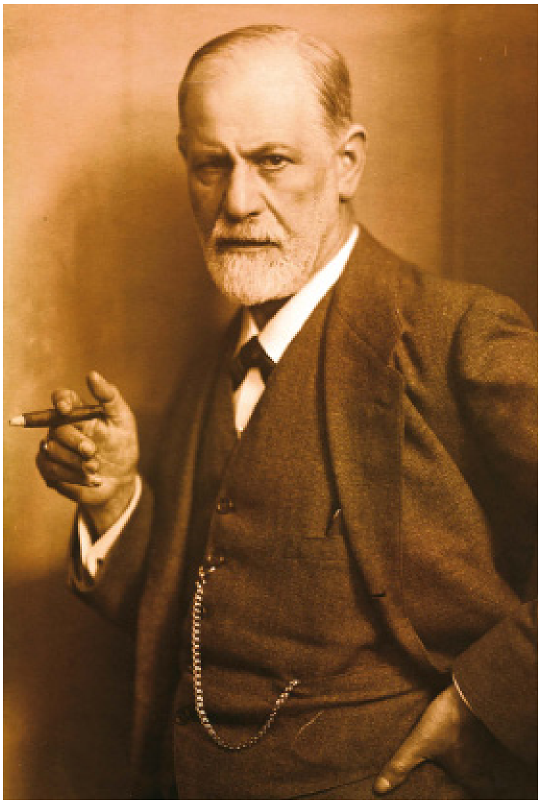


FIGURE 18.10 Sigmund Freud (1856–1939)

PSYCHODYNAMIC MODEL

The psychodynamic model (based on the work of Sigmund Freud) proposes that the development of phobias is due to unresolved conflicts that arise during the phallic stage of a child's development (see Table 18.2). This stage is characterised by the male child feeling hostile towards the parent of the same sex (the father) because of the child's underlying sexual impulses towards his mother – the 'Oedipal complex'. The female equivalent of this phenomenon is called the 'Electra complex' and is thought to operate in the same way.

According to psychodynamic theorists, if a person is unable to successfully deal with this conflict, their anxiety is displaced to a situation or object that is less relevant. It can also be shown in dreams and fantasies. The feared object or event thus becomes the symbol of the real source of conflict. Another theme within this theory is that there is a vast reservoir of unconscious drives and conflicts influencing behaviour. The psychodynamic approach attempts to resolve these conflicts by tapping into the unconscious and exposing what the symbols mean.

> … The unconscious contains unresolved conflicts and has a powerful effect on our behaviour and experience. [Freud] argued that many of these conflicts will show up in our fantasies and dreams, but the conflicts are so threatening that they appear in disguised forms, in the shape of symbols.
>
> Holah 2010

TABLE 18.2 Freud's psychosexual stages of development

STAGE	DESCRIPTION
Oral	Birth to approximately 15 months. The focus of pleasure is on the mouth.
Anal	Approximately 15 months to 3 years. Children gain pleasure from retaining or expelling faeces.
Phallic	3–5 years. The focus of a child's pleasure is on their genitals. This stage of development of the Oedipal and Electra complexes is where the child experiences sexual impulses toward the parent of the opposite sex and feelings of hostility towards the same-sex parent.
Latency	Approximately 5 years to puberty. Sexual drives are repressed.
Genital stage	Puberty onwards. The focus of sexual pleasure is again focused on the genitals but shown through relationships with members of the opposite sex.

CASE STUDY

HANS: A BOY WITH A HORSE PHOBIA

This classic case study involved a three-year-old boy known as 'Hans' who developed a particular interest in his and other people's 'widdler' (penis). 'Widdlers' and 'widdling' became the focus of his fantasies and dreams.

Exasperated by her son's obsession, Hans' mother told him to stop touching his penis or else she would have the doctor cut it off. This threat seemed to be effective in modifying Hans' fascination with penises, yet seemed to spark another unexpected problem: a fear of horses. Interestingly, this occurred around the time his sister Hanna was born, when Hans was around three-and-a-half years. Hans reported feeling jealous, but soon adjusted to the new circumstances.

When Hans was almost five years of age, his father wrote to Freud about his concerns about his son. '[Hans] is afraid a horse will bite him in the street, and this fear seems somehow connected with his having been frightened by a large penis.'

Freud believed that Hans' fear of horses emerged immediately after experiencing anxious dreams about losing his mother. This coincided with the time when he was warned against playing with his penis and the birth of his sister.

A month after Hans' father wrote to Freud, the phobia became significantly worse. Hans' father realised that there was a link between his son's fascination with his penis and his phobia of horses. Consequently, he told Hans that 'If you don't put your hand to your widdler any more, this nonsense of yours will soon get better.'

Unfortunately, this conversation was unsuccessful and Hans' anxieties and phobia continued, to the point where he did not want to leave the house. Once again, Hans' father wrote to Freud, this time relating a dream Hans had told him about. 'In the night there was a big giraffe in the room and a crumpled one: and the big one called out because I took the crumpled one away from it. Then it stopped calling out: and I sat down on top of the crumpled one.'

Both Freud and Hans' father recognised the dream as representing something Hans had seen – his parents engaging in sexual intercourse. Hans liked getting into his parents' bed in the morning but his father frequently objected (the big giraffe calling out because he had taken the crumpled giraffe – Hans' mother – away). Freud and the father realised that the long neck of the giraffe was a symbol for the large adult penis, though Hans rejected this idea.

From Freud's psychoanalytic perspective, Hans' phobia of horses was due to a repressed sexual desire for his mother (classic Oedipal complex) and the horse represented his father's erect penis.

Freud, S. (1909)

BEHAVIOURAL MODEL: CLASSICAL AND OPERANT CONDITIONING

The behavioural approach focuses on observable behaviours. It downplays the importance of thinking processes (cognition) and examines how an organism's behaviours are influenced by environmental factors. According to the behavioural model, phobias are learnt through classical conditioning and maintained through operant conditioning. Figure 18.11 shows the process of classical conditioning at work in the development of a dentist phobia.

BEFORE CONDITIONING

Neutral stimulus (NS)	→	No response
Unconditioned stimulus (UCS) *pain from injection*	→	Unconditioned response (UCR) *fear: due to pain from injection*

DURING CONDITIONING

NS + UCS	→	UCR
dentist + *pain*	→	*fear: due to pain from injection*

AFTER CONDITIONING

conditioned stimulus (CS) *visit to the dentist*	→	conditioned response (CR) *fear: due to visit to dentist*

FIGURE 18.11 Acquisition of dentist phobia through classical conditioning

Maintenance of phobia through operant conditioning

Having a phobia is not just as simple as learning through association. The process of a child actively avoiding going to the dentist or having a tantrum that makes a session impossible has more to do with operant conditioning.

In the case of the dentist phobia, the avoidance of the unpleasant injection acts as a negative reinforcer that strengthens the likelihood of that behaviour being repeated. You could also say that the 'good' feeling of relief (at being able to avoid the injection) presents a positive reinforcement of the behaviour.

Watson and Rainer's controversial experiment involving 'Little Albert' (see Chapter 13) demonstrated that an intense fear response can be classically conditioned at the sight of a white rat and a range of other stimuli. Essentially, Watson and Rainer enabled the scientific community to find a behavioural explanation for the development of a specific phobia.

While classical and operant conditioning provides a convincing behavioural explanation for the acquisition of a specific phobia, they do not fully explain situations where people are phobic about objects or events that they have never experienced. Observational learning (see Chapter 15) provides us with a behavioural (combined with cognitive) explanation for such an event.

1 Give an example of a psychological factor in a specific phobia.
2 Outline the psychodynamic explanation of specific phobias.
3 Explain the behavioural model of specific phobia using the appropriate terms.
4 How does the psychodynamic explanation differ from the behavioural model?

18.3 REVIEW

Cognitive model

Unlike the behavioural model, the cognitive model emphasises the influence of thought processes on how we feel and behave. Consequently, psychologists use this model to examine the distorted thinking processes involved in the development and maintenance of specific phobia and look at ways to change those incorrect thoughts. This approach also argues that anxious individuals have a propensity to exaggerate perceived threats, making them more likely to interpret some situations, objects or activities as more dangerous than the average person would (Beck & Emery 1985).

There are several effective methods of treating specific phobia. These include cognitive behavioural therapy (CBT), graduated exposure (systematic desensitisation) and flooding.

Cognitive behavioural therapy

Cognitive behavioural therapy (CBT) uses a combination of verbal and behaviour modification techniques to help people change irrational patterns of thinking that create and maintain a phobia. CBT focuses on helping the person change negative automatic thoughts and replace them with more positive, realistic ones. According to this model, there is a cycle that occurs. When a person is exposed to the object or situation (stimulus), negative automatic thoughts lead to an emotional (distress) and biological response (fight-or-flight). This then alters their behaviour (actively avoids the object or situation).

In CBT, the person is encouraged to recognise that the incidence of these events happening in real life is very small and that their catastrophic thoughts are not based on reality. The person is taught to monitor and document the occurrence of these negative thoughts in an 'automatic thought diary'. As the person becomes more aware of their frightening/anxious thoughts, they begin to understand that their thoughts are based on incorrect assumptions and, with the help of the therapist, learn to change those thoughts to more realistic and positive ones such as: 'Flies are not dangerous', and 'If a fly lands on me, I won't die'. This treatment teaches strategies that the person can use to deal with their phobia between sessions. Therapists give homework to assist clients to change their thoughts and behaviour until eventually they can deal with the feared stimulus without experiencing the phobic response.

Cognitive behavioural therapy, often combined with relaxation, has been successfully used to treat a wide range of specific phobias.

Understanding a phobia of flies using CBT model:

- Stimulus/event – fly buzzing around the room.
- Automatic negative thoughts – 'flies are dangerous and might kill me'
- Emotional response – terror!
- Biological response – fight-flight response.
- Behavioural response – run away from the fly screaming with hands flapping in the air.

A therapist using CBT will deal with a fly phobia as follows:

- Stimulus/event – fly buzzing around the room.
- Automatic negative thoughts – 'flies are dangerous and might kill me'
  - Challenge negative automatic thoughts by providing evidence that flies cannot kill. Person can be given further information and asked to do homework about flies.
- Emotional response – terror!
  - The emotional response of terror will be replaced with irritation or no particular feeling on seeing a fly.
- Biological response – fight–flight response.
  - No fight–flight response.
- Behavioural response – run away from the fly screaming with hands flapping.
  - Person will remain in the presence of the fly and possibly use a swatter or fly spray.

By replacing the negative automatic thought patterns with more realistic and positive ones, the therapist modifies the person's emotion, behaviour and physiological responses to the phobic object.

FIGURE 18.12 Flies can kill me!

FIGURE 18.13 Therapist and patient

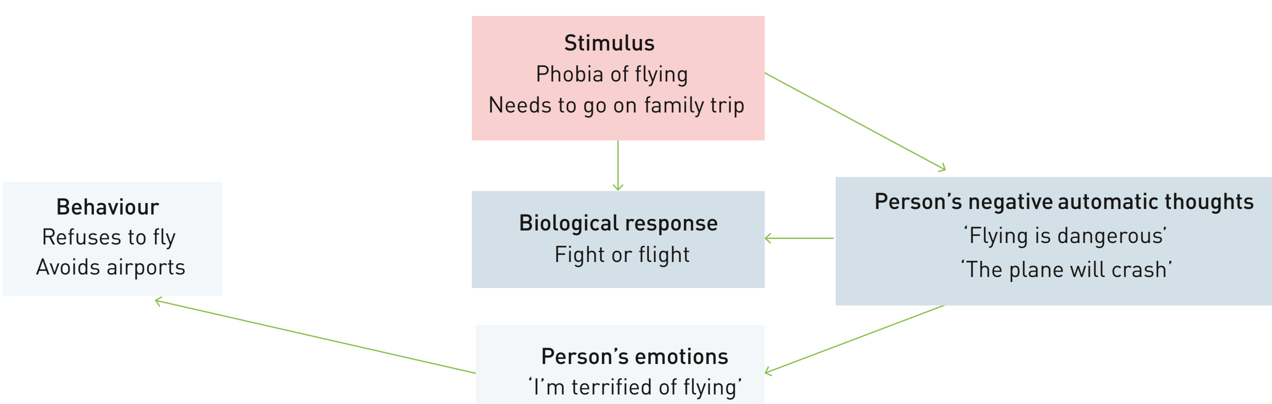


FIGURE 18.14 With CBT, when a person with a fear of flying is told they need to go on a family trip, they experience negative automatic thoughts that elicit feelings of fear and terror. This situation activates the fight-or-flight response and the person refuses to fly so as to avoid their fear. The basis of CBT is to challenge or change the negative automatic thoughts to more realistic ones. This then leads to more appropriate emotional, biological and behavioural reactions – so the person can eventually feel ok about flying.

BEATING BAKED BEANS PHOBIA

Search the Internet for a video of a therapist using CBT in treating a man with a phobia of baked beans. Search using the terms 'Baked Bean Phobia'.

Discuss the video with a friend and try to describe the patient's symptoms.

18.3 INVESTIGATE

Graduated exposure

Graduated exposure, which involves teaching relaxation and systematic desensitisation, was developed by Joseph Wolpe (1958). It is based on the assumption that most anxiety responses are initially acquired through classical conditioning, therefore eliminating a specific phobia can be achieved through counter-conditioning or by weakening the association between the conditioned stimulus (for example rat, needle, flying) and the conditioned response of fear or anxiety. This takes three steps:

1. The therapist trains the client in deep muscle relaxation.
2. The therapist helps the client build an anxiety/fear hierarchy. The client makes a list of anxiety-causing stimuli that are linked to their simple phobia, from least anxiety/fear-inducing to most anxiety/fear-inducing.
3. The client tries to work through the hierarchy, learning to remain relaxed while imagining each stimulus on their hierarchy. This is repeated until the person can imagine each situation or object with little or no anxiety/fear.

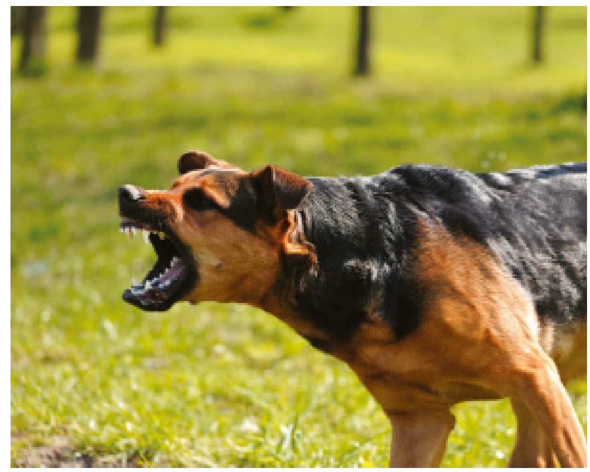


FIGURE 18.15 Cynophobia is a fear of dogs.

Essentially, the objective of graduated exposure (systematic desensitisation) is simple: to recondition people so that the feared object, animal or situation (the conditioned stimulus) elicits relaxation rather than fear or anxiety. Initially, treatment is done within a therapeutic environment, and when or if appropriate, the desensitisation process is achieved through gradual exposure in a safe and controlled manner. For example, if you have a fear of dogs, exposure can take the following path with the accompanying relaxation techniques at each step:

- step 1: teach patient relaxation techniques
- step 2: develop a hierarchy of fear with the person, from what causes them the least to the most fear
- step 3: work through the hierarchy
- step 4: draw a dog on a piece of paper
- step 5: read about dogs
- step 6: look at photos of dogs
- step 7: look at videos of dogs
- step 8: look at dogs through a closed window
- step 9: look at dogs through a partly-opened window
- step 10: look at dogs from a doorway
- step 11: move further out from the doorway
- step12: have a dog on a leash brought into the room
- step 13: have a dog on a leash sit beside you
- step 14: pat the dog's head while it is on a leash.

SUPPORTING UNDERSTANDING

The following is a sample fear-of-flying hierarchy to give you an idea of how one person may rate each of these stimuli in terms of being anxiety-producing (on a scale of 0 to 100). This will differ from person to person. Note: for this individual, the most frightening element of their flying phobia is the plane landing.

TABLE 18.3 Sample of fear of flying hierarchy

DEGREE OF FEAR (OUT OF 100)	STIMULUS
5	Packing my luggage
10	Making reservations for an interstate trip
15	Driving to the airport
20	Realising I must make it to the airport
25	Parking my car in the long-term car park
30	Standing in the checkout line with my baggage
35	Going through security to the waiting lounge
40	Waiting in the lounge for the plane to begin boarding
45	Waiting in line to board the plane
50	Entering the plane and finding my seat
55	Listening to the safety instructions from the flight attendant
60	The plane starting to taxi to the runway
75	The plane taking off
80	The plane climbing to cruising altitude
85	Waiting for the seatbelt sign to go off
90	Turbulence
95	The plane descending
100	The plane landing and screeching to a stop

Although graduated exposure (and systematic desensitisation) has been useful in treating specific phobia, the following points should be considered.

- Graduated exposure is more effective in treating specific phobia rather than social phobia or agoraphobia.
- Graduated exposure is less effective in treating performance fears such as exam anxiety if the person doesn't study. In this instance, the anxiety is based on lack of preparation rather than a phobia of exams.
- Some studies have shown that the success of graduated exposure is not always dependent on the intensity or duration of the phobia or whether the phobic anxiety was developed quickly or over time.
- It may not be effective in treating phobias that have an underlying evolutionary survival element, such as fear of spiders, fear of the dark or fear of other dangerous animals or situations.

Flooding

Flooding, sometimes known as exposure therapy, is a behavioural psychotherapy based on the premise that phobias are learnt through classical conditioning but, unlike systematic desensitisation where the person is gradually exposed to the object of the phobia, patients are actually exposed at once and for prolonged periods to the feared stimulus. Patients are subjected to high levels of anxiety that they seek to replace with feelings of relaxation. Although this method can achieve quicker results and has been successful in treating specific phobia, it is not suitable for all people as it can increase rather than decrease their phobia and has a greater incidence of spontaneous recovery of the phobia than other methods.

Did you know?

A psychiatrist by the name of Joseph Wolpe demonstrated the effectiveness of flooding in an experiment that involved a girl with a phobia of cars. He placed her in a car and drove around for several hours. The girl initially screamed and became hysterical but, as she was driven around, she began to relax until she no longer feared the car.

Wolpe (1990)

FIGURE 18.16 Flooding seeks to treat phobia through intense exposure to the fear stimulus.

18.4 REVIEW

1. What methods are available to treat specific phobia? Outline two of the methods.
2. Explain what cognitive behavioural therapy (CBT) involves and how it is used to treat specific phobia.
3. Little Andrew had a phobia of big fluffy bunny rabbits. Outline how a therapist could use CBT to cure Little Andrew of his phobia. Use a step-by-step process to illustrate your understanding.
4. What is the difference between graduated exposure and flooding?
5. What do graduated exposure and flooding have in common?
6. Imagine you have a specific phobia. Using graduated exposure, outline the steps involved in the treatment of your phobia.
7. Use your textbook and the Internet to complete the following table:

TREATMENT TYPE	ADVANTAGES	LIMITATIONS
CBT		
Graduated exposure		
Flooding		

INVESTIGATE 18.4

METHODS OF DEALING WITH PHOBIA

1 Search the Internet for videos to see cognitive behavioural therapy, graduated exposure and flooding in action and note the differences between the three methods.
2 Write a 500-word essay critiquing these methods.
3 For a demonstration of 'rapid exposure therapy', a combination of flooding and systematic desensitisation without the relaxation element, search for videos on the web.

Contributing sociocultural factors

Social and cultural factors can contribute to the type and incidence of specific phobia. Research has found that a child whose parent suffers from a phobia of moths, for example, is more likely to develop the same or a similar phobia as a result of simply observing their parent's fear response and making the cognitive connection that 'moths are dangerous'. Some phobias are culturally-specific, that is, they occur almost exclusively in a particular culture.

ENVIRONMENTAL TRIGGERS

In many instances, environmental triggers can lead to the development of a phobia. There are three possible environmental paths:

1 direct exposure to a distressing or traumatic event, such as being bitten by a dog
2 witnessing other people experiencing a traumatic event, such as seeing another person being mauled by a dog (observational learning)
3 reading or hearing about dangerous situations or events, for example, developing a fear of dogs after hearing stories about children, adults or family pets being attacked by vicious dogs.

PARENTAL MODELLING

What about other ways of developing a specific phobia? Albert Bandura combined behavioural and cognitive approaches to develop social learning theory. According to this theory (discussed in Chapter 15), a great deal of our behaviour is learnt through imitating or modelling other people's behaviours. It was suggested that specific phobias can be learnt vicariously, by observing other people's phobic reactions. Consider this scenario: a child is raised in a household where a parent is terrified of moths. Each time the parent sees a moth, they exhibit their fear by screaming and running out of the house. This in turn increases the child's anxiety and leads the child to believe that moths are dangerous and should be avoided at all costs. Children who are exposed to parents with phobic responses are more likely to develop comparable fears to similar stimuli. Thus, parental modelling can lead to the transmission of threat information which is incorporated into the child's long-term memory.

TRANSMISSION OF THREAT INFORMATION

The transmission of information that a person perceives as threatening is not limited to observing their parent's responses. This can also be received from a range of different sources such as the media, Internet, friends, and school. A student, who is interested in traveling, might develop a fear of flying if each time they search for 'travel or flying' they get plane crash websites with graphic pictures or video clips. If their fear prevents them from being able to board a plane, then the threat information delivered by the various media has led to a phobia.

FIGURE 18.17 Exposure to a parent's phobia can teach a child to fear the same stimulus.

RESEARCH INVESTIGATION

18.5 INVESTIGATE

Read the following account of an experiment and answer the questions below.

Participants were randomly selected to participate in a study that involved observing a person attached to a complex range of electrical apparatus, sitting in a chair. A buzzer sounded intermittently and the person, in what appeared to be great pain, would stand quickly and remove their hand from the arm of the chair. While the participants observed the individual in the chair, their physiological responses were monitored. What the participants did not know was that the person in the chair was not actually experiencing any pain or discomfort – they were pretending! Having observed the 'stooge's' pain reaction, the participants learnt to react emotionally to the sound of the buzzer, demonstrating that vicarious learning had taken place.

1 Write a possible aim for this experiment.
2 Write an operational hypothesis.
3 Outline the results of the study and what conclusions can be made, based on the information available.
4 Discuss two ethical considerations for this experiment.

Biopsychosocial approach

As with other areas in psychology, health professionals take a holistic approach to treating specific phobia and consider the following factors:

- genetic vulnerability and inherited personality predisposition
- physiological processes
- psychological determinants
- sociocultural factors
- family history of anxiety and specific phobia
- environmental influences
- symptoms and whether the person can function effectively at work, home and socially.

The biopsychosocial approach to specific phobia incorporates three major elements: biological, psychological and sociocultural.

BIOLOGICAL

The biological element of this model refers to the body's physiological make-up and how the brain processes and responds to fear. It incorporates the influence of genetics in terms of inherited vulnerability to an anxiety disorder and the potential effect of being born with a highly sensitive and easily startled personality predisposition.

PSYCHOLOGICAL

Does everyone with these tendencies develop an anxiety disorder such as a specific phobia? The answer is no. Psychological factors such as thoughts, beliefs, personal experiences and perceptions of ourselves and the environment can influence whether or not we interpret events around us as a source of danger. These interpretations can play an important role in the development of an anxiety disorder such as specific phobia. Indeed, cognitive distortions or thinking errors are characteristic of phobia, as individuals overestimate the perceived level of danger and experience a stress response and/or use avoidance strategies to alleviate the distress.

SOCIOCULTURAL

If a person has both biological and psychological vulnerabilities, their social environment (such as family) and cultural background can lead them to focus their apprehension on particular objects or situations. Consequently, the sociocultural elements may activate, shape and strengthen their biological and psychological vulnerabilities (Barlow 2002) and lead to the development of specific phobia. As mentioned earlier in the chapter, phobia can initially be learnt through classical conditioning and avoidance behaviours reinforced through operant conditioning, while learning to fear objects and/or situations can occur by observing family and other significant people in our social environment (observational learning).

COMBINING THE APPROACHES

Consequently, biological, psychological and sociocultural factors must be considered when treating social phobia to ensure the most effective therapeutic outcomes.

The first step to effective treatment is to have a full understanding of all the elements involved and to determine which therapy or combination of therapies is suitable for that particular individual. Most specific phobia symptoms can be dealt with through cognitive behavioural therapy, graduated exposure or the less-common flooding. Anti-anxiety medication is generally not required unless there are other medical factors to consider.

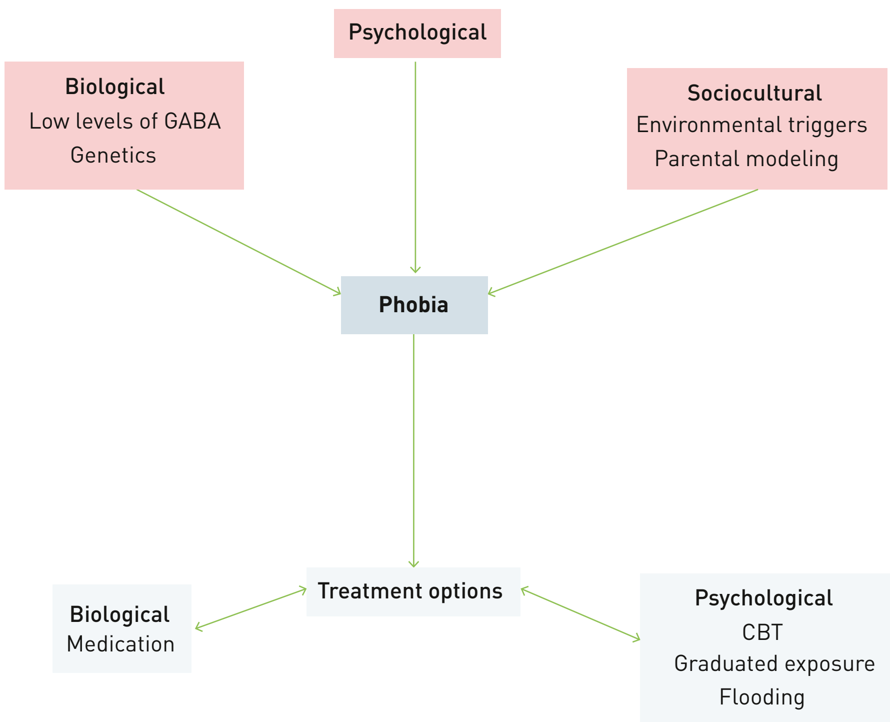


FIGURE 18.18 The biopsychosocial model considers the biological, psychological and socio-cultural factors when treating a phobia.

MULTIMEDIA PRESENTATION

INVESTIGATE 18.6

Present a biopsychosocial explanation of a selected phobia.

- Select a specific phobia (different from other members of the class). Using the textbook and other resources, develop a biopsychosocial explanation for your chosen phobia based on your research. Include the following:
  - biological and possible genetic and personality predisposition elements
  - psychological elements
  - sociocultural and environmental elements.
- Select a treatment method–CBT, systematic desensitisation or flooding – and provide a step-by-step process to treat the phobia.
- Present your findings and treatment plan to the rest of the class, using a PowerPoint presentation, podcast or scripted role-play.

Mood disorder: Major depression

During our day-to-day lives we have many experiences that may lead to feelings of happiness or joy, such as passing our learner driver test, winning a race or receiving a promotion at work. In contrast, there are also experiences that may lead us to feel down, such as failing a test, getting rejected for a date or losing a favourite item. These feelings are typical and appropriate; they are moods that can come and go and not affect our lives greatly.

FIGURE 18.19 Obtaining your driving licence creates a positive mood in most people.

Moods are emotional states that can affect our perceptions, thoughts and behaviours. When a person's mood is ongoing, severe and disrupts their life or daily functioning, then they may be experiencing a **mood disorder**. People who experience mood disorders may experience depression and/or mania. **Depression** is a low, sad emotion where a person may feel that life is miserable, dark and an overwhelming challenge. The opposite of this emotion is **mania**, the feeling of euphoria, irritability, unrealistic beliefs and impaired judgments and behaviours. If a person with a mood disorder experiences feelings of depression and then returns to their usual state of functioning, it is referred to as **unipolar depression**. If a person with a mood disorder experiences mania and depression, it is referred to as **bipolar disorder**.

As outlined in Table 18.4, there are several kinds of mood disorders. This section will examine major depressive disorder, its symptoms, and the application of the biopsychosocial framework to understanding and managing it.

TABLE 18.4 Types of mood disorders

UNIPOLAR DISORDERS	
Major depressive disorder	Recurrences of a sad mood or depression that occurs for at least two weeks with other symptoms, separated by periods of normal functioning.
Dysthymic disorder	A sad mood or depression that occurs for an extended period of time, typically for at least two years.
BIPOLAR DISORDERS	
Bipolar I disorder	The occurrence of one manic or mixed episode
Bipolar II disorder	The occurrence of one hypomania episode alternating with major depressive episodes and possibly periods of a normal mood
Cyclothymic disorder	Frequent up-and-down mood changes, from mild depression to mild mania

Symptoms of major depression

Everybody experiences mood changes; these usually pass quickly or are not severe enough to disrupt our daily lives. Experiences in our lives such as the end of a relationship or the death of a loved one can even cause some symptoms of depression, but this is a normal reaction. However, a diagnosis of major depressive disorder will occur if depressive symptoms are present for at least two weeks. These symptoms include being in a depressed (sad) mood, loss of interest or pleasure in all activities and four additional symptoms, as outlined on page 498. The severity and number of symptoms will vary from person to person and they can influence and worsen other symptoms. Depressive symptoms can be categorised as emotional, motivational, behavioural, physical and cognitive.

As outlined in the DSM, major depressive disorder is diagnosed when a person presents four of the listed symptoms below with either (a) a sad mood or (b) a loss of interest or pleasure in activities for at least a two-week period, every day and most of the day. Additionally, the symptoms will cause significant levels of distress and impairment.

At least four of the following symptoms must be present:

- a decreased appetite and weight loss, or increased appetite and weight gain
- difficulty in sleeping or sleeping longer than usual
- loss of energy
- feelings of agitation or restlessness
- feelings of worthlessness or inappropriate guilt
- inability to concentrate, think clearly or make decisions
- recurring thoughts of death and suicide.

Did you know?

During the coverage of the 1992 Olympics, researchers discovered that bronze medallists were much happier with their achievements than were silver medallists. Silver medallists often looked sad and dejected, having just missed out on a gold medal, whereas bronze medallists were happy just to win a medal!

McGraw, P., Mellers, B. A. and Tetlock, P. E. (2005)

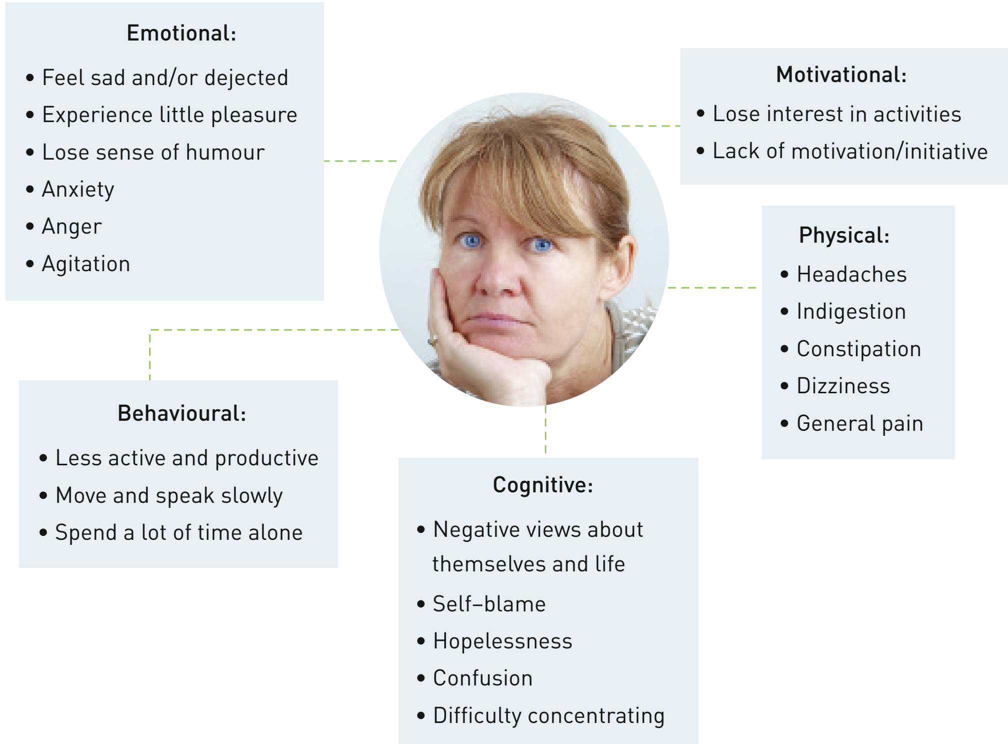
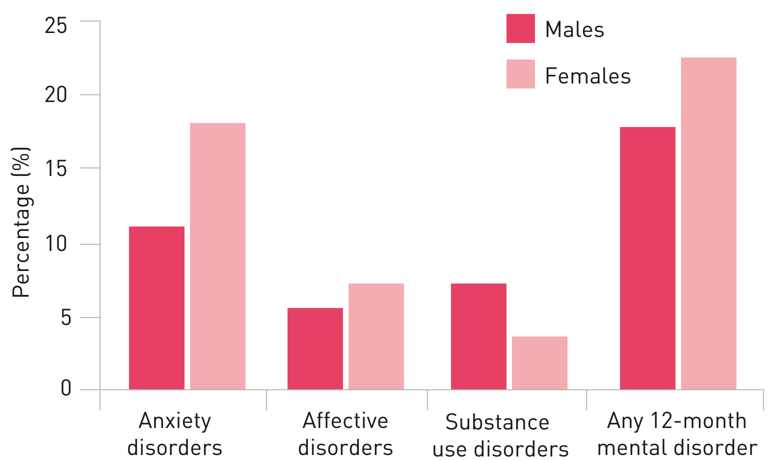


FIGURE 18.20 Major depression symptoms.



Sourced from ABS National Survey of Mental Health WellBeing, 2007

FIGURE 18.21 Occurrence of depression among Australians

Major depression is known as an **episodic disorder** as symptoms sometimes last for a period of time (episodes) and then disappear. Some episodes can last a couple of weeks while others can last for months or years. Some people may experience only one episode of depression and then return to their daily functioning. For most people (80 per cent), however, episodes of major depressive disorder recur. So a person with major depressive disorder will improve for a period of time but then suffer another episode at a later time. The average person can experience four episodes in their lifetime. Often, recurring episodes occur in people who may have some leftover depressive symptoms after their first episode.

Major depressive disorder is one of the most common mental illnesses, which can occur at any age. Each year, one million Australian adults and 100 000 young people have depression. One in five people will experience depression at some point in their lives, and one in 20 people aged 16–25 years will experience depression this year. Depression is more common in women than in men and there are several factors that place people at risk of developing major depression. Age is a factor, as the first occurrence of depression is more common among young adults than older adults. Also, people who come from a lower socioeconomic background are at a higher risk than people who are wealthier. Marital status can also have an impact on the likelihood of developing depression, as people who are separated or divorced are more likely to suffer depression compared with people who are married or have never been married (Nevid, Rathus & Greene 2005).

INVESTIGATE 18.7

RESEARCH A WEBSITE

In pairs or small groups investigate one of the following organisations' websites and answer the questions below.

Organisations (choose one)

- Youth Beyond Blue
- Headspace
- BlackDog Institute
- Sane
- ReachOut

Questions

1. Who could use this website?
2. What sort of information does this website provide?
3. Which mental health illness does this organisation work with?
4. Does it organise events? Explain.
5. Is this site best for adults or youth with a mental illness?
6. Where is the organisation located? Can it be contacted?
7. What is some other relevant information about the organisation?

REVIEW 18.5

1. Explain the difference between moods and mood disorders.
2. What is the difference between unipolar and bipolar disorders?
3. Read the two scenarios below and determine which person is more likely to be suffering from major depression disorder. Justify your answer.
   a. Samantha was feeling down last week for a few days after receiving an unsatisfactory result on her English essay. She has spoken to her English teacher about it to ensure it does not happen again.
   b. Mary has noticed that Joe, her son, has stopped playing football and is finding it difficult to go to school. He no longer wants to hang out with his friends on the weekend.
4. What factors may increase the risk of developing major depression disorder?

DOONA DAYS

by Kirsty Kelly

Ever woke up and wished you hadn't? Wished you could just be swallowed up by the bed and disappear? It doesn't matter how long you lie there... the sun continues to rise and fall and the world outside the doona continues on.

No one tells you it's going to be like this.

Doona Days were the seconds that turned into minutes, then hours ... The days when the doona wasn't going anywhere and neither was I. The irrational thoughts and fears all submerged below a layer of cotton and eider down!

Staggering in a dopey daze from the doona to the toilet – only because if I didn't my bladder would surely burst. Occasionally seeing sunlight peaking in from behind the venetians. If I dared to step into another room and look outside and see a person or car go by, knowing that the world was continuing on without me.

It is hard when I experience Doona Days. I don't want to talk to, or see anyone. Exactly the opposite of what would be good for me. I just hope that with the work I am doing with my shrink, and the right medication, I can get back on track – wherever that may be. At the moment I'm just working on decreasing the number of Doona Days.

Something strange happens to a person when the doona takes control. People start to ask where's the chick that used to run, paddle, sing, dance, socialise and hold a job down.

Strangely enough when I look in the mirror I see the body I used to live in, slightly emaciated with panda eyes and bad hair. It is as if aliens have visited and replaced me with a shadow of my former self. If it's hard for family and friends to accept the changes in this once 'the life of the party', 'out there', 'bubbly, happy girl,' imagine how I feel.

When faced with a mirror, usually on 'excursions' to the shower (during Doona Days I was lucky if I fought my way out more than a few times a week), add a little make-up and clothes, I was actually able to appear as a 'sane'/'stable' human being.

Upon careful observation you may notice one little feather attached, and no that feather is not the latest fashion accessory in hair garnish! I may think that I am out fooling everyone and on the road to success, but alas the doona still has plans I can't yet escape.

Baby steps are required when planning your escape from the doona. Be prepared for experiencing moments of frustration. Once I started to see some light I wanted to run straight towards it and to have everything return to normal ASAP! The doona is not so forgiving.

Simple things start the recovery process such as getting up at roughly the same time each morning, exercising, even if it you can only manage a 15–30 minute walk per day. As the days pass, the time will increase and so your mood will improve!

Employing the thought police was another necessary step for me to escape the doona. It is strange to think that I am my own worst enemy. As well as a chemical imbalance, allowing negative thoughts and worries to build up lead to feeling down. I thought that the depression led to the negative thoughts – go figure!??

Recovery like anything takes time; good and bad days. Friends and family beware! You may want to prepare yourself for the recovery phase. It is a time in which I know that I have felt so good to be over the Doona Days that I was 'up bright and early, energetic and looking for someone to play with. Run, talk, brekki, whatever...' so don't worry when the doona and aliens return your friend, just be prepared!

Although there were times when I saw no light, I trusted in the people who loved and supported me. They also allowed me to learn that it is ok to take time out for myself and to find the help I needed. After all what strength do a few ducks and a bit of cotton really have to keep you down?

Biological factors contributing to depression

GENETIC FACTORS

Most researchers believe that major depression disorder is partly caused by biological factors, such as genetics and neurotransmitter functioning.

In the past, much research was conducted that indicated genetic factors contribute to the likelihood of developing major depression disorder. Studies show that the closer the genetic relationship one shares with a person who has depression (relatives that have a high percentage of the same genes, such as parents and siblings), the greater the likelihood of developing depression (Vincent *et al.* 1999, cited in Nevid, Rathus & Greene 2005). Twin studies by McGuffin (1996) have examined monozygotic (identical) twins, who share 100 per cent of their genes and dizygotic (fraternal) twins, who share 50 per cent of their genes. It was found that when a monozygotic twin had depression there was a 46 per cent chance that the other twin would have the disorder, compared to fraternal twins, where there was only a 20 per cent chance of developing depression. Some adoption studies have also supported this theory, as evidence suggested that the biological parents of the adoptees had a higher incidence

FIGURE 18.22
Depression can be shown in many ways and not always in a quiet passive response.

of depression compared to a control group of biological parents with non-depressed adoptees (Wender *et al.* 1986, cited in Comer 2004). Currently, researchers believe that it is not one gene that causes this disorder but a set of genes. Even if those genes are identified, however, it is unlikely that they alone control whether or not a person develops depression. It is thought that these genes, along with other conditions, may increase the risk of developing depression.

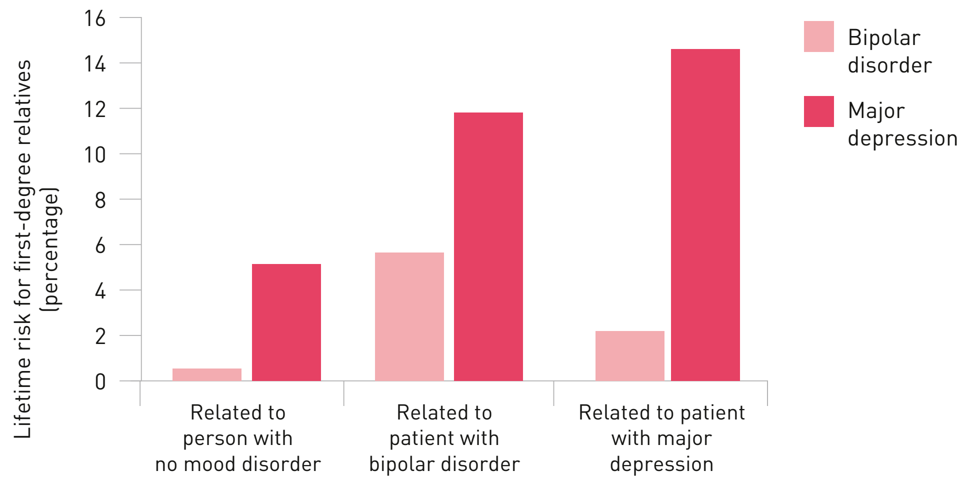


FIGURE 18.23 The risk of developing major depression among relatives of patients with depression is three times the normal rate.

NEUROTRANSMITTER FUNCTIONING

Neurotransmitters are the brain chemicals that carry messages from one neuron to the next. Neurotransmitters that researchers believe play a role in major depression are serotonin, noradrenalin (norepinephrine) and dopamine, which are present in many areas of the brain. Figure 18.24 indicates the areas of the brain where serotonin and dopamine can be found.

At first, researchers believed that depression was caused by a lack of serotonin, noradrenalin and dopamine. It was suggested that there were low levels of these neurotransmitters in the synaptic cleft (gap) being sent from the presynaptic neuron to the postsynaptic receptor (receiving neuron), but researchers now believe it is more complicated than that. Some studies have found that the interactions between serotonin and noradrenalin may cause depression, or that depressed people may have an overall imbalance in the activity of the neurotransmitters serotonin, noradrenalin, dopamine and acetylcholine (Nicoletti & Nicoletti 2000, cited in Comer 2004).

Some other studies have not supported these theories and researchers are now focusing on the idea that depression may be caused by the sensitivity of the receiving neuron (postsynaptic receptor). For instance, if the postsynaptic receptor is oversensitive, then it may react to the smallest amount of a neurotransmitter in the synaptic cleft (gap). Alternatively, if the postsynaptic receptor is less sensitive, then it is difficult for it to detect small amounts of the neurotransmitter in the synaptic cleft. Therefore, if postsynaptic receptors are more or less sensitive, this implies that people will react differently to medication that influences the level of neurotransmitters.

Researchers have tried to test for the sensitivity of neurons and have focused their studies on serotonin and dopamine. Some research has found that people with depression will have an abnormal response to drugs that increase dopamine levels (Narano *et al.* 2001, cited in Kring *et al.* 2007).

Other research has been conducted where serotonin levels were experimentally raised or lowered; by doing this, researchers were able to test the sensitivity of postsynaptic receptors to fluctuations. It was found that when the level of serotonin was reduced, a person with less sensitive postsynaptic receptors would experience depressive symptoms. Generally, increased serotonin levels correlated with decreased levels of depression, and they concluded that people vulnerable to depression have less sensitive postsynaptic serotonin receptors. (Benkelfat *et al.* 1994, cited in Kring *et al.* 2007).

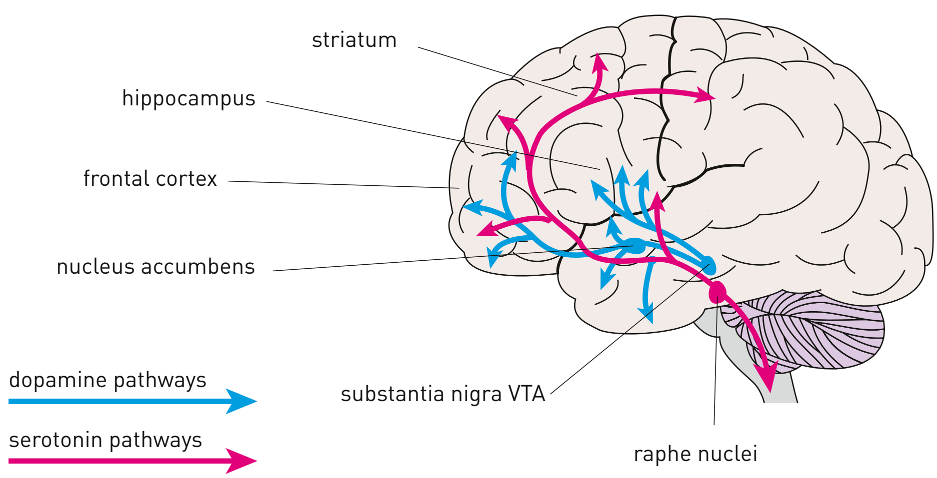


FIGURE 18.24 Areas of the brain where serotonin and dopamine occur

MANAGEMENT THROUGH ANTIDEPRESSANT MEDICATION

In order to treat depressive disorders, antidepressant drugs are most commonly prescribed. These drugs increase the availability of neurotransmitters in the synaptic cleft to alter the sensitivity of the postsynaptic receptor. There are three major categories of antidepressants: monoamine oxidase (MAO) inhibitors, tricyclic antidepressants and selective serotonin reuptake inhibitors (SSRIs).

TABLE 18.5 Antidepressant medications: benefits and side effects

TYPE OF ANTIDEPRESSANT	TRADE NAME	BENEFIT	SIDE EFFECTS
MAO inhibitors	Parnate	Blocks the enzyme that breaks down neurotransmitters serotonin and noradrenalin	Possible hypertension, dry mouth, dizziness, nausea and headaches
Tricyclic	Tofrani, Elavil	Increases levels of serotonin and noradrenalin by preventing the presynaptic neuron absorbing it (reuptake)	Heart attack, stroke, blurred vision, anxiety, tiredness, dry mouth, constipation and weight gain
SSRI	Prozac, Zoloft	Slows the reabsorption (reuptake) of serotonin by the presynaptic neurons that secrete it, keeping more of it in the synapse for longer	Nervousness, fatigue, gastrointestinal complaints, dizziness, headaches, insomnia and suicide ideation

These antidepressants can have therapeutic effects such as a brightened mood, improved sleep and increased energy, as well as speeding up the recovery from a depressive episode, although these effects may take several weeks before they are achieved. However, they do not work for all people and a major problem is that many people stop taking their medication because they find the side effects unpleasant.

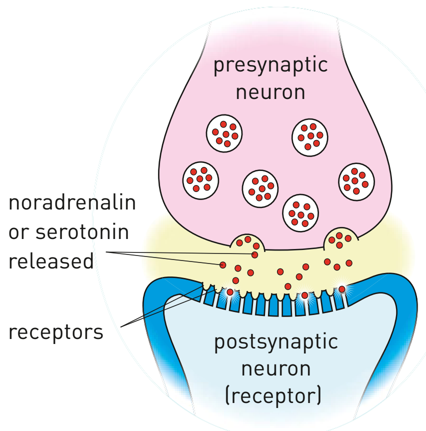


FIGURE 18.25 A neuron releasing noradrenaline (also called norepinephrine) into a synaptic cleft

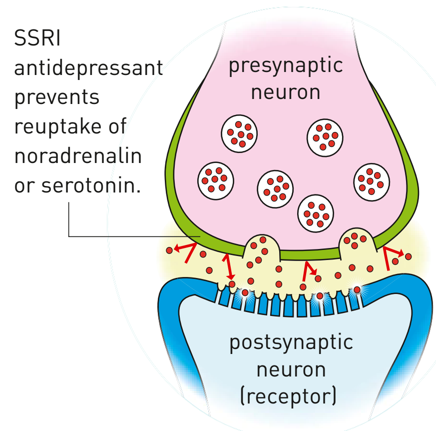


FIGURE 18.26 SSRI drugs block the presynaptic neuron from reabsorbing (reuptake) the serotonin and noradrenalin it has released, in order for it to reach and stimulate the postsynaptic receptor.

REVIEW 18.6

1. What have twin studies on depression found?
2. Is it one gene that determines if a person develops depression? Explain.
3. Which neurotransmitters have been found to influence the onset of depression?
4. Draw a diagram to explain how the sensitivity of neurotransmitters impacts on the onset of depression.

INVESTIGATE 18.8

METHODS USED BY CLINICIANS TO TREAT DEPRESSION

Using the Internet, research three of the possible depression treatments below and outline their costs and benefits:

- electroconvulsive therapy
- exercise
- music therapy
- St John's wort
- chocolate.

Psychological factors contributing to depression

So far we have looked at the biological factors that may contribute to major depression disorder, but we must remember that these factors interact with psychological factors. In this next section the psychological factors of learned helplessness and stress will be examined, as well as the psychotherapies that help manage major depression: cognitive behaviour therapy and psychodynamic psychotherapy.

LEARNED HELPLESSNESS

The learned helplessness model of depression suggested that when people feel that they are unable to control life events, especially stressful ones, they learn a sense of helplessness that may lead to depressive symptoms. This theory was proposed by Martin Seligman (1974) and first began to take shape while he was researching the behaviour of dogs. In his study, Seligman's dogs were exposed to inescapable electric shocks. After experiencing many repeated shocks, he found that the dogs gave up and accepted the painful situation. Seligman then changed the conditions so that the dogs could escape the electric shocks and found that many did not try to escape; instead, they tolerated the shocks, looking helpless and miserable. These and results from other studies led Seligman to propose that learned helplessness in humans interferes with people's ability to learn how to solve or cope with their problems. He also hypothesised that learned helplessness causes people to give up on solving problems, which eventually impairs motivation, mood and confidence in their abilities, and can lead them to suffer from depression.

Unable to influence and control stressful events → Sense of helplessness with an inability to learn solutions → Passivity when confronted with problems → Depression

FIGURE 18.27 Seligman's learned helplessness theory

SELIGMAN'S EXPERIMENTS WITH DOGS

18.9 INVESTIGATE

Using the Internet, conduct further research on Martin Seligman's experiments with dogs and determine the method of his studies.

While Seligman's theory created a lot of interest, there were problems because it did not account for differences in the severity of depression in different people. As a result, the theory was revised to include **attributional style**. Table 18.6 outlines the characteristics of these styles.

TABLE 18.6 Characteristics of attributional styles

STYLE	EXPLANATION
Internal attribution External attribution	People blame themselves for bad events. People blame their failures on environmental factors.
Stable attribution Unstable attribution	People see the bad events as isolated. People see failures as typical events.
Global attribution Specific attribution	People believe that their problems are due to many flaws in their personality. People believe that their problems are due to limited weaknesses.

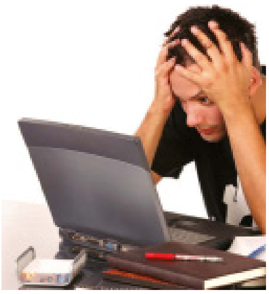


FIGURE 18.28 Stressful life events such as work or school can increase the risk of developing depression.

STRESS

Stressful life events such as the loss of a relative, a breakup of a relationship, divorce, unemployment, illness, pressure at work or school, financial stress and being the victim of racism can increase the risk of developing major depression or increase the likelihood of a recurrence of a depressive episode. Nevid, Rathus and Greene (2005) found that stress causes depression 80 per cent of the time and if people blame themselves for stressful and undesirable events such as financial difficulties, they are more likely to become depressed.

It is also important to note that not only can stressful life events cause depression, but depressive symptoms can be stressful in themselves. For example, when a person is depressed they may find it difficult to keep up with their school work and this, in turn, leads to more stress as they see their school work pile up.

INVESTIGATE 18.10

HINTS ON AVOIDING STUDY STRESS

Using the ReachOut website, find some helpful hints on avoiding stress while studying. Create a flyer to help other VCE students.

MANAGEMENT THROUGH PSYCHOTHERAPY

Cognitive behavioural therapy

Cognitive therapists believe that depression is caused by negative thoughts. Aaron Beck and colleagues developed the cognitive therapy approach that aims to help people with depression to recognise and change their dysfunctional thought patterns about events and themselves. In this approach, Beck identified several cognitive distortions that are typical of how depressed people process information. These distortions make it difficult for depressed people to make realistic judgements about themselves and events and can cause them to ignore positive feedback. Table 18.7 identifies the different cognitive distortions.

TABLE 18.7 Cognitive distortions

COGNITIVE DISTORTION	DESCRIPTION
Arbitrary inference	Drawing a conclusion with no evidence to support it, or if the evidence is contrary to the conclusion
Selective abstraction	Focusing on a detail taken out of context and ignoring other important features of the situation
Over generalisation	Forming a conclusion based on one or more isolated incidents and applying it to related or unrelated situations
Magnification and minimisation	Errors in judging the significance or magnitude of events
Personalisation	Relating events to oneself when there is no reason for doing so
Absolutistic, dichotomous thinking (black-or-white thinking)	Categorising experiences into one of two opposite categories, e.g. saints/sinners, flawless/defective

Cognitive therapy involves 14–16 weekly sessions where the therapist helps his or her clients identify and note their negative thoughts and feelings each day in a diary or daily thought record (DTR). The therapist then helps the client challenge the negative thoughts and teaches them techniques that will promote realistic and positive thoughts (see Table 18.8 for examples).

TABLE 18.8 Examples of negative thoughts and rational responses for cognitive distortions

NEGATIVE THOUGHT	TYPE OF COGNITIVE DISTORTION	RATIONAL RESPONSE
If people really knew me they would hate me.	Mind reader	What evidence do I have for that? It seems that more people like me than dislike me.
If things don't get better soon, I will go crazy.	Jumping to conclusions	I have dealt with these problems up till now without falling apart. I have to hang in there – things are not so bad.
I know I am going to fail this test.	Fortune teller error	I just need to focus on getting through this test and not jumping to negative conclusions.
I am too stupid to go to university.	Labelling and mislabelling	I need to stop calling myself 'stupid'. I can accomplish a lot more than I give myself credit for.
Nothing will ever work out for me.	Over generalisation	No one can see into the future. I need to focus on the present.
My looks are hopeless.	Magnification	I may not be perfect-looking, but I am not hopeless.

Research has supported the effectiveness of cognitive therapy in treating major depression and reducing the risks of recurrent episodes. In fact, the benefits of cognitive therapy seem to be similar, if not the same, as those achieved via antidepressant drugs. It is still unclear, however, if both cognitive therapy and antidepressant drugs work better together than in isolation (DeRubeins *et al.* 1999, cited in Nevid, Rathus & Greene 2005).

Psychodynamic psychotherapy

Traditional psychoanalysis has also helped people with depression; this technique was developed by Sigmund Freud. Psychoanalysis requires the client to focus on repressed problems that may have begun in childhood. Psychotherapy helped people to understand their feelings towards people they had lost or were in danger of losing. This therapy would take years to uncover and deal with these issues. Modern models of psychotherapy such as interpersonal psychotherapy (IPT) have been greatly influenced by psychoanalytic ideas. Interpersonal psychotherapy is a brief form of therapy that focuses on the person's current life and their interpersonal relationships. It helps a person to deal with unresolved or delayed grief reactions after bereavement or after conflicts in present relationships.

Did you know?

Daily thought records (DTRs) are worksheets that help patients to discriminate between situations, thoughts and feelings, which assists them in identifying distorted and maladaptive thinking. In their DTRs, patients are asked to:

- describe in detail the situations where the negative thought occurred
- detail the negative thought and rate its believability
- detail their feelings and rate the intensity of them
- detail any other thoughts and rate the believability of them
- detail feelings about providing the information above and rate those feelings.

During IPT sessions, the person is encouraged to discuss their problems, explore negative feelings, improve verbal and non-verbal communication to improve their relationships, problem solve, and try new and more fulfilling modes of behaviours. This technique is an effective method of treating major depression.

REVIEW 18.7

1 What is learned helplessness?
2 How can stress cause depression?
3 Explain two differences between cognitive behaviour therapy and psychodynamic therapy.

Sociocultural factors contributing to depression

Finally, major depression disorder can be caused by sociocultural factors. Sociocultural theorists state that depression is significantly influenced by the social structures in which people live. For instance, research was conducted on people from different societies and cultures. It was found that the number of people with depression was lower in Hong Kong and Taiwan than in Western countries. The reason for these findings may be that people in those societies have strong social support from families and other groups, and hence the impact from any stress or loss is reduced (Tseng *et al.* 1990).

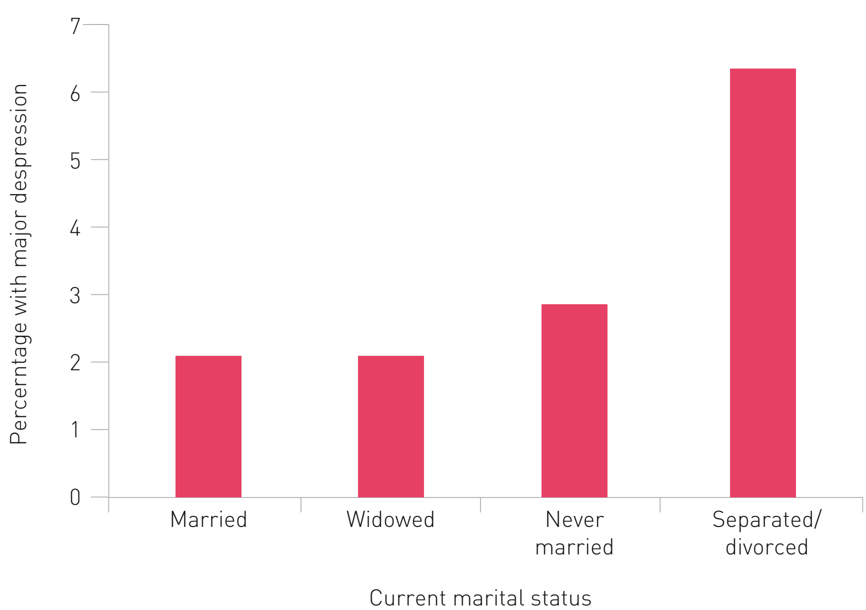
FIGURE 18.29 Stressful life events can cause depression. Depression is most common in women.

Stressful life events can also cause major depressive disorder; these include job loss, or loss of a friend or romantic relationship. Many research studies have indicated that 42–67 per cent of depressed people stated that they suffered depression after a stressful life event (Kring *et al.* 2007).

As mentioned earlier, women are more likely to suffer from major depression disorder than men and there are several explanations for this. Cochrane (1995) suggested that girls are more likely than boys to be sexually abused and that victims of abuse are twice as likely to suffer from depression in adulthood as non-abused adults (Gross *et al.* 2004). Another study revealed that poverty was also a factor in contributing to the risk of developing depression. This study by Brown and Moran (1997) examined the relationship between marital status, poverty and depression. Their research involved single and married mothers whose behaviour was observed over a two-year period. It was found that the risk of developing depression was double among single mothers compared to married mothers, due to lack of marital support and poverty.

Another sociocultural factor contributing to depression is the lack of social support and social isolation. Often, people who are depressed may have very few social networks and this low social support can weaken a person's ability to cope with stressful life events, hence making the person more vulnerable to depression. Findings from research have shown that people who are separated or divorced have twice the depression rate of people who have never been married, and three times the depression rate of married and widowed people (Weissman, cited in Comer 2004). Additionally, those people who live isolated lives or lives without intimacy are more likely to become depressed during stressful times (Nezlek, Hampton & Shean 2000). Those with little social support will also experience depression for longer than those with a supportive partner. Another study showed that women experiencing a stressful life event without support from a close friend had a 40 per cent risk of developing depression, compared to those who had support, who had a 4 per cent risk of developing depression (Brown & Andrews, cited in Kring *et al.* 2007).

Further research has also revealed that a possible trigger for depression is interpersonal problems within families. These studies state that when a person experiences critical or hostile comments, known as 'expressed emotion', this can cause depression. Findings from studies have found that 69.5 per cent of depressed people in families with high expressed emotion will relapse within a year, compared to 30.5 per cent of depressed people in families with low expressed emotion (Butzlaff & Hooley, cited in Kring *et al.* 2007).



Source: adapted from Weissman *et al.*, cited in Comer 2004

FIGURE 18.30 Separated or divorced people are more likely to be depressed than those who are married, widowed or who have never been married.

Did you know?

While people all around the world experience depression, the way in which they view it depends on their culture. People in Western societies see depression as an illness that they themselves cause internally, such as helplessness, low self-esteem and hopelessness. People from the Maori culture believe that depression is caused by an imbalance in spiritual, mental, physical and family well-being.

Indigenous Australians believe that depression is the feeling of loss, trauma and grief. These feelings have stemmed from the impact of Europeans' arrival in Australia, as well as the loss of land and culture, separations from children and parents, deaths in custody and other traumatic life experiences.

Burton, Westen & Kowalski, 2006.

MANAGEMENT OF SOCIOCULTURAL FACTORS

Techniques used to help people who have major depression are cognitive behaviour therapies and interpersonal psychotherapy (IPT). People who have IPT not only have less depressive symptoms but also function more effectively within their social and family interactions. Social skills training can also help to alleviate depression, as overt social behaviours are improved and people begin to believe in themselves and their abilities.

FIGURE 18.31 Family therapy helps family members understand depression and the factors that may cause it.

People who have major depression may choose to seek help and support from family and social networks, as well as support groups via different therapies, such as group therapy and family therapy. Group therapy involves a small group of people (usually 5–10) and a therapist. This group meets often and works together to achieve therapeutic goals. During these sessions, people with depression talk about their problems and their lives. They will notice that others within their therapy group also struggle with problems similar to their own, which may help to alleviate shame, anxiety or guilt. They can also feel supported, accepted and a sense of belonging, which can help reduce feelings of social isolation. Further, group therapy highlights to new clients within the group that older clients have progressed and moved forward, giving the new members a sense of hope.

As well as therapeutic sessions, people with depression may also seek help from support groups or organisations. Beyond Blue is a not-for-profit Australian organisation that provides information on the illness as well as counselling and treatment choices. It provides information for carers on how to live and support someone who has depression. Additionally, Grow Australia and Blueboard are online community support groups for depressed people and their friends and carers. These community support groups offer advice and education about major depression, as well as information about finding accommodation or work.

Interaction between biological, psychological and sociocultural factors

There are three main factors that contribute to the likelihood of developing major depression disorder. Depression can also be caused by the interaction of biological factors, psychological factors and social and environmental factors. For example, a stressful life event such as loss of a friend may have a depressing effect by reducing neurotransmitter activity in the brain. Such biological effects are more likely to occur in people with a certain genetic predisposition for depression. However, those people who have support networks from others may be able to cope better with the effects of stress than those without.

Alternatively, the cause of depression may begin from psychological factors, where the person will focus on negative thoughts and believe themselves to be helpless in creating change. These thoughts can interact with the biological factors that can increase the likelihood of depression following stressful life events. If a person has the social support needed to cope with the stressors, then they may be able to prevent depression although, at times, biological chemicals in the brain may still make it difficult for a person to cope effectively, as these chemical can worsen feelings of helplessness.

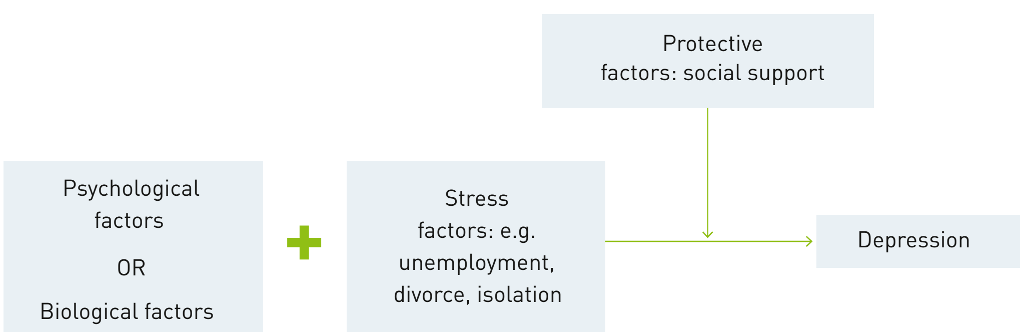


FIGURE 18.32 Interaction between biological, psychological and sociocultural factors

Using your own example, explain how the biopsychosocial framework is used in understanding depression. You may want to draw a Venn diagram to enhance your explanation.

18.8 REVIEW

COMMUNITY/SUPPORT GROUPS

Find other community/support groups in your area and explain the services they provide.

18.11 INVESTIGATE

Addictive disorder: Gambling

Through the course of your life you may have heard of people who suffer from some sort of addiction, such as drug or alcohol addiction. When psychologists use the term **addiction** they are referring to an activity that people are completely absorbed in and pursue, regardless of any of the negative consequences. Under this definition, gambling is considered an addiction. **Gambling** is any behaviour that involves the risk of money or possessions on the outcome of a game that is determined by chance. You may have heard of many different forms of gambling such as purchasing lottery tickets, sports betting, using electronic gambling machines and playing games at the casino. Gambling can become a mental health problem for people, with approximately 2 per cent of Australian adults experiencing some form of gambling problem. On average, a person with a gambling problem will lose $21,000 each year. Until recently, gambling was a male-dominated activity, but gaming machines have caused an increase in the number of female problem gamblers. Those people with gambling problems not only affect themselves but their behaviour also has an impact on their family, friends and employers. Pathological gambling is the term that describes this addiction.

INVESTIGATE 18.12

WHAT ARE THE CHANCES?

Use the Internet to research how pokie machines work, what the odds are of winning, and how the machines are designed to draw people in.

There are three levels that describe gambling behaviour as outlined in Figure 18.33.

Level 1: Recreational gambler or non-gambler
Gambles for social reasons and rarely goes beyond their limits

Level 2: Problem gambler
Displays some symptoms or gambling-related distress

Level 3: Pathological gambler
Displays at least five symptoms as outlined in the DSM-IV-TR

FIGURE 18.33 Levels of gambling behaviour

A person must exhibit five or more of the ten symptoms in Table 18.9 to be diagnosed as being a pathological gambler. These symptoms must be present at some time during the previous 12 months. As well as exhibiting these symptoms, a pathological gambler may experience a breakdown of their relationships, a loss of their home, work performance problems or job loss and criminal involvement.

FIGURE 18.34 Gambling is an addictive disorder.

TABLE 18.9 Diagnostic criteria for pathological gambling

CRITERIA	DESCRIPTION
1	Person is preoccupied with gambling (i.e. planning their next gambling opportunity or thinking of ways to access money to gamble with)
2	Person needs to gamble with a large amount of money to feel excitement
3	Person has unsuccessfully attempted to control, reduce or stop gambling
4	Person becomes restless and short-tempered when trying to cut back or stop gambling
5	Person gambles to avoid other problems or to relieve depression, guilt or anxiety
6	When they lose money, person will often return to gambling to recoup their losses
7	In order to hide the extent of their gambling habits, the person will lie to their family members, therapist or others
8	In order to support their gambling habits, the person has committed illegal acts such as forgery, fraud, theft or embezzlement
9	Due to gambling, the person has put at risk or lost a job, relationship, educational or career opportunities
10	Person has at some point relied on others to give them money to help them with a desperate financial situation caused by gambling

REVIEW 18.9

1. What is meant by the term 'addiction'?
2. Define gambling.
3. Why do you think gambling behaviours have been described as being on a continuum?

INVESTIGATE 18.13

VISUAL PRESENTATION

Using the Internet, find one community service that can help gamblers. Create a poster that outlines:

- who they are
- where they are
- the type of help they offer
- other information that can be obtained from this service.

GAMBLING IS ERODING OUR LOVE OF SPORT

Tim Costello, *Herald Sun*, 14 February 2013

Australian Rules does not deserve to be co-opted by gaming and sports betting sponsorship, says Tim Costello.

I have had my stoushes with Jeff Kennett over gambling. Stoushes so strong that when he was premier he once called me un-Victorian and a troublesome priest.

But Kennett was magnificent on the ABC earlier this week when he called for a nationwide ban on all sports betting advertising in the wake of the "darkest ever day in sport."

He rightly analysed the problem of how millions of gambling dollars undermine confidence in the game and how that shapes the mindset of children who are exposed to a relentless sports betting culture.

The AFL itself and all but three clubs are now hopelessly ensnared with sponsorship from sports betting. More than $900 million a year is now turned over by AFL betting, so they cannot see a way out of this easy money to fund the game.

Worryingly they are relying on the belief that because it is a team game - unlike tennis - it would be hard to fix a match. Maybe, but how can they be sure?

They also believed their anti-doping code was working until last week's wake-up call from the Australian Crime Commission. How confident can they be now with reports of links to criminals intent on compromising players and even administrators?

I would suggest they take a look at how the United States deals with this issue. Advertising of betting on all team sports, from football to basketball, ice hockey and even college games, is banned federally.

When the state of New Jersey came up with a familiar argument - that sports betting was a multi-billion dollar industry and that betting sites could be regulated offshore and onshore - the National Football League opposed it in court, saying it would undermine confidence in the game.

The Americans have got it right. The game comes before gambling.

Our game is more than 100 years old and until recently was not dependent on gambling revenue. It does not deserve to be co-opted by gaming and sports betting sponsorship, which corrodes our sport's family and youth culture. Even worse, it is now threatening faith in the code.

We may never get genuine answers on match-fixing, but there are some things we do know. We know that horse racing has historically had the highest level of corruption of any sport, because of its dependence on advertised gambling.

By contrast, when fans bet 20 bucks in a pub on the outcome of a footy match, it poses little risk to the game.

Now, with smart phones and saturation television advertising (including on national footy shows), millions of dollars are punted on a match. We're also hearing about crime figures named in association with offshore betting companies, so we should expect corruption.

Every fan knows all too well the power of one player's behaviour and attitude in shaping the outcome of a match. And if you combine that with huge financial rewards, then I believe our code is at risk.

We need to act decisively and quickly with an advertising ban. Why? Because it will soon be too late, and sport will be captured - just like state governments - by pokies revenue. Around 80 per cent of problem gambling in our nation is still pokies-related, and most of that involves addicted people.

It is a tragedy that good policy (approved by the public in every opinion poll) has been compromised by the $12 billion-a-year pokies industry.

Addicted states would not protect the vulnerable, because it was too late to plug their revenue hole. So the Federal Government stepped in to impose the Productivity Commission recommendation of mandatory pre-commitment. That is where gamblers lock in their losses before playing, and if they go over their self-imposed limit they are locked out.

But after months of debate and a $40 million campaign by the pokies lobby directed against ALP members, Prime Minister Julia Gillard buckled under the pressure.

I am amazed when I talk privately to Coalition and ALP members about this sad state of affairs. Members from both sides say to me "of course we should have enacted this policy, but the gambling lobby is just too powerful and punishing."

Now sport needs to act before it, too, has to dance to the tune of these interests.

The game must come first!

18.14 INVESTIGATE

1 Why does Jeff Kennett want a nationwide ban on sports betting advertising?
2 How is the AFL involved with online sports betting? What impact will it have if the AFL cuts ties with the online betting industry?
3 How has the NFL in the USA dealt with online gambling advertising?
4 How is the AFL at risk?
5 How was the Government going to deal with this issue? Do you think this policy would have worked?
6 Why do you think online betting is so popular in Australia?
7 Next time you watch a sports game count the number of online betting advertisements, or count the number of advertisements in the sports section of a newspaper. In your opinion, are we bombarded by advertising?
8 How has technology contributed to the problem?

Contributing biological factors

SEROTONIN, NOREPINEPHRINE AND DOPAMINE

For many years, researchers have been trying to determine the biological cause of gambling and have highlighted three types of neurotransmitters that may contribute. These are serotonin, norepinephrine and dopamine. **Serotonin** is responsible for initiation and inhibition of behaviours, aggression and suicide; **norepinephrine** is responsible for arousal, mood and impulse control. A few studies suggest some pathological gamblers have abnormalities in receptors that have these neurotransmitters, which may explain their gambling behaviours.

Dopamine can also play a part in gambling behaviour and the role of dopamine has been studied extensively. In order to understand the contribution of this neurotransmitter, we must first look at the reward pathway that exists in our brains. A **reward** is something that, when offered, causes a behaviour to be repeated. The reward creates a positive feeling or emotion in the brain, which is gained from an object, behaviour or an internal physical state. The part of the brain activated is called the reward pathway. The **reward pathway** is responsible for our feelings of motivation, reward and behaviour; it makes us feel good when we participate in behaviours such as eating, drinking, taking drugs or gaining money. Figure 18.35 shows the reward pathway in our brain. When activated, the reward pathway will release the neurotransmitter dopamine, which provides us with feelings of euphoria and pleasure. This activation of the reward system will cause a person to repeat the behaviour to create a pleasurable feeling, and this can cause an addiction. The anticipation of a 'win' can also trigger the dopamine reward system.

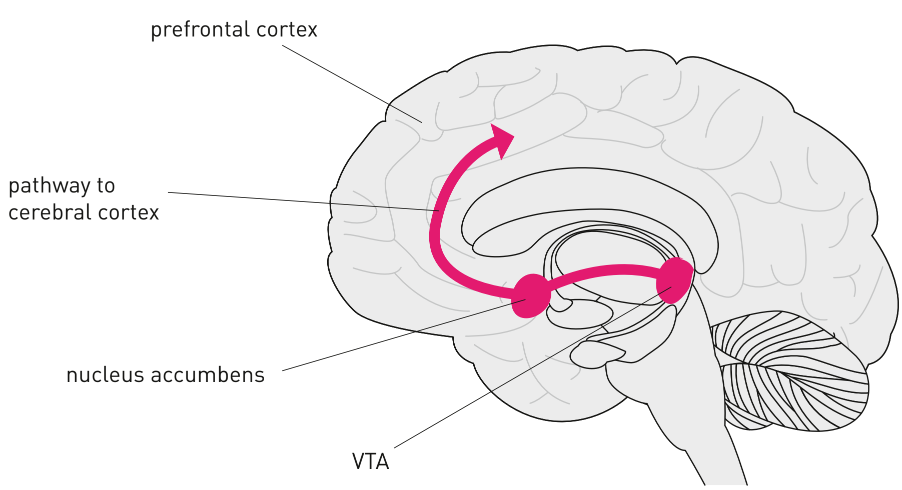


FIGURE 18.35 The reward system pathway. The ventral tegmental area (VTA), the nucleus accumbens and the prefrontal cortex are the major structures involved in this process. The information travels from the VTA to the nucleus accumbens and then up to the prefrontal cortex, when activated by a rewarding stimulus.

INVESTIGATE 18.15

REWARD PATHWAY SYSTEM

Look at the University of Utah website, which has a great animation of the reward pathway system.

Using the information on the website, briefly explain how drug dependence can occur. You may present your information in a Word document, PowerPoint presentation or directional flow chart.

Evidence suggests that gamblers may have abnormalities in dopamine receptors in the brain. That is, if a person has a reduced level of dopamine in their reward system pathway, then they may look for greater than normal levels of pleasure or reinforcement through behaviours such as gambling. Research conducted by Reuter and colleagues (2005) compared the reward system activity of pathological gamblers to normal controls. Using an *f*MRI, they looked at the brain activity of each group while they were undertaking a guessing task. They found that pathological gamblers have reduced brain activity in the brain structures responsible for reward experiences. Further research has found that people who have sustained some damage to the prefrontal cortex will demonstrate behaviours similar to those people who have addictions; that is denying their problems and choosing immediate rewards regardless of the consequences (Bechara 2003, cited in Whelan, Steenbergh & Meyers 2007).

18.10 REVIEW

1. Explain the role of the neurotransmitter dopamine in the 'reward system'.
2. What was the aim of Reuter's research in 2005?
3. What did Reuter's study find? Explain.
4. What area of the brain has been linked with addictive behaviours?

MANAGEMENT OF BIOLOGICAL FACTORS

The brain is a complex organ and research in the areas of medication to manage biological factors of gambling is only just emerging. From the limited research available, it has been suggested that antidepressants and mood stabilisers may help in managing serotonin and norepinephrine abnormalities. Additionally, research conducted on the role of dopamine on the reward pathway has shown that opiod antagonists such as naltrexone is the most effective in reducing the urge to gamble (Leung & Cottler, 2008 cited in Forbes *et al.* 2011). Naltrexone blocks the absorption of dopamine by the post synaptic neuron. This decreases the feelings of pleasure and the need to satisfy the urge to gamble.

In a study conducted by Kim and Grant (2001a, cited in George and Murali, 2005) 17 pathological gamblers (diagnosed via the DSM-IV) gambled for 6 weeks with naltrexone and discovered that there was a decrease in gambling thoughts, urges and behaviours. In a larger study conducted by Kim and Grant (2001b, cited in George and Murali, 2005), 75% of gamblers using naltrexone showed improvement in gambling urges and behaviours, but many participants reported health issues as a side effect of the drug. Research has also indicated that there may be an association between Parkinson's disease and pathological gambling. Parkinson's disease

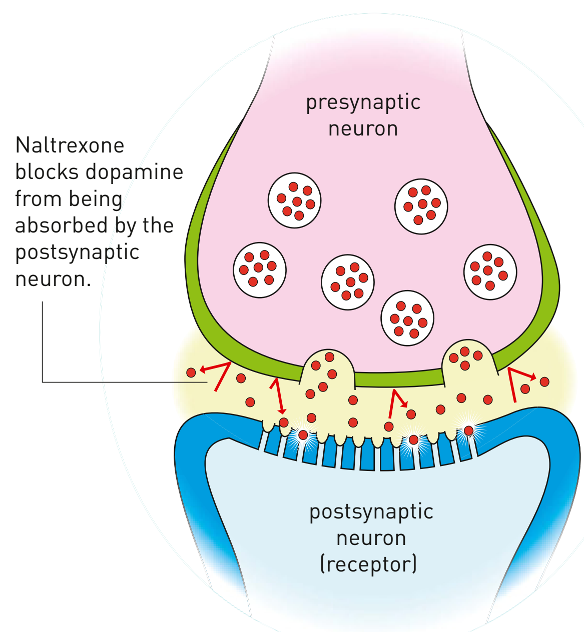


FIGURE 18.36 When naltrexone is taken, it blocks the dopamine from being absorbed by the postsynaptic neuron, which reduces the effects of dopamine – such as the pleasure from gambling, or the urge to gamble.

develops when there is a deterioration of dopamine in the brain. Studies have looked at the effects of a drug that mimicked or increased dopamine (agonist). One of these studies observed 11 Parkinson's patients with a pathological gambling problem who were taking a dopamine agonist. They found that seven of these patients developed a pathological gambling problem within three months of beginning treatment or increasing the dose, while the other four patients developed pathological gambling after 12 months of taking the agonist. It was also found within this study that pathological gambling ended once patients stopped taking the dopamine agonist (Dodd *et al.* 2005). Obviously, further research in treatments for pathological gambling is needed.

FIGURE 18.37 The Victorian government has produced advertisements to highlight the dangers of gambling addiction.

NEW METHOD TO STUDY GAMBLING ADDICTIONS DEVELOPED

ScienceDaily
June 21, 2009

University of British Columbia researchers have created the world's first animal laboratory experiment to successfully model human gambling. The advance will help scientists develop and test new treatments for gambling addictions, a devastating condition that affects millions worldwide.

In addition to showing that rats can 'play the odds,' the study finds that gambling decisions can be impaired or improved with drugs that affect brain dopamine and serotonin levels suggesting that these neurotransmitters may moderate gambling behaviour.

'For most individuals, gambling is enjoyable and harmless, but for others, it is as destructive as being addicted to drugs,' says Catharine Winstanley, an assistant professor in UBC's Dept. of Psychology, whose study was published June 17 in the Nature journal *Neuropsychopharmacology*.

'This new model is an important next step because the neurobiological basis of gambling is still poorly understood and few treatment options exist,' adds Winstanley, noting that gamblers experience higher rates of divorce, suicide and crime than non-gamblers. 'It brings us a step closer to the goal of drug-based treatments for people suffering from gambling disorders.'

For the study, rats had a limited amount of time in which to choose between four gambling options which were associated with the delivery of different numbers of sugar pellets. If the animals won the gamble, they received the associated reward. However, if they lost, they experienced a time-out period during which reward could not be earned.

High-risk options offered more potential sugar pellets but also the possibility of more frequent and longer timeouts. Rats learned how to be successful gamblers, selecting the option with the optimum level of risk and reward to maximise their sugar pellet profits.

The study found that rodents treated with drugs that reduced their levels of serotonin levels – associated with impulse control in humans – dramatically reduced their ability to play the odds. A drug that reduced dopamine levels – associated with pleasure in humans – improved their ability to optimise profits. The findings are consistent with recent clinical findings in humans, helping to validate the technique as a model for studying human gambling behaviours.

'We hope this will speed up the development of gambling treatments for humans by giving us a working model to explore drugs and therapies,' says Winstanley.

In future studies, Winstanley says she will seek to replicate other aspects of human gambling behaviours, including 'loss-chasing' – when a gambler follows a loss with a high-risk gamble – and the 'near-miss effect,' when a near-win motivates individuals to continue gambling.

INVESTIGATE 18.16

STUDYING GAMBLING

Read the article 'New method to study gambling addictions developed' and answer the following questions.

1 What was the aim of this study?
2 Describe the method of this study.
3 Who were the subjects in this study and why do you think they were used?
4 What were the results of this study?
5 How does this study contribute to our understanding of gambling?

Contributing psychological factors

SOCIAL LEARNING THEORY

Think about role models in your life. Who are these role models? Why are they your role models? Often the role models we chose include our parents, siblings, peers and other influential people. In Chapter 15 you studied Albert Bandura's work on the **social learning theory**. Remember the social learning theory describes the way in which people acquire certain behaviours by watching and learning from their role models. Consequently, theorists believe that Bandura's theory explains gambling behaviour – that is, that when people first gamble they are usually learning and imitating a role model.

FIGURE 18.38 Early introduction to gambling by family members can cause pathological gambling later in life.

Several theorists believe that the early introduction to gambling via parents or other family members can cause pathological gambling later in life, with people generally believing that gambling can result in social and monetary rewards. The modelling of gambling behaviour often occurs during family outings to venues that allow gambling, such as pubs, and this can cause a child to imitate the behaviours they see. This notion was supported by the research of Delfabbro, Lahn and Grabosky (2005) who studied gambling in Australian adolescents. Their research included 926 children aged 11–19 years. They found that 70 per cent of the adolescents had gambled in the previous month, at least 10 per cent gambled weekly and 4 per cent were problem gamblers. The research also highlighted that most of the gambling was undertaken with family or peers. It is the gambling experiences of others that reinforces and teaches people to gamble.

SCHEDULES OF REINFORCEMENT

In Chapter 12 we looked at the topic of learning and schedules of reinforcement. It is through those explanations that we can understand gambling a little more, as the learning behaviour in people is a response to the schedules of reinforcement that can contribute to gambling behaviour. Often the main reason for gambling is to win money, or for entertainment or excitement. Occasional gamblers will gamble while they receive reinforcement of a reward or money; pathological gamblers will continue to gamble even if there is a monetary loss. Psychologists have found that the strength and persistence of a gambler's behaviour is great when they are rewarded in a random and unpredictable pattern or schedule. Early research stated that gaming machines used a variable ratio schedule. However, more recent research suggests that electronic gaming machines operate using a random ratio schedule. Both these schedules are effective in maintaining behaviour. When people are not rewarded for long periods of time, there is a greater likelihood that they will continue to gamble if they had been rewarded earlier, as they do not want to miss a win.

In a **variable ratio schedule** the number of times a response is reinforced will vary within a range. A variable ratio of 10 means that a person will be rewarded on average after 10 responses, however because it is a variable schedule it means that they could be rewarded after 1 or 2 responses or even after 20 (as long as the average of 10 is maintained). So with this schedule there will always be an upper limit and an average rate of reward, and the chance and predictability of a response being rewarded increases with every unrewarded response.

The **random ratio schedule** is when a reinforcer is given after a number of random responses but each outcome from a response is independent of the previous one. With a random ratio schedule there is no upper limit set on the number of responses made before a reinforcement is given. So there is an element of unpredictability that is resistant to extinction and causes people to continue gambling on electronic gaming machines. The number of responses between each reinforcement is determined by a random number generator.

Gamblers' behaviour is shaped using schedules of reinforcement as they will continue to gamble even if they do not receive reinforcement. The gaming industry is aware that gamblers have a false sense of hope and anticipation because they believe that the 'next one' will be a winner or a big win. The reinforcer of almost hitting the jackpot will increase the likelihood of a person continuing to gamble.

18.11 REVIEW

1. Explain social learning theory.
2. How do Delfabbro, Lahn and Grabosky (2005) support social learning theory?
3. Do you think access to technology impacts on gambling? Explain.
4. Write down as many gambling activities as you can think of. Compare your list to the class.
5. How does Skinner's theory of reinforcement schedules affect gambling behaviours?
6. Imagine and write down the thought patterns of a gambler at an electronic gambling machine.

INTERNET GAMBLING ON THE RISE

University of Sydney
18 January 2012

Internet gambling is on the rise in Australia according to new research from the University of Sydney and Southern Cross University, with factors such as convenience and ease of access contributing to its popularity.

The study shows that internet gamblers had significantly more positive attitudes towards gambling and that people appear to be gravitating towards online gambling because of its availability and convenience.

Professor Alex Blaszczynski, from the School of Psychology at the University of Sydney, collaborated with lead researcher Dr Sally Gainsbury from Southern Cross University's Centre for Gambling Education and Research (CGER).

Also collaborating on the study, An investigation of internet gambling in Australia, were CGER director Professor Nerilee Hing and the University of Lethbridge's Dr Robert Wood.

'For people with existing gambling problems, internet gambling may create additional risks,' Dr Gainsbury said.

'Overall the research showed internet gamblers were not more likely to be problem gamblers, but they do appear to be at higher risk of developing problems.'

The findings are part of the largest survey of internet gamblers to date in Australia, with more than 6680 participants taking part in the self-selected, online questionnaire.

Over half of the 450 problem internet gamblers responding to the survey said the use of credit cards or internet bank transfers increased the amount they spent, compared to less than one in 10 of the 2270 non-problem internet gamblers.

'While internet gambling has been around since the 1990s its popularity has soared in the past few years, with clear trends indicating an increasing number of participants starting to gamble online,' Dr Alex Blaszczynski said.

Most study participants played on Australian-based sites, where these are available (wagering and lottery), but they showed little concern about the legality of sites and where they are based.

'This is a worrying trend as playing on offshore sites may result in identify theft, fraud, losing funds and cheating, leaving Australians with little recourse,' Dr Alex Blaszczynski said.

Internet gambling was perceived to be too addictive by 15 percent of players and poses unique risks, particularly for vulnerable populations: young, single, uneducated and unemployed gamblers.

'Gambling problems take a while to set in before causing severe consequences so as people continue to play online more problems are likely to emerge from this form of gambling,' Dr Blaszczynski said.

'The study's researchers are calling for the online gambling space to be made safer for users. Among our recommendations are that players be encouraged to set limits on their spending; pop-up messages suggesting a break in long continuous sessions; and self-tests to determine the risk of developing gambling problems.'

INVESTIGATE 18.17

Read the article 'Internet gambling on the rise' and answer the following questions.

1 What was the aim of this study?
2 Describe the method of this study.
3 What were the results from this study?
4 How does this study contribute to our understanding of gambling?
5 What suggestions did the researchers make about tackling this problem?

MANAGEMENT OF PSYCHOLOGICAL FACTORS

There are many psychological approaches to treating pathological gambling that can explain the reason people gamble and why they continue to do so even when they lose often. The two approaches we will look at are cognitive behavioural therapy and psychodynamic therapy.

FIGURE 18.39 When gamblers win they disregard the 'fluke' and believe they won because of good judgement.

Psychologists who use the **cognitive behavioural therapy** (CBT) approaches believe that people continue to gamble because of their unrealistic thoughts and irrational beliefs about gambling and their ability to win. For example, some gamblers will have biased estimates of their probability of success; that is, they overestimate their chance of winning. Other gamblers will be in denial and explain their losses by making excuses for them, such as 'the track was wet' or 'the umpire made a wrong call' or 'it was rigged'. These excuses explain their losses as random and uncontrollable events rather than their lack of skill or inability to pick the winner. Often gamblers will justify their loss by claiming that the outcome was a 'fluke', but when they win they disregard the 'fluke' and believe they won because of good judgement. The aim of CBT is to alter the thoughts and beliefs associated with gambling as well as teach people how to cope with the urge to gamble and emotions that may cause them to gamble. There are various CBT techniques that psychologists can use to help gamblers. These therapies may include any of the following strategies:

- educating gamblers about games of chance
- correcting biased gambling thoughts
- problem-solving skills training
- social skills training
- relapse prevention
- identifying gambling triggers and methods to deal with them
- development of different leisure activities
- helping people deal with urges.

Psychologists will deliver CBT in at least eight sessions and encourage their patients to attend Gamblers Anonymous during this time. CBT has been found to be effective for adolescents and adult gamblers in group therapy (Ladouceur *et al.* 2002). A research study was conducted on 231 pathological gamblers to evaluate the effectiveness of CBT. All the participants were required to attend Gamblers Anonymous but only two thirds of the participants received CBT. They found that there was a greater reduction in gambling behaviours among those participants who received CBT compared to those who only attended Gamblers Anonymous. Evidence also suggested that those gamblers who attended Gamblers Anonymous had reduced their monthly betting amount from $1200 to $350, while those participants who underwent both Gamblers Anonymous and CBT had reduced their monthly betting amount to $80 (Petry 2005).

Psychodynamic psychotherapy is another technique that psychologists may choose to use when dealing with pathological gambling. This therapy looks at the current behaviour of the gambler and attempts to find the underlying reasons for it by delving into their past. They examine the emotions connected with past events and how those emotions contribute to gambling behaviours. The psychologist will encourage and help the gambler identify any emotions that seemed to be relieved by gambling in order for them to understand the reasons for their gambling. Those psychologists who use psychodynamic therapy will usually do so in conjunction with other treatments such as Gamblers Anonymous or cognitive behavioural techniques (Petry, 2005).

REVIEW 18.12

1 Explain how cognitive behavioural therapy can be used to assist adolescent and adult gamblers.
2 Explain how psychodynamic psychotherapy is used to help people with pathological gambling.
3 Are these approaches successful in treating gambling addiction? Explain your answer.

Contributing sociocultural factors

In order to understand gambling behaviour, we must be aware that there are sociocultural factors that encourage people to gamble, such as positive or accepting attitudes among the community about gambling. Recently, there has been a huge increase in gambling venues in Australia – there are approximately 200 000 electronic gambling machines – and a resulting increase in gambling opportunities. Electronic gambling machines have proven to be the most popular form of gambling and often the public has a positive attitude towards this form of gambling and see it as harmless. Young adults often learn gambling behaviours from their parents. One study conducted by Moore and Ohtsuka (1997) on Australian adolescents found that family and friends were accepting of young people's gambling activities. From their study, they found that 67 per cent of adolescents had gambled with their parents and 53 per cent had gambled with friends.

FIGURE 18.40 Emotions contribute to gambling behaviour.

TABLE 18.10 Gambling behaviour for a sample of young adults aged 18–24 years of age

BEHAVIOUR	PERCENTAGE
Reported gambling in the previous year	90
Regular gamblers in the previous year	37
Electronic gambling	64
Racing	54
Pool/snooker/billiards	53
Casino table games	52
Lottery	50
Card games	38
Sports betting	28

Source: Dowling, Clarke, Memery and Corney (2005)

As mentioned earlier, accessibility to gambling venues does make it easier for people to participate in these activities. The location of the venue, the number of venues in an area and the internal features of a venue can influence people. Also advertising that promotes gambling, or free travel or accommodation at the venues, and free food or alcoholic beverages also entice people to gamble.

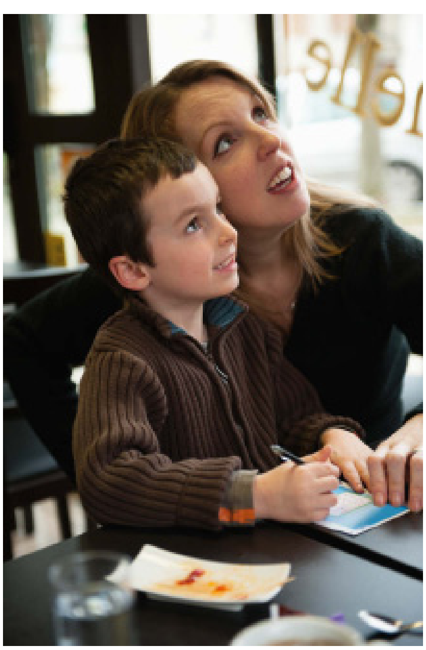


FIGURE 18.41 Young adults often learn gambling behaviours from their parents.

FIGURE 18.42 The location of the venue, the number of venues in an area and the internal features of a venue can influence people.

MANAGEMENT OF SOCIOCULTURAL FACTORS

There are many self-help groups and organisations that can help gamblers deal with their addiction. A **self-help group** meets often; its members all share a similar problem such as gambling and they focus on discussing their issues. Usually, this type of group does not have professionally trained leaders. By discussing problems, members feel a sense of togetherness and belonging and it helps the group form a social support. One of the most well-known organisations is Gamblers Anonymous (GA), an organisation where groups of people who are or have been pathological gamblers come together. They share their experiences and strength by trying to help people overcome their gambling problems. GA operates around Australia with several meetings in different locations all week. This organisation also conducts sessions called Gam-Anon to support family and friends of gamblers. These meetings bring family members of gamblers together to discuss their issues and help them deal with their lives living with a gambler.

Often people will not only seek self-help groups for their problems but may also choose to seek professional help. Many organisations offer services where people can access counsellors, either over the phone or in face-to-face sessions. Alternatively, people may choose to go and see a psychologist. These sessions provide opportunities for people to talk about their problems and help them to develop strategies in dealing with them.

Each state within Australia has organisations and services that provide help to gamblers and their family. Often there are help lines that gamblers or family members can call.

INVESTIGATE 18.18

LOCAL GAMBLING

Go to your local (or another) council's website and find the following information:

- the number of gambling venues in the area
- the services provided by the council for gamblers
- organisations the council recommends for help.

FIGURE 18.43 By discussing problems, self-help group members feel a sense of togetherness and belonging and it helps the group form a social support.

Interaction between biological, psychological and sociocultural factors

There are several factors that can contribute to pathological gambling but it is crucial that psychologists do not view the biological, psychological and sociocultural factors independently when attempting to explain why a person develops gambling problems. While many people have similar gambling problems, the route that has led them to gambling behaviours will be different. Some people may gamble because their parents were problem gamblers, hence they were biologically and psychologically vulnerable. Others may not have had any family members who gambled but the experience of a large win may have reinforced their gambling behaviour and supported their beliefs – psychological and sociocultural factors can contribute here.

When psychologists understand this interactive approach, they are able to provide the best treatment options and are better equipped with dealing with the person's gambling behaviours. Figure 18.44 shows how these factors may interact.

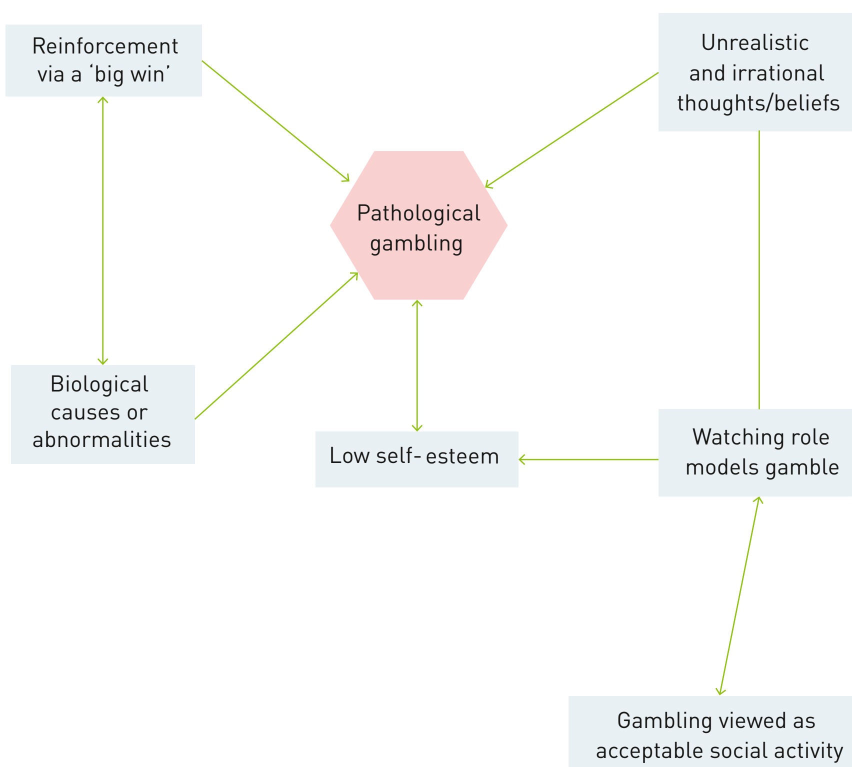


FIGURE 18.44 Interaction of biological, psychological and sociocultural factors in gambling behaviour

Psychotic disorder: Schizophrenia

The person in the case study above, Mike, suffers from psychosis or a psychotic disorder. **Psychosis** is a category of mental disorders where people lose contact with reality. **Schizophrenia** is one type of psychotic disorder, characterised by disturbances and disorganisation of thoughts, unusual emotions and behaviours. There are many symptoms of schizophrenia and not every person diagnosed with schizophrenia will experience all of them, nor will they experience their symptoms all at the same time. Hence, people with schizophrenia differ from one another.

Almost one in 100 people will develop schizophrenia, and males are more likely than females to suffer from the disorder. Males tend to develop schizophrenia between 18 and 25 years of age, and females from 25 years old to the mid-30s.

FIGURE 18.45 People with delusions may believe that they are being pursued by the police.

The symptoms of schizophrenia can be categorised as positive symptoms, negative symptoms, disorganised symptoms or other symptoms. **Positive symptoms** are those experiences or behaviours that occur in addition to the person's usual functioning, such as experiencing delusions. **Negative symptoms** refer to the removal of usual normal reactions, such as a loss of motivation. **Disorganised symptoms** include disorganised speech and behaviours.

The types of positive symptoms a schizophrenic may experience are delusions and hallucinations. **Delusions** are persistent, false beliefs that are illogical or lack evidence to support them. Schizophrenics may have an extremely strong belief in their delusions, even if they seem far-fetched to others, and may experience delusions of persecution, reference, grandeur or control (further explained in Table 18.11). More than 50 per cent of people who have schizophrenia will experience delusions. People with delusions may believe that they are being pursued by the police, being watched, dying from a disease or even that they do not exist in this world.

TABLE 18.11 Types of delusions

DELUSION	EXPLANATION	EXAMPLE
Persecution	Belief that you are being tormented or harassed by a person or group	Believing you are being watched by the FBI
Reference	Belief that sounds or other stimuli have a personal reference only to you	Believing that song lyrics refer to you or that people are talking about you
Grandeur	Belief that you are someone important or powerful	Believing that you are the Prime Minister or someone who will save the world
Control	Belief that your thoughts, feelings and behaviours are being controlled by an external force	Believing that someone/thing is controlling you like a puppet

CASE STUDY

THE CASE OF MIKE

Mike is a 37-year-old divorced male with one child. He has never been seen by a psychologist. His doctor has referred him to a psychologist but Mike refuses to go. Mike believes that someone has removed his brain and replaced it with someone else's. He thinks that this new brain is controlling him and that he is not responsible for his actions. Mike has a university-level education and a degree in finance and has been in his current job for 15 years. He says he has a lot of friends but sometimes he thinks it's one of them who did this to him.

18.13 REVIEW

1 What is meant by the term 'psychosis'? Explain.
2 Schizophrenia is one type of psychotic disorder. What symptoms characterise this disorder?
3 Complete the table below.

TYPE OF SYMPTOM OF SCHIZOPHRENIA	DESCRIPTION
Positive	
Negative	
Disorganised	

Hallucinations are another type of positive symptom that schizophrenics may experience. **Hallucinations** are experiences of perceptions, such as sight or sound, which are not present in reality. Hallucinations can be experienced in any of the senses, as shown in Table 18.12.

TABLE 18.12 Types of hallucinations

SENSE	HALLUCINATION EXPERIENCE
Auditory	Hearing voices that may offer commentary on your behaviour, instruct you to behave in a certain way or insult you
Tactile	Experiencing tingling, electrical or burning sensations or unexplained pain
Visual	Seeing something that is not actually there
Gustatory	Believing that you can taste something that is not present
Olfactory	Smelling odours that do not exist

Auditory hallucinations are the most common and occur in 70 per cent of schizophrenic patients. Studies have also found that there is great activity in the Broca's area of the brain when schizophrenic patients hear voices (McGuire, Shah & Murray, cited in Nevid, Rathus and Greene 2005).

People with schizophrenia may also experience negative symptoms, including avolition, alogia, or anhedonia. **Avolition** occurs when the person lacks energy or is disinterested in their personal grooming, hygiene, work, school or other activities. **Alogia** is when the person experiences a reduction in speech or content of speech, so that they say very little and can be vague or repetitive. **Anhedonia** occurs when the person does not gain any pleasure from normally enjoyable activities.

People with schizophrenia may experience disorganised symptoms, including disorganised speech and disorganised behaviour. **Disorganised speech** is the inability to organise ideas and speech in a meaningful way. **Disorganised behaviour** occurs when patients are unable to organise their behaviour or are unable to perform everyday routine tasks.

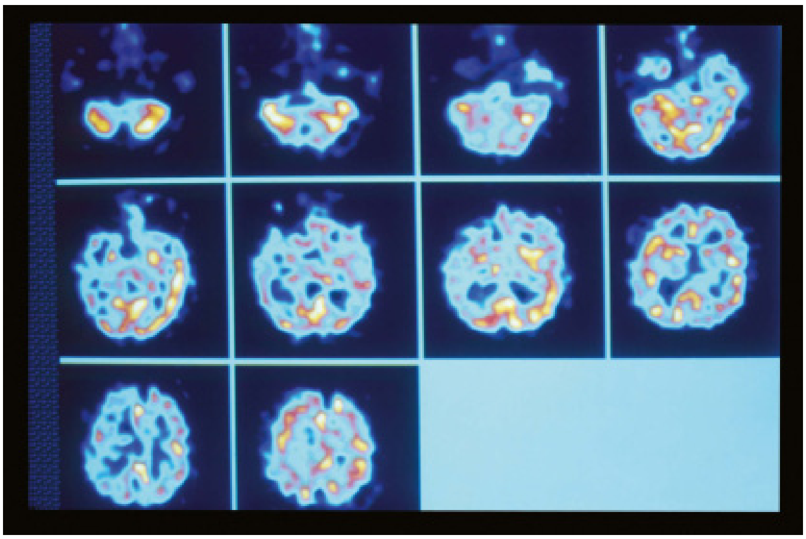


FIGURE 18.46 PET scan images of a schizophrenia patient experiencing visual and auditory hallucinations. Brain activity is in the visual and auditory association cortex.

Two further symptoms not categorised into the above symptoms are catatonia and inappropriate affect. **Catatonia** refers to impaired or abnormal motor movements, such as repeated gestures, unusual hand or arm actions, or wild waving of arms or legs. Alternatively, a person with catatonia may experience catatonic immobility, staying in one position for very long periods of time (for example, standing on one leg). **Inappropriate affect** symptoms refer to showing inappropriate emotional responses, for example, laughing at a funeral.

According to the DSM-5, a diagnosis of schizophrenia can be made when a person:

- presents some indication of disturbance in thoughts, emotions or behaviours for at least six months
- presents at least two of the symptoms discussed above for one month
- displays some deterioration in social interactions or deterioration in work or school.

There are five subtypes of schizophrenia:

- disorganised schizophrenia
  - disorganised thoughts and speech
  - delusions and hallucinations
  - inappropriate emotions and behaviours
- paranoid schizophrenia
  - organised and complicated delusions
  - auditory hallucinations
- catatonic schizophrenia
  - behaviour switches between catatonic trance and negativity to excitement or violent and hysterical behaviour

- residual schizophrenia
  - minor symptoms develop such as unusual behaviour, withdrawal from people and a general lack of interest
- undifferentiated schizophrenia
  - for those people who experience symptoms that do not fit into the other subtypes.

18.14 REVIEW

1 What is schizophrenia?
2 List and explain any four symptoms a person with schizophrenia may experience.
3 Do all people who are diagnosed with schizophrenia experience all the symptoms discussed in this section so far?
4 Read the scenarios below and determine the type of delusion that is being experienced.
   a Tim, who has been diagnosed with schizophrenia, sometimes believes that he is Elvis Presley.
   b Susan, who has been diagnosed with schizophrenia, believes her phone is being tapped and thinks that people at work are listening to her conversations to find evidence so that they can fire her.
   c Joel, a schizophrenic patient, believes that a Beatles song was written about him.
5 What are the five subtypes of schizophrenia?
6 When can a diagnosis for schizophrenia be made?

18.19 INVESTIGATE

CREATE A POSTER

Using the Internet and other resources, create a poster that includes information about one of the subtypes of schizophrenia.

Contributing biological factors

Many researchers propose that schizophrenia has a genetic component or is caused by the use of drugs or changes in the brain activity.

GENETIC PREDISPOSITION

Findings from research have concluded that there is a significant heritability factor in schizophrenia. Researchers have conducted family, twin and adoption studies in this area and their findings suggest that relatives of people with schizophrenia are at an increased risk of developing the illness and the risk increases the closer the genetic relationship (parents or siblings) with a person who has the illness. Further, those patients who have a family history of schizophrenia are more likely to experience negative symptoms than those patients with no family history of the illness (Kring *et al.* 2007).

FIGURE 18.47 There is an increased risk of developing schizophrenia if one family member has schizophrenia, but genetics alone does not account for the development of schizophrenia.

Twin studies in this field have also supported the theory that schizophrenia is genetic. These studies have indicated that if one twin has schizophrenia, identical or monozygotic (MZ) twins have a risk of 48 per cent of developing schizophrenia compared to fraternal or dizygotic (DZ) twins, who have a 17 per cent risk (Gottesman 1991, cited in Passer et al. 2009).

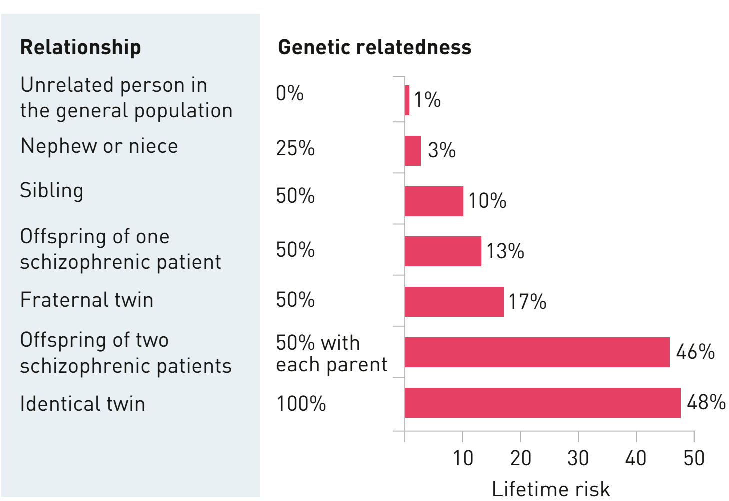


FIGURE 18.48 The chance of developing schizophrenia depends upon the genetic relationship with someone who has that disorder. This data summarises the results from 40 studies.

When examining results from family and twin studies, however, we must remember that family members and twins usually share a common environment, so not only do genetic factors account for the results obtained but environmental factors play a major part.

In order to eliminate the environmental factors that need to be considered with family and twin studies, researchers have conducted adoption studies. The environmental factor is eliminated when studies use children who had a schizophrenic biological parent but were raised by adoptive parents without schizophrenia. These studies have provided strong support for the importance of the genetic component in schizophrenia. Heston (1966) conducted a study on 47 infants who were raised by adoptive parents, but whose biological mothers had schizophrenia. He also obtained 50 control participants who were raised with their biological and non-schizophrenic mothers. The findings showed that 16 per cent of the children whose biological mother had schizophrenia were diagnosed with this disorder compared to no participants from the control group (Kring *et al.* 2007). In support of these findings, further research was conducted in Finland with a larger sample of adopted children. It was found that of the 164 adoptees who had a parent with schizophrenia, the risk of developing the illness was 8.1 per cent, compared to the 197 control group adoptees who did not have a parent with schizophrenia, whose risk was 2.3 per cent (Tiernari *et al.* cited in Kring *et al.* 2007).

The Genain quadruplets offer some insight into research on genetics and schizophrenia. These genetically identical quadruplets had psychological problems and had all developed schizophrenia in their 20s. There were several causes for the onset of schizophrenia and one of them was genetic. The quadruplets had a family history of psychological problems on their father's side (Nietzel *et al.* 1998).

FIGURE 18.49 The Genain Quadruplets. All sisters became schizophrenic later in life. The chances of four unrelated individuals all being schizophrenic is 1 in 100 million. ©AP photo

DRUG-INDUCED ONSET

There are many reasons for the cause of schizophrenia but not many people realise that this illness can be brought on by the use of marijuana. If someone has a predisposition to schizophrenia, then marijuana use can cause the first schizophrenic episode. The chemicals found in marijuana interfere with normal brain functioning, slowing down the functioning of the nervous system, which slows down the messages being sent around the body, causing cognitive impairment.

A study was conducted on 2437 adolescents aged 14–24 years who had a predisposition for developing schizophrenia because they had one or more relatives with the disorder. It was found that cannabis use increased the risk of developing schizophrenia. Additionally, those participants that were susceptible had a much greater risk (24 per cent) of developing schizophrenia after marijuana use than those who did not have a predisposition, who had a 6 per cent risk (Henquet *et al.* 2005). Many research studies on this area have been conducted and found similar results: marijuana use increases the risk of developing schizophrenia. Other studies have found that cannabis use can bring on schizophrenia at an earlier age (see the following article).

WHY POT MAKES SOME PEOPLE PSYCHOTIC

19 November 2012
www.livescience.com

People who smoke pot may be at increased risk for psychosis if they have a certain genetic marker, a new study finds.

The results show people with this genetic marker who use cannabis are twice as likely to experience psychosis compared with those who use the drug but do not have the genetic marker.

Among people who use the drug every day, the risk for psychosis increases sevenfold for those who have the genetic marker.

Previous studies have linked smoking marijuana with an increased risk of psychiatric disorders, such as schizophrenia, but only a small number of those who smoke pot will ever have a psychotic episode. The new finding could help identify which cannabis users might be at risk for this side effect, the researchers said.

'Our findings help to explain why one cannabis user develops psychosis while his friends continue smoking without problems,' said study researcher Dr. Marta Di Forti, of King's College London's Institute of Psychiatry.

The study involved 489 people living in London who had experienced a psychotic episode, and 278 healthy people without a history of psychiatric disorders.

The genetic marker in question is one variation of a gene called AKT1. The new finding confirms earlier research, which also linked this marker with the risk of psychosis after smoking pot.

The AKT1 gene is known to be involved in the signaling of the brain chemical dopamine, which is abnormal in those with psychosis, Di Forti said.

The genetic marker likely acts along with other genes to contribute to the risk of psychosis from cannabis smoking, the researchers said. Finding the genetic underpinnings of cannabis psychosis may lead to the development of therapies for the condition, said Dr. John Krystal, editor of *Biological Psychiatry*, the journal in which the study was published Nov. 15.

INVESTIGATE 18.20

Read the article 'Why Pot Makes Some People Psychotic' and answer the following questions.

1. What was the aim of the study?
2. Who were the participants in this study?
3. Read the findings and explain who is at risk of developing psychosis.
4. According to this research, what is the cause of the increased risk of psychosis from smoking cannabis? Explain.
5. How will the research be beneficial to our understanding of cannabis and psychosis?

CHANGES IN BRAIN ACTIVITY AND STRUCTURE

Through various technologies and brain imaging studies, researchers are examining the role of neurotransmitters and abnormalities in brain structures as a possible cause of schizophrenia. One popular theory, known as the **dopamine theory**, was that schizophrenia is caused by too much dopamine in the brain or an overreaction of the dopamine receptor sites on the post synaptic neurons. This theory was formed when researchers noted the effects of antipsychotic drugs. They found that antipsychotic drugs reduced the level of dopamine activity and, as a result, reduced some of the symptoms of schizophrenia such as hallucinations, delusions and disorganised thinking. Other studies by Kleven and Seiden (1991) have found that when a non-schizophrenic patient is given large doses of amphetamines (a stimulant drug), there is an increase of dopamine in the synaptic cleft. This increase can cause behaviours that mimic paranoid schizophrenia. There are some doubts about this theory, however, as not all schizophrenic patients' symptoms can be relieved with antipsychotic drugs (Kring *et al.* 2007). Further research that examines the relationship between dopamine and schizophrenia is being conducted.

Researchers also believe that it is unlikely that one neurotransmitter is responsible for all of the symptoms associated with schizophrenia and are conducting studies on the roles of serotonin and glutamate.

Brain imaging techniques have highlighted other possible causes, such as abnormalities in the brain structure of schizophrenic patients. Examinations of the patients' brains have consistently showed **enlarged ventricles** (the hollow spaces in the brain). There is an indication of a loss of brain tissue in areas of the brain that are responsible for emotions, thinking and information processing – behaviours that are disorganised in schizophrenia patients. Most deterioration of brain tissue seems to occur in the temporal and frontal lobes of the brain. MRI studies conducted using identical twins revealed that the twin with schizophrenia had enlarged ventricles compared to the non-schizophrenic twin (McNeil, Cantor-Graae and Weinberger 2000, cited in Kring *et al.* 2005). Many studies of brain functioning in schizophrenic people support the notion that impairments in cognitive abilities and processes are due to abnormalities, and that patients with negative symptoms will display decreased cognitive functioning associated with problems in the prefrontal cortex (an area in the frontal lobe).

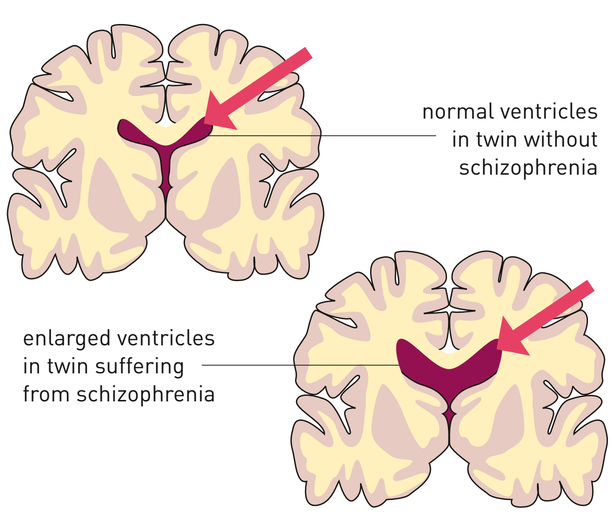


FIGURE 18.50 An illustration comparing the brains of identical twins. The schizophrenic twin on the right has enlarged ventricles in a region of the brain involved with memory and emotion. This indicates that brain abnormalities can be linked to schizophrenia.

MANAGEMENT OF BIOLOGICAL FACTORS

During the 1950s, antipsychotic drugs to treat schizophrenia were prescribed, allowing some patients to live and function normally without hospitalisation. Antipsychotic drugs, also called major tranquillisers or neuroleptics, help control the behaviours of schizophrenic patients if they are taken on a continuous basis, but they are not a cure. These drugs reduce hallucinations, delusions, disorganised thinking and speech. There are several varieties of these drugs and some patients will respond better to one type than to others. A majority of schizophrenic people who take antipsychotic drugs show improvement, but less than 30 per cent are well enough to live independently. These drugs are more effective with patients who experience positive symptoms of schizophrenia, such as delusions or hallucinations. Those people with negative symptoms of apathy and withdrawal have very little relief.

The function of antipsychotic drugs is to block the dopamine receptors in the brain that are overactive. While many people can benefit from these drugs, there are some side effects that cause schizophrenic patients to discontinue taking them. One of the major side effects of continual use of antipsychotic drugs is **tardive dyskinesia (TD)**. TD is a disorder where the person will experience uncontrollable movements of any body part, including the face and tongue. TD is irreversible and seems to occur in people who have been on antipsychotic drugs for longer than six months. One in four people who have long-term antipsychotic treatment will develop TD. However, researchers are currently developing medication that will reduce both positive and negative symptoms without producing TD in patients.

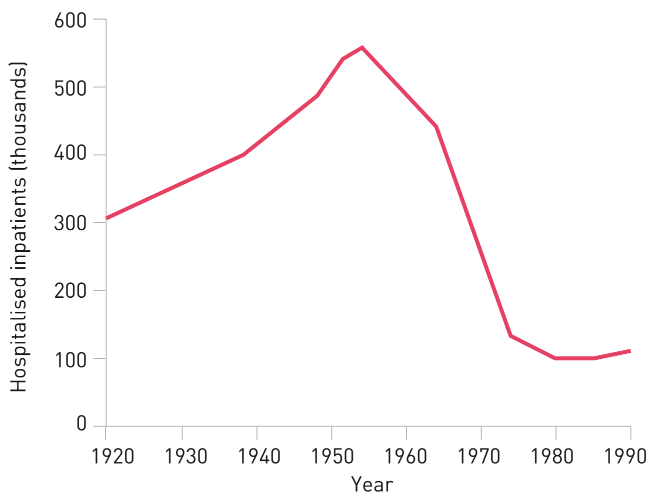


FIGURE 18.51 This graph shows a decrease in the number of people hospitalised once antipsychotic drugs were introduced.

REVIEW 18.15

1 Why did researchers believe it was important to conduct studies on schizophrenic patients who had been adopted?
2 Explain the dopamine theory.
3 a What are enlarged ventricles?
 b How do enlarged ventricles impact on behaviour in schizophrenic patients?
 c In your notes, draw a picture of the brain and indicate the areas that would most likely be affected by enlarged ventricles.
 d Where in the brain is it more likely to occur?
4 What is one of the major side effects of antipsychotic drugs?
5 Conduct some research and determine other possible side effects from antipsychotic drugs.

Contributing psychological factors

IMPAIRED REASONING AND MEMORY

As well as experiencing positive or negative symptoms, a majority of people with schizophrenia will also experience cognitive impairment. These problems often begin to occur years before the onset of schizophrenia and can impact the normal day-to-day functioning of a person. Cognitive impairments refer to impairments in memory, attention, planning, learning, vocabulary and visual perception skills. Some studies have examined the slow cognitive processing in patients by using tests that measure their speed of encoding. It was found that people with schizophrenia demonstrated poor working memory because they would process information slower than non-schizophrenic people (Hartman *et al.* 2003).

Further research has found that commonsense reasoning abilities in schizophrenics are impaired. Participants in a study took tests that included questions that required either logical reasoning or commonsense reasoning. It was found that schizophrenic participants were better at logical reasoning than commonsense reasoning (Owen, Cutting & David 2007).

MANAGEMENT OF THE CONTRIBUTING PSYCHOLOGICAL FACTORS

While antipsychotic medication can benefit and alleviate some of the biological symptoms, there are several therapies that can assist in dealing with the psychological factors that contribute to schizophrenia. These are psychodynamic therapies, cognitive behavioural therapy, remediation therapy and stress management.

Psychotherapies

Psychotherapy stemmed from Freud's psychoanalysis therapy, a time-consuming process where patients would have been seen by their therapist approximately five times a week for as long as five years. Psychoanalysis focused on events from the patient's childhood. Current psychotherapies, used together with antipsychotic drugs, can help relieve thought disturbances, teach patients about their disorder, allow them to effectively take part in their therapy and make changes in their behaviour. Generally, the number of psychotherapy sessions required is fewer than that required for psychoanalysis, and focuses on understanding influences from the past and current negative behaviours, as well as teaching interpersonal skills. One type of psychotherapy is 'personal therapy'. This type of therapy focuses on relationships and helps the patient learn social skills, to cope with stress and to deal with criticism. This type of therapy can reduce the number of relapses and improve social interactions.

Cognitive behaviour and remediation therapies

The aim of cognitive behaviour therapy (CBT) is to change the distorted thoughts and beliefs of schizophrenic patients. During this therapy, the patient is asked to test and question their delusional beliefs. This task can only be achieved with help from the therapist and when the patient is also taking antipsychotic medication. This technique can help reduce the intensity of the symptoms, particularly negative symptoms such as anhedonia. CBT, together with antipsychotic medication, can help reduce hallucinations and delusions.

In contrast, remediation therapies such as **cognitive remediation therapy** (CRT) focus on improving cognitive functions in schizophrenic patients. More specifically, it helps patients improve their working memory, language abilities, problem-solving skills and attention. CRT involves the patient undertaking cognitive training or mental activities (such as those on computers or paper-and-pencil tasks) that will improve their functioning. A treatment plan is devised, highlighting the patient's strengths and weaknesses and where the focus is needed. CRT not only attempts to improve cognitive functioning but also social and emotional functioning. In one study, researchers wanted to determine the effectiveness of CRT in improving cognitive abilities. They obtained participants from community mental health services who had recently developed schizophrenia and had cognitive, behavioural and social difficulties. A single-blind experiment was conducted with two groups: group one received CRT and group two received standard care. Those in group one received CRT over a three-month period, with three sessions per week. Their cognitive and social abilities were assessed at the beginning of the study, three months after therapy and again three months later. The results of the two groups were compared and the findings indicated that those in the group who received CRT showed greater improvement in cognitive and social functioning (Wykes *et al.* 2007).

REVIEW 18.16

1 Create a table outlining the three different types of therapies to treat people with schizophrenia.
2 Using the Internet or phone book, locate some organisations that offer these types of therapies.
3 Explain the impairments in cognitive abilities and brain structure in schizophrenic patients.

Contributing sociocultural factors

SOCIAL DISADVANTAGE, TRAUMA AND STRESS

Over the years, studies have found that the number of people with schizophrenia is higher in lower socioeconomic groups. Two theories might explain this statistic: the social causation hypothesis and the social drift hypothesis. The **social causation hypothesis** states that those people in lower socioeconomic groups experience higher levels of stress, which increases the likelihood of someone developing schizophrenia. The **social drift hypothesis** states that those people with schizophrenia may experience personal difficulties which impair their work and, as a result, they may fall into a lower socioeconomic category (Passer and Smith, 2012).

Researchers have also been trying to determine if family stress can cause schizophrenia. Theorists who study this area have suggested that some families are high in **expressed emotion**, which can cause severe schizophrenic symptoms. A family with high expressed emotion will criticise each other, show disapproval and hostility towards each other and can invade each other's privacy. These negative attitudes can cause stress. As a result, those who are trying to recover from schizophrenia will often relapse when placed back into these family situations. However, researchers are still unclear if expressed emotion causes schizophrenia or if it is a response to living with a person with schizophrenia.

Research has also highlighted the fact that trauma such as child abuse, war or natural disasters can increase the risk of developing schizophrenia for those people who have a predisposition to it. Researchers Read and colleagues (2003) examined the relationship between child abuse and schizophrenia. They studied the differences in symptoms between people who had been sexually and/or physically abused as a child compared to those who had not. They found that those who were abused as a child were four times more likely to experience hallucinations and 15 times more likely to hear voices than those who were not abused (findings from studies conducted by Kavanagh, 1992).

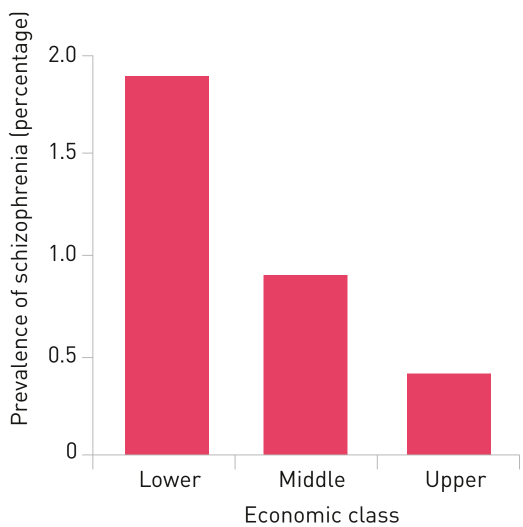


FIGURE 18.52 The graph indicates the connection between socioeconomic status and the occurrence of schizophrenia.

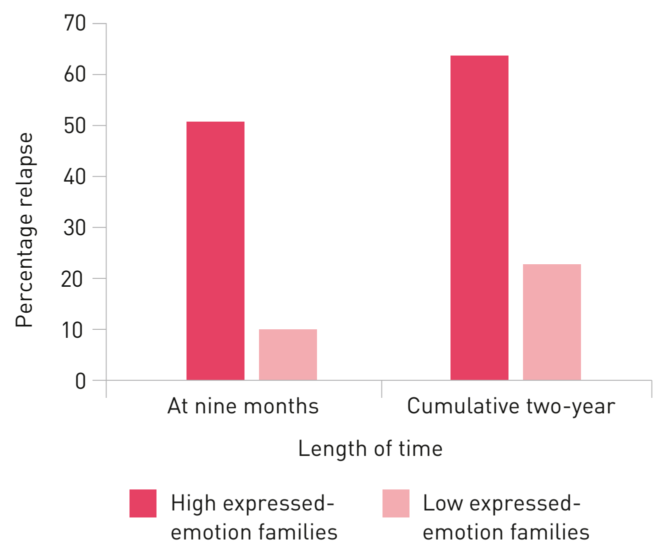


FIGURE 18.53 This graph indicates that people whose families have high expressed emotions are more likely to have a relapse compared with those whose families have low expressed emotions.

MANAGEMENT OF SOCIOCULTURAL FACTORS

There are several methods used to manage sociocultural factors: psycho-education, supportive family environments, stress management and the removal of social stigma.

Psychoeducational approaches educate people about the illness – it is not a treatment. People with schizophrenia will learn about the symptoms and how long they will last. They are also taught about the biological and psychological factors that can trigger these symptoms, as well as strategies to treat their illness. Not only can it benefit sufferers, it can educate their carers, providing them with improved knowledge and techniques to deal with the illness. Through psychoeducational approaches, carers can receive some encouragement, advice and assistance, as well as meeting with other people in the same situation to share experiences and learn more about the illness.

People with schizophrenia can also benefit from a supportive social or family environment. This is achieved either through psychoeducational approaches or social support networks. A **social support network** includes the friends and family members that a person with schizophrenia can go to for support. Social support networks can help a person with schizophrenia by providing solutions for stressors, as well as reassurance that they are cared for and valued.

Psychologists will often teach patients stress management techniques to deal with stressors that may contribute to the illness or bring on symptoms. **Stress management** refers to a set of techniques that people can use to help them deal with challenges. A variety of techniques that can be used are outlined in Table 18.13.

TABLE 18.13 Stress management techniques for coping with schizophrenia

TECHNIQUE	EXPLANATION
Arousal reduction	The person is trained in muscle relaxation and to apply these techniques to real-life stressors to lower their stress levels.
Cognitive restructuring	The person is trained in altering their beliefs and reconsidering their interpretations of experiences to reduce stress.
Environmental changes approach	The person is taught to look to the environment for support, such as social support and support from their workplace.

Further, the removal of social stigmas about schizophrenia and mental health can benefit people. A stigma in this context refers to a negative label of a person who may have a mental illness. These stigmas are inaccurate, hurtful and often portray people with schizophrenia as crazy, violent or incompetent. Organisations such as SANE Australia have developed strategies to reduce and prevent such stigmas.

INVESTIGATE 18.21

INTERNET RESEARCH

Visit the SANE website and investigate how they try to reduce social stigmas about mental health.

Interaction between biological, psychological and sociocultural factors

Schizophrenia is a very complex mental illness and research about its cause continues. Researchers must ensure that when they study this illness they consider all three factors: biological, psychological and sociocultural. The **vulnerability theory** of schizophrenia describes how these factors interact. This theory proposes four points that may determine (a) whether a person will get this illness and (b) the course that the illness will take:

- that susceptibility to the illness is biological
- that different people have different levels of vulnerability
- that a person's susceptibility to the illness depends upon genetics and abnormalities
- that psychological and sociocultural factors (such as family life) can influence a person's vulnerability.

Hence, the vulnerability of a person combined with stress can lead to schizophrenia – those who are more vulnerable (i.e. have a genetic predisposition to schizophrenia) may be more likely to develop schizophrenia if they experience family problems or other stressors. However, those who are least vulnerable may not develop the disorder when faced with the same sort of stressors (Bernstein *et al.* 2008).

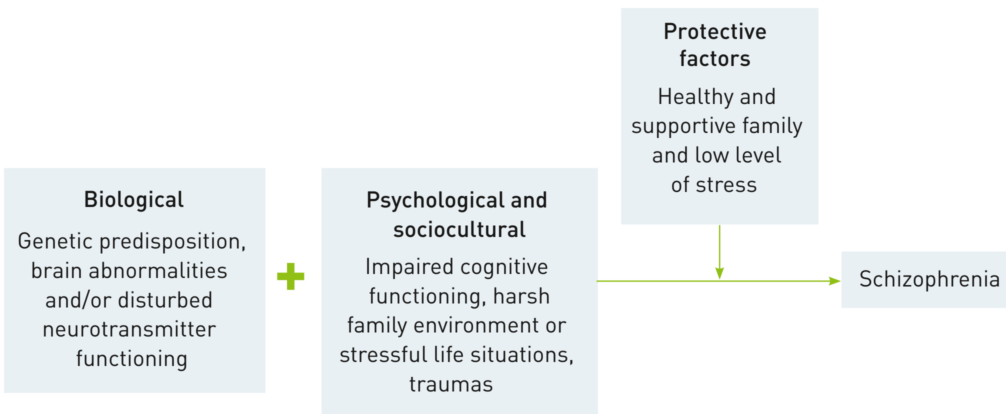


FIGURE 18.54 Biopsychosocial influences in schizophrenia

18.17 REVIEW

Match the term with the correct definition.

psychosis	impaired or abnormal motor movements, such as repeated gestures, unusual hand or arm actions, or wild waving of arms or legs
schizophrenia	that those people who live in lower socioeconomic areas experience higher levels of stress increasing the likelihood of someone developing schizophrenia
enlarged ventricles	a major side effect of long-term use of antipsychotic drugs
catatonia	hollow spaces in the brain
social causation	a type of psychotic disorder, characterised by disturbances and disorganisation of thoughts, unusual emotions and behaviours
tardive dyskinesia (TD)	a way to help manage schizophrenia by educating people about the illness (not a treatment)
psychoeducational approach	a category of mental disorders where people lose contact with reality

→ CHAPTER SUMMARY 18:

Anxiety disorder: Specific phobia

- → Anxiety disorders are characterised by feelings of extreme apprehension, fear, stress and unease. There are five main types of anxiety disorders: generalised anxiety disorder, phobic disorder, panic disorder, obsessive-compulsive disorder and post-traumatic stress disorder. Phobic disorder has three further subcategories: social phobia, specific phobia (simple phobia) and agoraphobia.
- → A specific phobia (phobic disorder) is defined as a persistent, irrational and intense fear of a particular thing, animal, situation, activity or person that interferes with a person's day-to-day functioning.
- → Individuals with specific phobia experience both psychological and physiological symptoms. The fight-or-flight response, also referred to as the 'stress' response, is elicited when the person is faced with the object, situation or activity that they fear.
- → The amygdala is pivotal in initiating and processing emotional responses such as fear and anxiety. It works together with the hippocampus and thalamus where the formation and storage of classical conditioned fear is stored.
- → The neurotransmitter gamma-amino butyric acid (GABA), which has an inhibitory effect, contributes to the regulation of anxiety, arousal and sleep. Low levels of GABA lead to higher levels of anxiety

because there is an insufficient amount of GABA to regulate adequately anxiety or arousal levels in the central nervous system. Low levels of GABA can contribute to development of a phobia.

- Psychological contributing factors refer to our thoughts, beliefs and perception about ourselves and the world around us. These beliefs are based on how we interpret environmental events.
- The psychodynamic model attributes the development of phobia to unresolved conflicts during the Oedipal stage of a child's development.
- The behavioural model focuses on behaviours and downplays the importance of thinking. Environmental factors influence and mould behaviour. According to this model, specific phobia is learnt and maintained through classical and operant conditioning.
- The cognitive model places greater emphasis on the thought processes involved in how we feel and behave. In this model, phobia is a result of distorted thinking processes, which may occur more readily if the person has a predisposition (personality or genetic) to exaggerate perceived threats.
- The methods used to treat specific phobia include cognitive behavioural therapy (CBT) that uses a combination of verbal and behavioural modification techniques to assist people to alter their negative automatic thoughts. This in turn alters their emotional, biological and behavioural response. Graduated exposure can be used: the person is taught relaxation techniques, develops a hierarchy of fear and is then gradually exposed to the source of their fear while using the relaxation techniques. Flooding (also known as exposure therapy) can also be used: the person is exposed to the source of their fear until they feel more relaxed.
- Biological methods used to treat phobia: The use of anti-anxiety drugs that mimic GABA's inhibitory effects have been successfully used in conjunction with other treatments to manage phobic anxiety. Lorazepam (Ativan), Clonazepam (Klonopin) and Diazepam (Diastat, Diazemuls, Valium) are medications that are used by health professionals to help manage phobias by inhibiting anxiety.
- Other factors that contribute to the development and maintenance of a specific phobia include socio/cultural factors that are linked to specific cultural/religious beliefs, and the person's observation of parental phobic responses. Specific environmental triggers also play an important role, where the person experiences direct exposure to the object, situation or animal, observes another person interacting with the object of the phobia or reads about it in the newspaper.
- The biopsychosocial approach to understanding and managing simple phobia takes into account genetic vulnerability, physiological processes, psychological determinants, socio/cultural factors, family history of anxiety/phobia, environmental influences, and whether or not the person can function at home, work and in social situations.

Mood disorder: Major depression

- A mood disorder is when moods are severe or persist and disrupt a person's life or daily functioning. People who experience mood disorders may experience depression and/or mania.
- Depression is a low, sad emotion where a person may feel that their life is miserable and dark and that the challenges they face are overwhelming. Major depression will occur if depressive symptoms are present for at least two weeks.
- Major depression is one of the most common mental illnesses, which can occur at any age.
- Major depression is partly caused by biological factors, such as genetics and neurotransmitter functioning.
- Genetic factors contribute to the likelihood of developing major depression. The closer the genetic relationship one shares with a person who has depression, the greater the likelihood of developing depression.
- Neurotransmitters are the brain chemicals that carry messages from one neuron to the next. The neurotransmitters that play a role in major depression are serotonin, noradrenalin and dopamine.
- Researchers first proposed that the lack of serotonin, noradrenalin and dopamine were the causes of depression. However, current research has found that depression may be caused by the sensitivity of the postsynaptic receptor.
- In order to treat depression, antidepressant drugs can be prescribed. These drugs increase the availability of neurotransmitters in the synaptic cleft to alter the sensitivity of the postsynaptic receptor.
- Other than biological factors, there are several psychological factors that can cause the onset of depression, such as learned helplessness and stress.
- The learned helplessness model of depression suggests that if people feel that they are unable to control life events, especially stressful events, they learn a sense of helplessness that may lead to depressive symptoms. In addition, stressful life events can increase the risk of developing major depression or increase the likelihood of a reoccurrence of a depressive episode.
- These psychological factors can be managed through psychotherapies such as cognitive behaviour therapy and psychodynamic therapy.
- Socio/cultural theorists state that depression is significantly influenced by the social structure in which people live. Factors such as poverty, abuse, social isolation and lack of social support can all contribute to the likelihood of developing the disorder. Some patients may benefit through support groups, family and group therapy.
- Major depression can be caused by the interaction of biological factors, psychological factors and social and environmental factors, as negative thoughts associated with depression interact with the biological factors of a person. If there is social support (sociocultural factors), then the person may be able to avoid depression.

Addictive disorder: Gambling

- Addiction refers to an activity that people are completely absorbed in and pursue, regardless of any of the negative consequences. Gambling is considered an addiction. Gambling is any behaviour that involves the risk of money or valuable possessions on the outcome of a game that is determined by chance.
- There are three levels that describe gambling behaviour:
  - level 1: recreational gambler or non-gambler
  - level 2: problem gambler
  - level 3: pathological gambler.
- Three types of neurotransmitters that may contribute to pathological gambling are serotonin, norepinephrine and dopamine.
- The reward pathway is responsible for our feelings of motivation, reward and behaviour; it makes us feel good when we participate in behaviours such as eating, drinking or gaining money. When the reward pathway is activated, it will release the neurotransmitter dopamine, which provides the feeling of euphoria and pleasure. This activation of the reward system will cause a person to repeat the behaviour, which can cause an addiction.

- Evidence suggests that gamblers may have abnormalities in dopamine receptors in the brain. If a person has a reduced level of dopamine in their reward system pathway, then they may look for greater than normal levels of pleasure or reinforcement through behaviours such as gambling.
- Research that has been conducted in these areas is usually limited but it has been suggested that antidepressants and mood stabilisers may help in managing serotonin and norepinephrine abnormalities.
- Some research has indicated that there may be an association between Parkinson's disease and pathological gambling.
- Theorists believe that the social learning theory explains gambling behaviour. When people first gamble they are usually learning and imitating a role model.
- Psychologists have found that the strength and persistence of gamblers' behaviour is great when they are rewarded in a random and unpredictable pattern, known as the variable ratio schedule. However, a random ratio schedule is also used. This is when a reinforcer is given after a number of random responses but each outcome from a response is independent of the previous one. With a random ratio schedule, there is no upper limit set on the number of responses made before a reinforcement is given. So there is an element of unpredictability that is resistant to extinction and causes people to continue gambling on electronic gaming machines.
- Cognitive behaviour therapy (CBT) can be used to treat the psychological factors that contribute to gambling behaviour. The aim of CBT is to alter the thoughts and beliefs associated with gambling as well as to teach people how to cope with the urges and deal with emotions that may cause them to gamble.
- Psychodynamic therapy is another technique that psychologists may choose to use when dealing with pathological gambling. This therapy looks at the current behaviour of the gambler and attempts to find the underlying reasons for it by delving into their past.
- Generally, the community has a positive attitude towards gambling behaviours.
- Self-help groups allow gamblers to meet and discuss their issues; usually this group does not have professionally trained leaders.
- Often people will not only seek self-help groups for their problems but may choose to seek professional help from counsellors or psychologists.
- Psychologists must not view the biological, psychological and sociocultural factors independently when attempting to explain the reasons a person develops gambling problems. They must understand the interactive approach to be able to provide the best treatment options.

Psychotic disorder: Schizophrenia

- Psychosis is a category of mental disorders where people lose contact with reality. Schizophrenia is one type of psychotic disorder, characterised by disturbances and disorganisation of thoughts and unusual emotions and behaviours.
- The symptoms of schizophrenia can be categorised as positive symptoms, negative symptoms, disorganised symptoms or other symptoms.
- Many researchers propose that schizophrenia has a genetic component and is affected by the use of drugs or changes in the brain activity.
- Findings from twin studies have concluded that schizophrenia has a high heritability factor; that is, relatives of people with schizophrenia are at an increased risk of developing the illness.
- If someone has a predisposition to schizophrenia then marijuana use can cause the first schizophrenic episode. The chemicals found in marijuana interfere with normal brain functioning, slowing down the functioning of the nervous system.
- It is also believed that schizophrenia is caused by too much dopamine in the brain – the dopamine theory. Abnormalities in brain structure, such as enlarged ventricles, can cause schizophrenia.
- Antipsychotic drugs are used to treat the biological factors as they block the dopamine receptors in the brain that are overactive.

- Many people with schizophrenia will also experience cognitive impairment, which can affect their normal day-to-day functioning. Psychodynamic therapies, cognitive behaviour therapies and remediation therapies can help patients deal with these impairments.
- Socio/cultural factors can also affect the likelihood of developing schizophrenia, according to the social causation hypothesis and the social drift hypothesis. The social causation hypothesis refers to the socio-economic status of people and stress. The social drift hypothesis states that those people with schizophrenia may experience personal difficulties that impair their work and, as a result, they fall into a lower socio-economic category.
- Theorists have also have suggested that some families are high in expressed emotion, which can cause severe schizophrenic symptoms. These negative attitudes can cause stress and those who are trying to recover from schizophrenia will often relapse when placed back into these family situations.
- There are several methods used to manage sociocultural factors, including psychoeducation, supportive family environments, stress management and the removal of social stigma.
- The vulnerability theory of schizophrenia describes how biological, psychological and sociocultural factors interact. This theory proposes that the vulnerability of a person combined with stress can lead to schizophrenia. So those who are more vulnerable (i.e. have a genetic predisposition) to schizophrenia may be more likely to develop schizophrenia if they experience family problems or other stressors. However, those who are least vulnerable may not develop the disorder when faced with the same sort of stressors.

Concept maps

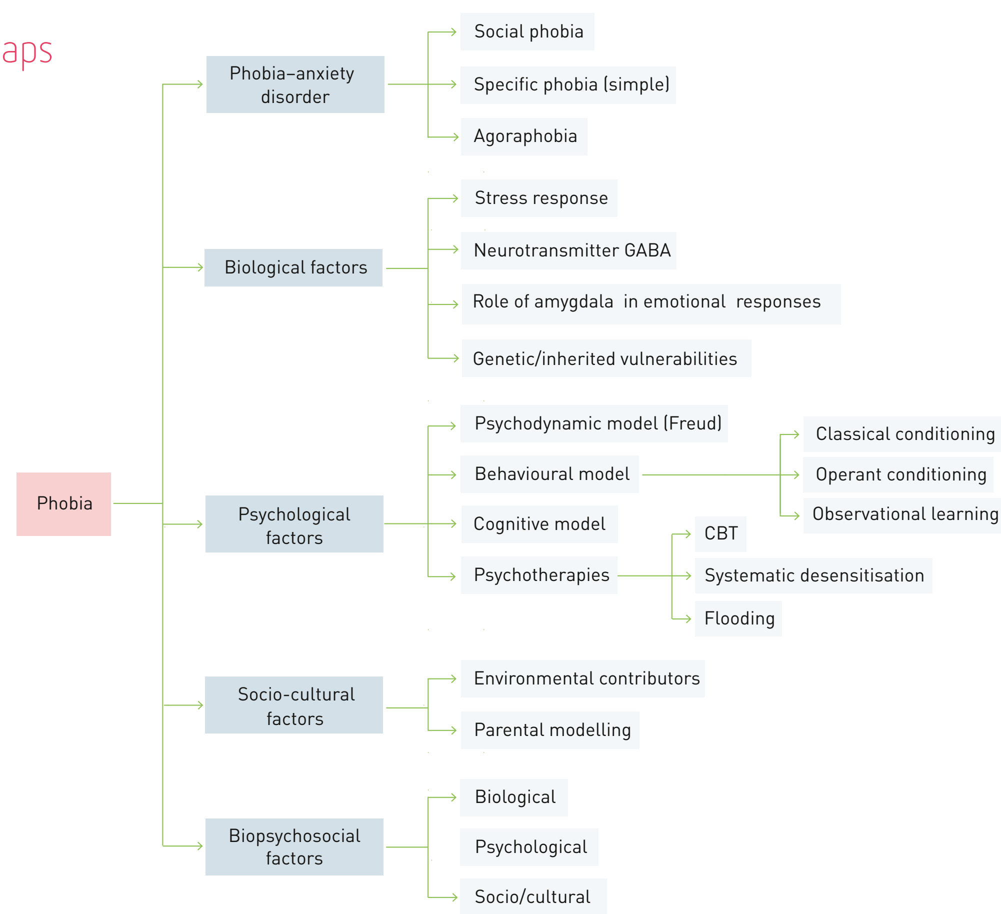


FIGURE 18.55 Concept map – Anxiety disorder: Specific phobia

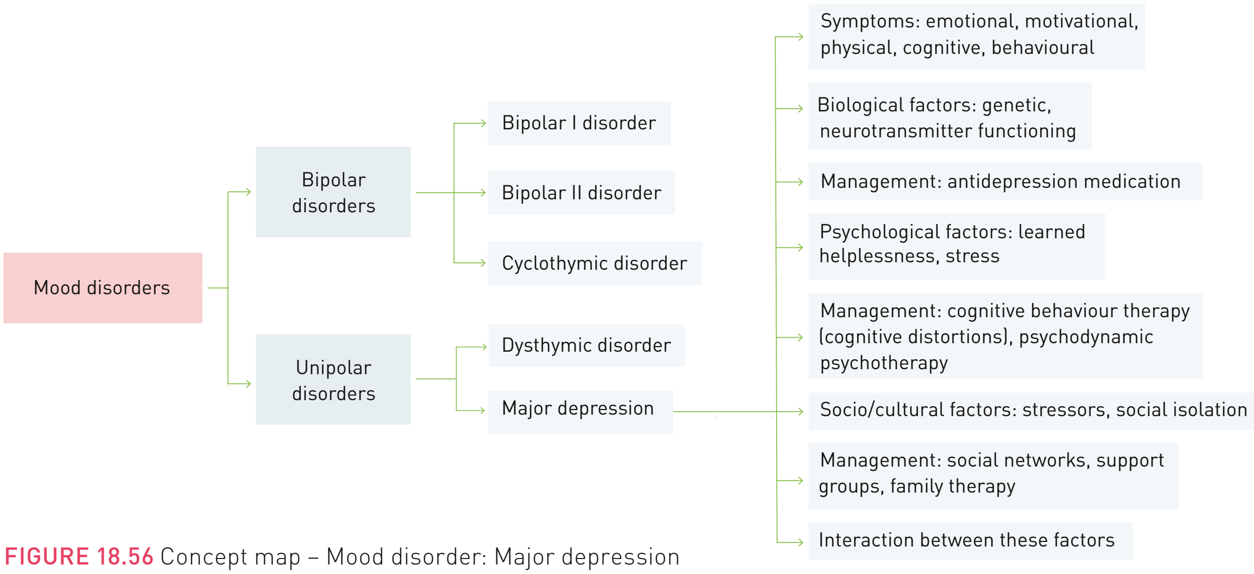


FIGURE 18.56 Concept map – Mood disorder: Major depression

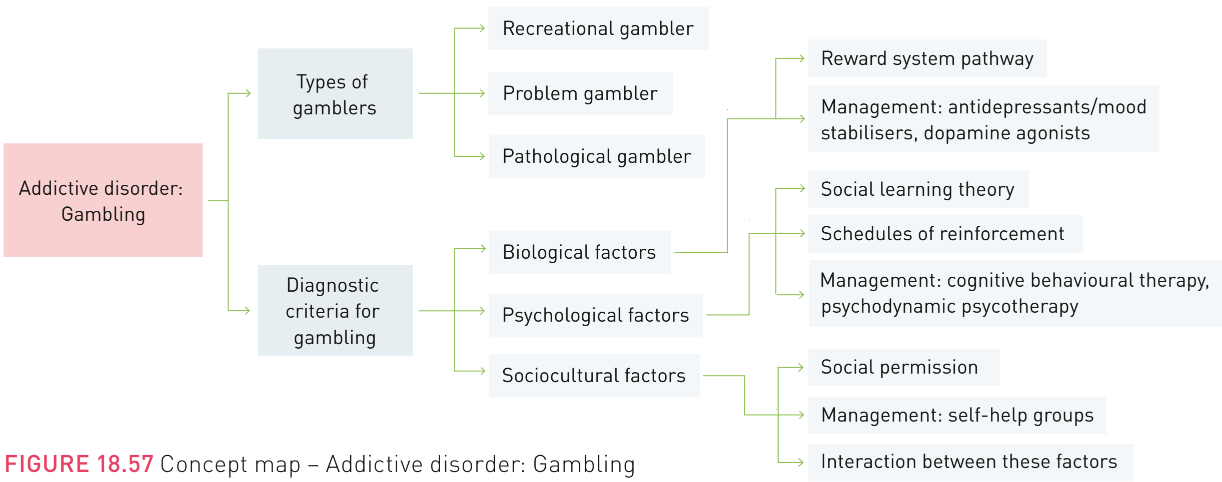


FIGURE 18.57 Concept map – Addictive disorder: Gambling

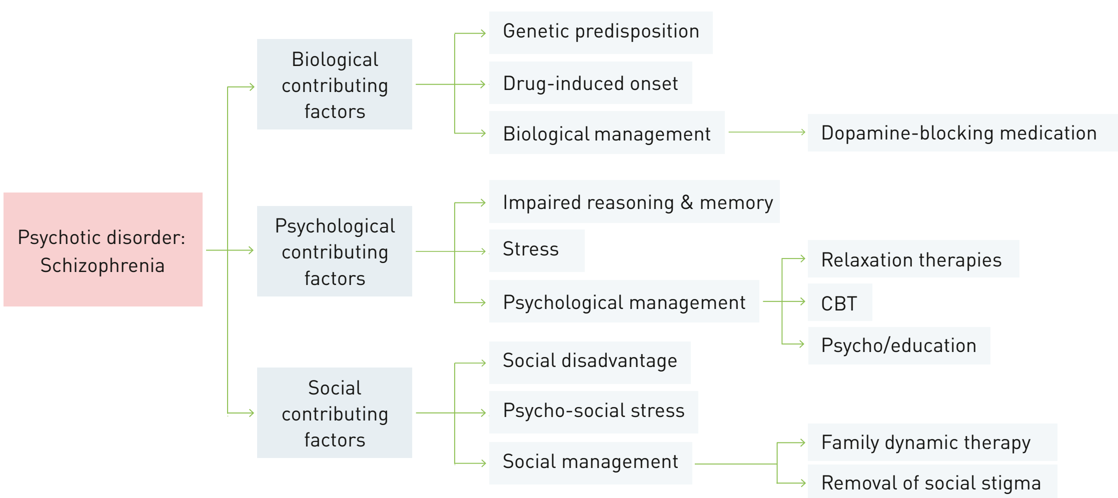


FIGURE 18.58 Concept map – Psychotic disorder: Schizophrenia

→ ESSENTIAL KNOWLEDGE

KEY TERMS – ANXIETY DISORDER: SPECIFIC PHOBIA

For the exam, you must know definitions for the following terms and concepts and be able to relate them to an example where appropriate:

amygdala
anxiety disorders
behavioural model
biopsychosocial factors
cognitive behavioural therapy (CBT)
cognitive model
environmental triggers in specific phobia
fight-or-flight response
flooding
hippocampus
modelling
neurotransmitter gamma-amino butyric acid (GABA)
phobic disorder
psychodynamic model
specific phobia
sociocultural approach
systematic desensitisation
thalamus

KEY KNOWLEDGE

For assessment, you must able to show your understanding and apply your knowledge of:

- biological contributing factors in a simple phobia
- phobia – an anxiety disorder
- role of stress response (fight-or-flight)
- role of amygdala, hippocampus and thalamus in fear response
- neurotransmitter gamma-amino butyric acid (GABA)
- psychological contributing factors in specific phobia
- psychodynamic explanation of specific phobia
- behavioural explanation of specific phobia: classical conditioning and operant conditioning
- cognitive explanation of specific phobia
- treatment methods – cognitive behavioural therapy (CBT); systematic desensitisation; flooding
- sociocultural contributing factors in specific phobia – environmental triggers; parental modelling
- biopsychosocial approach to understanding and management of specific phobia.

KEY TERMS – MOOD DISORDER: MAJOR DEPRESSION

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

antidepressant drugs
bipolar disorder
cognitive behavioural therapy (CBT)
depression
episodic disorder
learned helplessness
major depression
mania
mood
mood disorder
noradrenaline
psychodynamic psychotherapy

seratonin
sociocultural factors
stress
unipolar depression

KEY KNOWLEDGE

For assessment, you must able to show your understanding and apply your knowledge of:

- what major depression is, including symptoms.
- the biological factors that contribute to the risk of developing major depression:
  - genetic factors
  - neurotransmitter functioning
- the function of antidepressant medication in management of depression
- the psychological contributing factors:
  - Seligman's learned helplessness theory including the attributional styles
  - stress
- the use of psychotherapies in managing depression:
  - cognitive behavioural therapy including cognitive distortions
  - psychodynamic psychotherapy
- the socio/cultural contributing factors:
  - abuse
  - poverty
  - social isolation and social stressors as risk factors
- the use of family and social networks and recovery groups to manage socio/cultural factors
- the interaction between biological, psychological and socio-cultural factors which contribute to an understanding of the disorder and its management.

KEY TERMS – ADDICTIVE DISORDER: GAMBLING

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

addiction
cognitive behavioural therapy (CBT)
dopamine
gambling
norepinephrine
pathological gambler
problem gambler
psychodynamic psychotherapy
random ratio schedule
recreational gambler
reward
reward pathway
schedules of reinforcement
self-help groups
serotonin
social learning theory
socio/cultural factors
variable ratio schedule

KEY KNOWLEDGE

For assessment, you must able to show your understanding and apply your knowledge of:

- three levels that describe gambling behaviour
- biological contributing factors:
  - role of the dopamine reward system
- management of biological factors; including the role of antidepressants, mood stabilisers and drugs that block dopamine

- psychological contributing factors:
  - social learning theory
  - schedules of reinforcement
- the use of psychotherapies in treatment:
  - cognitive behavioural therapy
  - psychodynamic therapies
- sociocultural contributing factors:
  - social permission of gambling opportunities
- management of sociocultural factors:
  - social network
  - recovery groups
- the interaction between biological, psychological and socio/cultural factors that contribute to an understanding of the disorder and its management.

KEY TERMS – PSYCHOTIC DISORDER: SCHIZOPHRENIA

For the exam, you must know definitions for the following key terms and concepts and be able to relate them to an example where appropriate:

alogia
anhedonia
avolition
catatonia
delusions
disorganised behaviour
disorganised speech
disorganised symptoms
enlarged ventricles
hallucinations
inappropriate affect
negative symptoms
positive symptoms
psychosis
schizophrenia
social causation hypothesis
social drift hypothesis
tardive dyskinesia (TD)

KEY KNOWLEDGE

For assessment, you must be able to show your understanding and apply your knowledge of:

- the symptoms of schizophrenia, including different delusions and hallucinations
- the subtypes of schizophrenia
- biological contributing factors:
  - genetic predisposition
  - drug-induced onset
  - changes in brain activity; including the dopamine theory and enlarged ventricles
- management of schizophrenia through the use of medication that blocks dopamine
- psychological contributing factors:
  - impaired mechanisms for reasoning and memory
- the use of psychotherapies in management:
  - cognitive behavioural
  - remediation therapies
  - stress management
- sociocultural contributing factors:
- social disadvantage; including the social causation hypothesis and the social drift hypothesis
- psychosocial stress
- management of sociocultural factors:
  - psychoeducation,
  - social support networks and stress management techniques
  - removal of social stigma
- the interaction between biological, psychological and sociocultural factors which contribute to an understanding of the disorder and its management.

→ TEST YOUR UNDERSTANDING

ANXIETY DISORDER: SPECIFIC PHOBIA
MULTIPLE CHOICE

1 How many subcategories does specific phobia have?
   a 4
   b 2
   c 3
   d 5

2 Which of the following is *not* a subcategory of specific phobia?
   a natural environmental phobia (for example, fear of the dark)
   b animal phobia (for example, fear of rats)
   c social phobia (for example, fear of interacting with others)
   d situation phobia (for example, fear of flying)

3 When do most specific phobias first appear?
   a after developing social phobia
   b during early childhood
   c at any time, but particularly in early adulthood
   d at any time, but particularly during adolescence

4 Young Roger is terrified of dogs, particularly big black-and-white ones. What does he experience whenever he sees a dog?
   a the fight-or-flight or stress response
   b the flee-or-fight or amygdala reaction
   c the run-or-hide or stress response
   d the fight-or-flight or amygdala reaction

5 What type of role does the neurotransmitter GABA play in regulating anxiety?
   a excitatory
   b inhibitory
   c antagonistic
   d synaptic

6 Which of the following brain structures are involved in initiating and processing the fear response?
   a amygdala, hippocampus, thalamus
   b amygdala, hippocampus, pons
   c amygdala, thalamus, pons
   d hippocampus, adrenal gland, amygdala

7 GABA can be found in approximately ______________ per cent of all synapses.
   a 10
   b 30
   c 40
   d 25

8 The psychodynamic model proposes that specific phobia is due to:
   a biological and genetic factors that a person is born with.
   b unresolved conflicts that usually emerge during the Oedipal and Electra stages of development.
   c anger towards one's mother or father that is transferred to an object, situation or animal.
   d unresolved psychological trauma.

9 Which of the following statements relating to the behavioural model is correct?
   a Cognitive processes are the focus and can influence avoidance behaviours in people exhibiting specific phobia.
   b Environmental factors influence how a person develops a phobia and this usually involves classical conditioning.
   c Cognitive processes are downplayed with a greater focus on how behaviours are influenced by the person's environment.
   d Phobias are thought to develop through operant conditioning and are maintained with avoidance behaviours through classical conditioning.

10 Some therapeutic methods are more effective than others. CBT has been useful in treating specific phobia and incorporates the ____________ and ____________ approach.

- a cognitive; biological
- b cognitive; behavioural
- c cultural; biological
- d cultural; behavioural

11 Unlike the behavioural model, the cognitive model emphasises the importance of what on how we feel and behave?

- a thought processes
- b personality predispositions
- c psychodynamic factors
- d cultural and environmental elements

12 Which therapy involves a gradual exposure to the feared object, situation or animal?

- a flooding
- b cognitive behavioural modelling
- c rapid exposure
- d systematic desensitisation

13 What does the technique of flooding involve?

- a A person develops a hierarchy of their fear and learns relaxation techniques that they can use as they are gradually exposed to the feared stimulus.
- b A person is exposed to the feared stimulus immediately without sequential exposure over time.
- c A person is asked to think about their feared stimulus and to recognise that it is not as threatening or dangerous as they originally thought.
- d A person is placed into a flotation chamber and shown pictures of the feared stimulus until they no longer experience distress.

14 Specific phobia can also be influenced by environmental factors and learnt through:

- a cognitive learning
- b operant conditioning
- c classical conditioning
- d observational learning

15 The biopsychosocial approach to specific phobia takes the following into account:

- a genetic vulnerability, physiological and psychological processes, family history and environmental influences.
- b environmental influences, personality predisposition, socio/cultural factors and conflicts developed during childhood.
- c family history, social tendencies, symptoms, genetic vulnerability and physiological and psychological factors.
- d physiological and psychological processes, flooding, environmental influences, genetic predisposition and family influences.

SHORT ANSWER

16 Identify four typical physiological symptoms of specific phobia.

2 marks

17 Many people experience anxiety and fear towards objects, situations or animals. Explain at what point a fear is considered a specific phobia.

2 marks

18 Explain the relationship between anxiety disorders and phobic disorder according to the DSM.

2 marks

19 Name the four main types of specific phobia.

2 marks

20 Julia has a fear of hairdressers. Every time she needs a haircut, she experiences physiological symptoms related to anxiety. Name four possible symptoms.

2 marks

21 Outline one biological factor that can contribute to the development of a phobia.

1 mark

22 Explain how the neurotransmitter GABA can influence specific phobia.

2 marks

23 Outline the key difference between flooding and systematic desensitisation.

2 marks

24 Explain the role of classical and operant conditioning in specific phobia.

2 marks

25 'Today, therapists take a biopsychosocial approach to the treatment and management of phobia.' Explain what this statement means.

3 marks

MOOD DISORDER: MAJOR DEPRESSION

MULTIPLE CHOICE

1 Cognitive therapists believe that depression is caused by:
- a positive thoughts.
- b negative thoughts.
- c delusions.
- d egocentric behaviours.

2 Twin studies have found that:
- a fraternal twins have a higher chance of developing depression when one twin has it already.
- b twins have a higher chance of developing depression when the other has it.
- c adopted children have a higher chance of developing depression.
- d identical twins have a higher chance of developing depression when the other twin has it.

3 Depression is more common in:
- a children.
- b women than men.
- c parents.
- d the elderly.

4 Who was the theory of learned helplessness developed by?
- a Aaron Becks
- b Sigmund Freud
- c Martin Seligman
- d all of the above

5 John is seeing a cognitive therapist about his depression. He mentions to the therapist that he is going to fail his university course. What is the therapist likely to encourage John to do?
- a leave his course before he fails because he is a failure
- b change his negative thoughts into a positive rational response
- c get an MRI to determine what is wrong with him
- d seek psychoanalysis

6 Interpersonal psychotherapy (IPT) focuses on:
- a the person's current life and their interpersonal relationships.
- b the person's childhood and their interpersonal relationships then.
- c a person's distorted thoughts.
- d conflicts in families from the past.

7 The antidepressant drug type MAO inhibitors will:
- a prevent the reabsorbtion of serotonin by the postsynaptic neuron.
- b prevent the reabsorption of dopamine by the presynaptic neuron.
- c block the enzyme that breaks down serotonin and noradrenalin.
- d all of the above.

8 Sue has noticed that her daughter Meg has been withdrawn lately. Meg does not want to go to school and has stopped going to softball training. She complains of headaches and loss of concentration. She says this has been going on for four weeks. It is likely Meg is experiencing:
- a a bad mood.
- b mania.
- c bipolar disorder.
- d major depression.

9 Research has shown that __________ people are more likely to experience depression than __________ people.
- a happy; sad
- b divorced; married
- c single; divorced
- d widowed; divorced

10 Natasha, a Year 11 student, was struggling in her science subject and this was giving her feelings of depression. She was failing tests and not understanding the content. Natasha decided that she would give up on this subject, as there was nothing she could do about it, and focus on other subjects. What is this an example of?
   a interpersonal psychotherapy
   b learned helplessness
   c cognitive therapy
   d none of the above

SHORT ANSWER

11 List one emotional, physical and behavioural symptom of depression.

3 marks

12 Depressed people may have cognitive distortions. One of these is magnification. Provide an example of this cognitive distortion and a rational response to it.

2 marks

13 Stuart has been divorced recently. His doctor has advised him to join some recovery groups for depression. With reference to research, explain why his doctor gave him this advice.

3 marks

14 List one benefit and one side effect of antidepressants.

2 marks

ADDICTIVE DISORDER: GAMBLING
MULTIPLE CHOICE

1 What is the aim of cognitive behavioural therapy (CBT) in treating gambling?
   a to look at the current behaviours of people and find underlying reasons caused by the person's past
   b to alter the thoughts and beliefs associated with gambling as well as teach people how to cope with the urges and deal with emotions that may cause them to gamble
   c to observe the person gambling and produce some strategies to deal with the problem
   d to conduct 'talking therapy' with the person

2 Pathological gambling can be caused by abnormalities in neurotransmitters. What are the neurotransmitters affected?
   a glutamate, dopamine and serotonin
   b cortisol and glutamate
   c dopamine and cortisol
   d dopamine, serotonin and norepinephrine

3 Timothy is a pathological gambler and decided to get some help. Every week, he attends a group session at the Salvation Army. There, he meets other gamblers and they discuss their problems and provide support to each other. What is this group an example of?
   a psychological clinic
   b mediation
   c self-help group
   d CBT

4 Sue has a gambling problem. She tells her psychologist that gambling makes her feel good and when she wins she feels rewarded. Her psychologist may attribute these feelings to:
   a the social learning theory.
   b the dopamine reward system.
   c a permission to gamble.
   d none of the above.

5 The strength and persistence of a gambler's behaviour increases when the person is rewarded with a __________ schedule.
   a fixed ratio
   b variable ratio
   c variable interval
   d fixed interval

6 Moore and Ohtsuka's (1997) Australian studies on adolescents have found that:
   a family and friends accepted gambling behaviours among young adults.
   b family and friends often used self-help groups.
   c family and friends prevented gambling behaviour.
   d family and friends prevented gambling behaviour, but would often take young adults to gambling venues.

7 When Perri went to a therapist about his gambling behaviour, the therapist kept asking him questions about his past, including his childhood. The therapist was likely to be using:
- a CBT.
- b self-help group therapy.
- c behavioural therapy.
- d psychodynamic therapy.

8 Dr F. Reud discovered that Ahmed gambled because he had always seen his father gamble, he had irrational beliefs about gambling, and he recently had a big win that has reinforced his gambling behaviour. What is Ahmed's gambling behaviour caused by?
- a sociocultural factors
- b biological factors
- c psychological factors
- d the interaction of biological, psychological and sociocultural factors

9 Occasionally, when Feri goes out with her friends, she will have a go at the electronic betting games. She never spends more than $20 on these machines and always walks away and stops gambling when she has spent her $20. Feri may be considered to be a:
- a level 1 gambler.
- b level 2 gambler.
- c level 3 gambler.
- d pathological gambler.

10 In order to be diagnosed as a person with pathological gambling, they must:
- a present two symptoms from the 10 outlined in the DSM.
- b present all symptoms outlined in the DSM during the previous 12 months.
- c present at least five symptoms from the 10 outlined in the DSM, which must be present at some time the previous 12 months.
- d present two symptoms from the 10 outlined in the DSM, which must be present at some time the previous six months.

SHORT ANSWER

11 Explain the difference between a level 2 gambler and a level 3 gambler.

2 marks

12 After some brain imaging tests, a psychologist believes that her client may be a pathological gambler because of biological reasons. Provide two reasons why the psychologist should not prescribe medication to treat this.

2 marks

13 Explain one reason why it is difficult to stop or extinguish gambling behaviour.

1 mark

14 How does the social learning theory explain gambling behaviour?

1 mark

15 Jake is a pathological gambler. He has been going to gambling venues since he was a young boy. His parents would take him to the local pub for dinner, which had electronic gambling machines. Often his parents would take turns to gamble on the machines and they always returned happy, even if they lost money. He said they always enjoyed themselves. When Jake was 15 years old, his parents gave him lottery tickets for his birthday. He loved them and that is when he started gambling. He started to use his pocket money to purchase tickets. This behaviour worsened once he had a big win, as he believed another win was around the corner. Explain the factor/s that have contributed to his gambling problem.

3 marks

16 What is an addiction?

1 mark

PSYCHOTIC DISORDER: SCHIZOPHRENIA
MUTIPLE CHOICE

1 Stuart has recently been diagnosed with schizophrenia. His therapist has been spending the last few sessions educating him about the illness, its symptoms and its triggers. Stuart's family has also been given information about the condition and how they can support Stuart. What is this approach an example of?
   a the vulnerability theory
   b cognitive behavioural therapy
   c psycho/educational therapy
   d expressed emotion

2 Stuart has also recently had an MRI on his brain. Doctors found enlarged ventricles, which are:
   a blood vessels in the brain.
   b hollow spaces in the brain.
   c blood clots in the brain.
   d tumours.

3 The dopamine theory states that schizophrenia is caused by:
   a too much serotonin in the brain.
   b too much dopamine in the brain.
   c too little dopamine in the brain.
   d too little serotonin and glutamate in the brain.

4 Gianni has recently been diagnosed with schizophrenia. He suffers from complex delusions and mainly auditory hallucinations. What type of schizophrenia does he have?
   a catatonic
   b residual
   c disorganised
   d paranoid

5 What is a major side effect of long-term use of antipsychotic drugs?
   a blurred vision
   b tardive dyskinesia (TD)
   c depression
   d none of the above

6 Hallucinations and delusions are examples of __________ symptoms of schizophrenia.
   a disorganised
   b negative
   c positive
   d catatonic

7 Vanessa has schizophrenia and often experiences delusions. She was recently telling her therapist that her behaviours are controlled by the aliens from the mother-ship. What is this an example of?
   a a control delusion
   b a reference delusion
   c a grandeur delusion
   d a persecution delusion

8 Vanessa also experiences hallucinations where she believes that every time she does something wrong she gets an electric shock. What is this an example of?
   a olfactory hallucination
   b tactile hallucination
   c visual hallucination
   d auditory hallucination

9 Family stress can contribute to the onset of schizophrenia and those families who are high in expressed emotion may:
- a be civil towards each other.
- b feel pity for the person with schizophrenia.
- c criticise each other and show disapproval and hostility.
- d be overly sensitive about everything.

10 Studies on the use of marijuana and schizophrenia have found that:
- a marijuana causes schizophrenia.
- b marijuana improves schizophrenia
- c marijuana is a therapeutic alternative to antidepressants.
- d marijuana increases the risk of developing schizophrenia.

11 Stefan has schizophrenia. What does this mean for his siblings?
- a They have an increased risk of developing schizophrenia.
- b They have a decreased risk of developing schizophrenia.
- c They have no risk of developing schizophrenia.
- d They will have schizophrenia.

12 Stefan's therapist has asked him to complete some computer tests to improve his memory, language, problem-solving skills and attention. This is an example of:
- a cognitive behavioural therapy.
- b psychotherapy.
- c remediation therapy.
- d stress management.

SHORT ANSWER

13 Explain the difference between the social causation hypothesis and the social drift hypothesis.

2 marks

14 Sue's therapist has recognised that Sue comes from a family that is very hostile and critical. Explain the factors that may instigate Sue's schizophrenia symptoms and the best way to manage it.

3 marks

15 Zak is a schizophrenic patient who believes that the police are following his every move. This is an example of a __________ delusion. He is convinced that he can see them following him. This is an example of a __________ hallucination.

2 marks

16 Zak's therapist is trying to get him to question and test his delusional beliefs.
- a What type of therapy is Zak undertaking?
- b What are the benefits of this therapy?

2 marks

17 One schizophrenic symptom is __________, which is when the person does not gain any pleasure from normally enjoyable activities.

1 mark

RESEARCH METHODS AND ETHICS IN MENTAL HEALTH

KEY KNOWLEDGE

Research methodologies and ethical principles associated with the study of mental health, as outlined in Chapter 1.

(VCE Study Design 2013)

Evaluation of research

CASE STUDY 1

Most children are scared of the dark at some stage during their life. However, there are some who experience an extreme, irrational and persistent fear of the dark well into their teenage years.

Although phobia of the dark persists into adulthood, this experiment reflects the benefits of dealing with the fear early and in a creative way.

In this study, the sample consisted of 78 children – 41 boys and 37 girls aged 4–8 years (M = 6.49, SD = 1.46) who presented with darkness phobia that had persisted for over 2.5 years. Participants were randomly assigned to three conditions: bibliotherapy and games (BT), emotional (EP) and no treatment group (control).

Parents underwent a training program that they implemented at home over five weeks for 20 minutes on three consecutive days per week. Night time fear level was assessed daily by the parent. Follow-up with the BT group was carried out by phone three and six months after treatment and with all groups 12 months after treatment.

The BT group had two main components: a 12-chapter treatment book where the hero is a coping model, and nine games that linked to each of the 12 chapters and were designed to overcome night time fear. The book and the games consisted of imaginary and actual exposure to the dark.

The treatment for the EP group consisted of gradual exposure to the dark. The treatment was developed as a game ('Olympiad of the Braves') guiding the child through words, demonstration and modelling. The child chose a character who transmitted bravery and security. While lying on the bed in this character, the child was gradually exposed to a range of darkness conditions by the parent.

The children in the BT and EP groups achieved significant improvement in their darkness phobia compared with the control group. Both the BT and EP groups used a variation of systematic desensitisation with success.

Reference: Santacruz, I., Méndez, F., & Sánchez-Meca, J. (2006). 'Play therapy applied by parents for children with darkness phobia: comparison of two programmes'. *Child & Family Behavior Therapy*, 28(1), 19–35. doi:10.1300/J019v28n01_02

Questions

1 What was the aim of this experiment?
2 Write a research hypothesis for this study.
3 List the details of the participants (number and any other important details).
4 What was the experimental design use?
5 Outline one limitation and one advantage of using this experimental design.
6 Were the participants randomly allocated into the groups? Why/why not?

7 Why might the experimental conditions in this study be more effective with children aged 4–8 years? Explain.
8 Based on your understanding of how most phobias are treated, devise an alternative treatment for young children. Would this differ if it were for adolescents or adults? Explain how.
9 What can be concluded from this study?
10 Outline two ethical considerations that would have been addressed in this study.

CASE STUDY 2

With the advent of the Internet, children and adolescents have access to a range of unsuitable websites such as those that promote gambling. These sites are addictive and can have a negative effect on young people's lives and finances.

This study examined the relationship between problem gambling and psychological and social problems in Australian adolescents. The sample consisted of 926 adolescents (mean age 14.46 years) from the Australian Capital Territory. Participants were given a series of measures relating to gambling and psychological and social adjustment. Subjects were asked to indicate how often they gambled, to report any difficulties that they might have been experiencing with gambling and to complete a variety of measures of psychosocial health.

Results supported previous international studies. Adolescents classified as problem gamblers were found to have poorer scores on all psychosocial measures. Although many in the problem gambling group reported being part of a socially active peer group, they also reported being more alienated and unpopular among their classmates.

It was concluded that problem gambling appears to be a significant risk factor for poorer mental health among Australian adolescents. Given previous research on adults indicating a link between early gambling and long-term gambling problems and poorer life outcomes (e.g. Abbott, McKenna and Giles, 2000), these findings suggest a need to enhance existing educational initiatives and services specifically designed to assist adolescents with gambling problems.

Reference: Delfabbro, P., Lahn, J., & Grabosky, P. (2006). 'Psychosocial correlates of problem gambling in Australian students'. *Australian & New Zealand Journal of Psychiatry*, 40(6/7), 587–595. doi:10.1111/j.1440-1614.2006.01843.x.

Questions

1 What was the aim of this experiment?
2 Write a research hypothesis for this study.
3 List the details of the participants (number and any other important details).
4 Addictive disorders such as gambling can have a devastating effect on individuals and their families. What are the implications of this study in the treatment of gambling addiction?
5 What can be concluded from this study?
6 Outline two ethical considerations that would have been addressed in this study.
7 How has the Internet influenced gambling addiction?
8 Explain these results in terms of the biological perspective of addictive disorder.

ASSESSMENT ACTIVITIES

OUTCOME 2

On completion of this unit the student should be able to differentiate between mental health and mental illness, and use a biopsychosocial framework to explain the causes and management of stress and a selected mental disorder. (VCE Study Design 2013)

In Unit 4 Area of Study 2, students are required to study one of the following mental disorders: specific phobia, major depression, gambling or schizophrenia. Outcome 2 requires the completion of two assessment activities worth 25 marks each. Students must complete one task from a report, visual presentation, oral presentation or media response AND one task from evaluation of research, data analysis, essay, media response, report of a student investigation, oral presentation using two or more data types or a test. The overall allocation of marks is 50.

Report

Use the biopsychosocial framework to explain the causes and management of one of the following mental disorders: specific phobia, major depression, gambling or schizophrenia. The report must incorporate biological, psychological and social factors, and consider the different approaches and methods used for treatment of the chosen disorder (1000 words).

Visual presentation

Select one of the following topics and present your findings on a concept map, graphic organiser or poster. Ensure that a biopsychosocial framework is used to explain the causes and management of the chosen mental disorder.

- You have a senior role in a school where you are required to work long hours and deal with difficult students and demanding parents. In addition, you have an elderly parent who you are caring for at home who does not speak English. Recently, your doctor has advised you to cut back your hours. Using the biopsychosocial framework, clearly outline the physiological, psychological and sociocultural factors that are involved in your experience of stress. Provide a detailed description of the physiological and psychological symptoms that prompted you to see the doctor originally.
- Choose an unusual specific phobia and explain how it might have developed using both the biological and cognitive models. Name and explain one treatment option for each model and outline the steps involved in using each treatment method. Also consider the acquisition and treatment of the specific phobia from a biopsychosocial framework.
- Several factors have been identified that contribute to the development of a mood disorder such as major depression. Within a biopsychosocial framework, outline the psychological factors involved and compare the effectiveness of using cognitive behavioural therapy and/or psychodynamic psychotherapy.
- Pretend that you have an addictive disorder such as gambling. Using a biopsychosocial framework, highlight the biological, psychological and social factors involved in the development and maintenance of the gambling disorder and suggest how the disorder might be managed therapeutically.

- Many of Melbourne's homeless suffer from a psychotic disorder such as schizophrenia. Discuss the biological and psychological factors involved. Outline the different forms of treatment available and how socio/cultural circumstances or pressures can hinder or assist in the management of the disorder.

Oral presentation

Use the biopsychosocial framework to develop the following topics.

- Create an advertising campaign, aimed at teenagers, that promotes mental health and 'busts' the myths that surround mental disorders.
- Create an advertising campaign that highlights the issue of either stress or gambling. You could consider one of the following topics:
  - stress and its effects on physical and mental health
  - a specific phobia of your choice and how it links to anxiety disorder
  - mood disorder and how it is managed
  - addictive disorder–gambling.
  - psychotic disorder–schizophrenia.

Media response

Research a media clip that relates to stress or a selected mental disorder and answer the following questions.

1 Give a brief description of the media clip.
2 Which topics of mental health are covered in the media clip?
3 Which theories, issues and studies are related to the media clip?
4 Do you think the media clip portrays the mental health topic accurately? Explain with reference to the relevant knowledge and understanding.
5 Do you think the media clip may contribute to any misconceptions or negative stereotypes within our society? Explain your answer.
6 How has this media clip contributed/not contributed to your knowledge and understanding of this area of study?

OR

Read the article on the following page from the World Health Organization (WHO) and use the questions above.

FIGHTING STIGMA: A KEY TO INCREASING ACCESS TO TREATMENT

World Health Organisation

Depression is a common illness and people suffering from depression need support and treatment. WHO marks 21st Anniversary of World Mental Health Day on 9 October 2013.

Globally, more than 350 million people have depression, a mental disorder that prevents people from functioning well. But because of the stigma that is often still attached to depression, many fail to acknowledge that they are ill and do not seek treatment.

Depression is different from usual mood fluctuations. Depression induces a sustained feeling of sadness for two weeks or more and interferes with the ability to function at work, school or home. Effective treatments include psychosocial treatment and medication. The active involvement of depressed people and those who are close to them in addressing depression is key. The first step is to recognize the depression and reach out for support. The earlier the treatment begins, the more effective it is.

"We have some highly effective treatments for depression. Unfortunately, fewer than half of the people who have depression receive the care they need. In fact in many countries this is less than 10%," says Dr Shekhar Saxena, Director of the Department for Mental Health and Substance Abuse. "This is why WHO is supporting countries in fighting stigma as a key activity to increasing access to treatment."

Cultural attitudes and lack of proper understanding of the condition contribute to a reluctance to seek help for depression.

Depression common in all regions

WHO estimates suggest that depression is common in all regions of the world. A recent study supported by WHO revealed that around 5% of people in the community had depression during the last year.

Depression results from a complex interaction of social, psychological and biological factors. There is a relationship between depression and physical health, for example cardiovascular disease can lead to depression and vice versa. Up to one in five women who give birth experience post-partum depression.

In addition, circumstances such as economic pressures, unemployment, disasters, and conflict can also increase the risk of the disorder. At its worst, depression can lead to suicide. Tragically almost one million people commit suicide every year and a large proportion of them had experienced depression.

WHO response

WHO assists governments in including treatment of depression in their basic health care packages. Through WHO's Mental Health Gap Action Programme (mhGAP), health workers in low-income countries are trained to recognize mental disorders and provide proper care, psychosocial assistance and medication to people with depression.

World Mental Health Day was initiated by the World Federation for Mental Health in 1992. The day is used by many countries and organizations to raise public awareness about mental health issues and to promote open discussion of mental disorders, and investments in prevention, promotion and treatment services.

Evaluation of research

Follow one of the links and answer the questions using your textbook and the information in the articles:

Stress:

Stress Management and Treatment

Search for the 'Brain Therapy Centre' website, follow the link 'Stress' and access the article 'Stress Management and Treatment' by Harold L. Burke.

Specific phobia: Phobias and fears

Symptoms, Treatment, and Self-Help for Phobias and Fears

Search for the 'Helpguide' website, follow the 'Anxiety' link and access the article 'Phobias & Fears' by Melinda Smith *et al*.

Mood disorder – Major depression:

Monitoring awareness of and attitudes to depression in Australia

Access the article 'Monitoring awareness of any attitudes to depression in Australia' by Nicole J. Highet *et al*. in the *Medical Journal of Australia*; 2002; 176(10); page 63.

Gambling:

Types of Psychotherapy for Pathological Gamblers

Access the article 'Types of Psychotherapy for Pathological Gamblers' by Timothy W. Fong in *Psychiatry* (Edgmont); 2005 May; 2(5); pages 32-39.

Schizophrenia:

Atypical antipsychotics in the treatment of schizophrenia: systematic overview and meta-regression analysis

Access the article 'Atypical antipsychotics in the treatment of schizophrenia: systematic overview and meta-regression analysis' by John Geddes *et al* in the *British Medical Journal*; 2000 December 2nd; 321 (7273); pages 1371-1376.

Use the following questions to guide your analysis of the articles.

1 At what stage is the mental disorder diagnosed?
2 Explain the biological basis of the mental disorder and how it is maintained.
3 Outline the different treatment options discussed in the article and the authors' assessment of effectiveness.
4 Based on the findings, which treatment option(s) are/were more effective in treating the disorder?
5 Discuss the overall key findings of the article.
6 Does the article provide a balanced point of view about the disorder?

Data analysis

The following questions refer to Table 1.

1 Calculate the mean stress score for:
  a all participants
  b males
  c females
  d participants aged 20–30 years.
2 Compare the mean stress scores for males and females. Is there a difference?
3 Based on your understanding of stress, is the mean difference between males and females consistent with past research? Explain.
4 Draw a line graph of total scores.
5 Draw a line graph showing the difference in scores between males and females.
6 What can be concluded from these results?

TABLE 1 Participant stress scores based on age and gender

PARTICIPANT	AGE	GENDER	STRESS SCORE /100	PARTICIPANT	AGE	GENDER	STRESS SCORE/100
1	20	F	75.5	11	33	F	84.5
2	33	F	43.2	12	31	M	36.3
3	26	F	22.5	13	35	M	25.7
4	22	M	47.7	14	20	M	34.6
5	21	M	33.5	15	27	F	31.4
6	35	M	55.6	16	29	M	45.0
7	21	M	46.4	17	24	F	67.6
8	25	F	70.0	18	29	F	57.3
9	28	M	34.0	19	30	F	33.4
10	25	F	60.6	20	24	M	34.5

Essay

Select from one of the following essay topics:

→ Discuss the concept of 'normality' and outline the methods and criteria used in distinguishing mental health from mental illness.

→ Outline the benefits of using a biopsychosocial approach to understanding and treating mental health issues. Choose one of the mental disorders in this chapter to illustrate your understanding.

→ Critically evaluate how abuse, poverty, social isolation and social stressors pose a greater risk to those who suffer from mental illness.

Report of student investigation

In this research investigation, you will conduct your own experiment on stress using the questionnaire provided on page 610. Essentially, you will be obtaining a snap shot of how 'stressed' your parents, friends and fellow students are when they complete the questionnaire.

You may work with a partner or within a small group.

As with any experiment, you must ensure that ethical guidelines are followed. Your teacher will guide you with regard to obtaining 'informed consent' from participants and to ensure that all who take part in the study are aware of their rights. Refer to Chapter 1 for more detailed information on this.

You will need 5–10 participants for each group so that scores can be collated as a class. Try to work towards a minimum of 30 participants for the whole class.

Photocopy, scan or retype the questionnaire on the following page. Make sure you include the instructions to participants that may be at the top of the questionnaire.

NOTE: You may advise participants that a score above 150 indicates that they may be stressed. If this questionnaire causes any discomfort or distress, participants should be given an option to speak with the school psychologist or for you to provide an appropriate contact. This must be determined prior to undertaking the experiment with your teacher.

After all data is collated (class data), present your findings in a table and graph. Examine gender differences with a comparative graph.

Formally write up this research investigation, following the assessment criteria outlined on page 612.

1 What was the aim of your experiment?
2 What was the research hypothesis?
3 What were the operational independent and dependent variables?
4 How were participants selected? Outline one advantage of using this selection method and one limitation.
5 Why is the use of standardised instructions important?
6 What were your results?
7 What conclusion(s) can you draw from this study?

Stress Questionnaire

Age:________________ Gender ________________

Read through all of the life events below. Each has a score out of 100. Put a ring around the score for each one that has happened to you in the last 12 months. When you've thought about them all add up your scores and write your total at the bottom.

1	Death of parent, boyfriend/girlfriend	100
2	Parental divorce	65
3	Going through puberty	65
4	Pregnancy (or causing pregnancy)	65
5	Break up with boyfriend/girlfriend	60
6	Being on court probation	60
7	Death of other family member (other than parent or boyfriend/girlfriend)	60
8	Having a serious injury or illness	45
9	Beginning a new year at school	45
10	Given more responsibility or independence (e.g. mobile phone)	45
11	Developing a need for alcohol	45
12	Being expelled/excluded	45
13	Getting back together with boyfriend/girlfriend or family	40
14	Trouble at school	40
15	Serious health problem of a family member	35
16	Having a part-time job	35
17	Working more than 40 hours a week	35
18	Changing course of study	35
19	Confused sexual identity	35
20	Gain of new family member	35
21	Death of a close friend	30
22	Arguing more with family or friends	30
23	Sleeping less than eight hours a day	25
24	Trouble with boyfriend's or girlfriend's family	25
25	Outstanding personal achievement (awards, grades etc.)	25
26	Parents start or stop working	20
27	Begin or end school	20
28	Change in living conditions (redecorating, making space for visitors, etc.)	20
29	Starting or stopping a habit (like dieting, smoking, etc.)	20
30	Trouble with the head teacher	20
31	Moving house	25
32	Moving schools	10
33	Getting in debt (you or your family)	10
	TOTAL SCORE	

FIGURE 1 Stress questionnaire

Oral presentation using two or more data types

Select **one** of the following topics for your presentation. You will be required to use information technology to organise and communicate data.

You will need to research the statement and give a detailed explanation of the topic, and support your position with research data that is presented correctly (such as graphs, tables, pie charts, averages, percentages).

1 Chronic stress can affect many areas of your life.
2 Medicine is the best method of managing mental disorders.
3 Gambling venues should be banned.
4 Depression is more common than people realise.
5 Schizophrenia can be inherited or acquired.

Test

The following topics may be answered in essay or dot-point form.

→ Explain the role of hormones and/or neurotransmitters in mental disorders (depending on which disorder was studied).

OR

→ Outline how environmental factors can hinder and assist in the management of mental disorders.

OR

→ Discuss the importance of family, social and professional support in the effective management of mental disorders.

ASSESSMENT RUBRIC

CRITERION	0 TO 1
1 Psychological knowledge and understanding The work demonstrates an accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices.	Limited knowledge and correct use of psychological terminology, concepts and practices.
2 Evidence-based arguments Employs higher order thinking (analysis, synthesis, evaluation and application) to complete task. Constructs evidence-based arguments that draw on psychological research findings and theoretical models to justify the student's explanations, evaluations and applications.	Limited display of higher order thinking and/or incorrect or inappropriate application of psychological knowledge to draw relevant conclusions.
3 Location and use of psychological information Locates and draws on a range of appropriate and legitimate (valid and reliable) psychological sources to complete the assessment task.	Limited or inappropriate use of legitimate psychology sources of information have been draw upon to complete this task.
4 Strategies to complete the task Displays initiative, independence, critical reflection and cooperation while completing the task. Develops monitors and executes effective strategies to successfully complete the task.	Little or ineffective planning and monitoring of appropriate strategies to complete the task.
5 Communicating Communicate psychological ideas and information in a concise, focussed and logical manner to meet the demands of the assessment task.	Assignment lacks logical structure and/or relevant psychological information to communicate ideas.
6 Referencing Cite and reference sources of information within body of text and reference list according to APA format (if relevant).	Sources of information are inaccurately referenced or not shown.

* Teachers must indicate to their students which aspects of each criterion are applicable to the relevant assessment task that has been set for their class.

2 TO 3	4 TO 5	6 TO 7
Correct use of psychological terminology appropriate to the assessment task.	Correct and appropriate use and understanding of the psychological terms, concepts and practices in a manner that directly relates to meeting the demands of the assessment task.	Accurate and detailed knowledge and deep understanding of the psychological terms, concepts and practices to clearly meet the demands of the assessment task.
Demonstrates understanding of the task and summarises information to state conclusion. Relies on source material rather than transform psychological information to demonstrate higher order thinking.	Able to differentiate the key elements of the task and psychological understandings and draw logical conclusions. Uses evidence-based arguments to support student's point of view.	Able to analyse and evaluate psychological information to draw insightful, appropriate and meaningful conclusions. Constructs evidence-based arguments to explain, analyse and justify the student's point of view including explanations, evaluations and applications
Legitimate psychological sources have been located and used to address the requirements of the task.	A comprehensive range of relevant and legitimate psychological sources have been located and used effectively to address the requirements of the task.	
Development of strategies to complete the task.	Develops monitors and executes strategies to successfully complete the task. Displays initiative, independence, critical reflection and cooperation while completing the task.	Displays initiative, independence, critical reflection and cooperation throughout the process of completing the task. Develops, monitors and executes effective and efficient strategies to successfully complete the task.
Logical structure is used to communicate psychological ideas in an appropriate manner suitable for the intended audience.	Focussed and logical structure is used to communicate psychological ideas and information in a clear and concise manner suitable for the intended audience.	
Sources of information are correctly referenced and cited using APA format.		

→ GLOSSARY

A-B-C of operant conditioning (also see D-B-C)
Antecedent condition – Behaviour – Consequence.

abnormal
used to describe data that lie outside the normal range for the population; statistically the 2% at the extreme top and extreme bottom of the distribution.

acetylcholine
neurotransmitter present in both central and peripheral nervous systems

acquiescent response set
the tendency to either answer 'yes' or provide the same response to all questions in an interview or questionnaire.

acronym
a mnemonic device in which a pronounceable syllable, word or words is made from the initial letters of the words in the sequence to be remembered.

acrostic
a mnemonic device in which a sentence is created where the initial letter of each word is the same as the initial letters of the words in the sequence to be remembered.

adaptive and evolutionary (survival) theory of sleep
a theory stating that sleep serves as a means to increase an animal or human's chance of survival in its environment. It allows us to adapt to our environment and the amount needed depends on how much food we need, how available it is (we may need to conserve energy) and how safe it is when we sleep. These sleep requirements have evolved over time in order for the species to hunt food, hide and conserve energy.

adaptive plasticity
the ability of the brain to change, adapt and grow throughout life (but does diminish with age).

adaptive theory
survival theory of sleep, where the amounts of sleep change to meet the demands of environment

addiction
an activity that people are completely absorbed in and pursue it regardless of any of the negative consequences.

addictive disorder
a disorder whereby people are completely absorbed in and pursue an activity regardless of any negative consequences, e.g. gambling.

adolescence
a lifespan stage, between childhood and adulthood (approximately 12–20 years of age) including the teenage years.

adaptation
inherited characteristic which is increased in a species through natural selection because it helped the species survive in its environment

adaptive and evolutionary (survival) theory of sleep
sleep serves as a means to increase an animal's chances of survival in its environment – it allows us to adapt to our environment and depends on how much food we need, how available it is (we may need to conserve energy) and how safe it is when we sleep. These sleep requirements have evolved over time in order for the species to hunt food, hide and conserve energy.

adrenaline
neurotransmitter

age-related memory decline
memory loss associated with getting older but with no health issues or brain damage.

aggression
acts and feelings involving hostility.

agnosia
severe deficit in ability to perceive sensory information

agoraphobia
fear of leaving a familiar place such as home; literally 'fear of open spaces'.

agrammatism
verbal communication that lacks grammar (syntax) – see also Wernicke's aphasia.

akinetopsia
inability to perceive motion.

alarm
the first stage of Selye's General Adaptation Syndrome (GAS) where the fight-or-flight response is activated to prepare the person to deal with the challenge or stressor. This stage has two components: shock followed by countershock.

alcohol
a psychoactive drug of tolerance. It is a depressant – it slows down the nervous system and causes an altered state of consciousness.

alcohol-induced state of consciousness
an altered state of consciousness due to the consumption of alcohol, a depressant drug.

alcohol myopia
known as shortsightedness: thinking that relates to situations where a person in an alcohol-induced state loses the ability to pay attention to as much information as when they are sober. The loss of the ability to weigh up the advantages and disadvantages with carrying out a behaviour.

alcohol
a psychoactive drug of tolerance. It is a depressant; it slows down the nervous system and causes an altered state of consciousness.

Allostasis
"where the body maintains stability or homeostasis through change" (Sterling & Eyer, 1988). When a person interprets an event as being stressful; several internal physiological and behavioural processes are activated so that adaptation to the stressor or allostasis can be achieved.

allostatic load
refers to the cumulative effects of our body trying to re-establish allostasis in response to frequent and intense stressors.

allostatic overload
when the demands of the stressor exceed the body's ability to repeatedly adapt, the person is no longer able to meet the demands.

alogia
when the person experiences a reduction in speech or content of speech, so they say very little and can be vague or repetitive.

alpha waves
the typical brainwave pattern (reasonably high frequency (but not as high as beta waves) and low amplitude (but slightly higher than beta waves)) that occurs when awake but very relaxed

altered states of consciousness
any state of consciousness that deviates from normal waking consciousness, in terms of marked differences in level of awareness, perceptions, memories, thinking, emotions, behaviours and one's sense of time, place and self-control. It can be deliberately induced or occur naturally.

alternate-forms reliability
correlation between scores for two versions of the same sort of test.

Alzheimer's disease
a disease which progressively destroys neurons in the brain, causing memory loss.

amnesia
memory loss.

amplitude
in terms of brain waves, the height of the peaks and troughs of the curved graph that represents brain wave activity.

amygdala
an almond-shaped structure, located in the medial temporal lobe of the brain that is central in emotion, aggression and in implicit learning. It is vital in initiating and processing emotional responses and in forming emotional memories.

amyloid plaques
a protein that forms among axon terminals and interferes with communication between neurons in patients with Alzheimer's disease.

anhedonia
occurs when the person does not gain any pleasure from normally enjoyable activities.

anomia
partial or complete loss of the ability to recall names.

anosodiaphoria
a condition in which the person knows that they suffer from a serious condition (usually as a result of brain damage) but is not concerned about it.

anosognosia
a condition in which the person is blissfully unaware that they suffer from a serious condition (usually as a result of brain damage)

anterograde amnesia
inability to encode and store new memories.

antidepressant drugs
medications used to treat major depressive disorder (tricyclics, MAOIs, SSRIs & SNRIs).

antisocial behaviour
behaviour that is harmful to others and, ultimately, to the community, for example prejudice or aggression.

anxiety disorder
dysfunctional feelings of extreme apprehension, fear, stress and uneasiness; characterised in Axis I in the DSM-IV-TR by feelings of extreme apprehension, fear, stress and uneasiness. There are five main types of anxiety disorders: generalised anxiety disorder, phobic disorder, panic disorder, obsessive-compulsive disorder and posttraumatic stress disorder.

aphasia
the impairment of language caused by damage to the brain (usually stroke).

aplysia
sea hare; used by Eric Kandel and colleagues in studies of memory and learning.

artificial environment
a place that is unfamiliar and contrived

artificiality
a confounding variable that arises because experiments are performed in laboratories where the conditions do not replicate the real world. This makes external validity a problem.

association
a learned connection between two (or more) objects or events – especially significant in classical conditioning.

association areas
regions of the cerebral lobes that are not part of the sensory (visual, auditory, somatosensory) or motor cortices. The association areas make up 75% of the cortex and integrates the information between the motor and sensory areas and higher-order mental processing.

Atkinson and Shiffrin's multi-store model of memory
a model of memory which suggests that memory is comprised of three memory stores: a sensory store, a short-term memory store and a long-term memory store.

attention
relates to the information that you are actively processing, either consciously or outside our conscious awareness. Attention can be focussed on events that are taking place in the environment (external) or inside our minds (internal) and shift consciously or unconsciously.

attention deficit hyperactivity disorder (ADHD)
a condition characterised by difficulties with paying attention, impulsivity and over-activity .

audience
in persuasive communication it is the intended target of persuasion.

automatic processes
processes that require very little awareness or mental effort to be performed well and generally don't interfere with other automatic or controlled processes. Automatic processes require little attention and can allow you to do two things at once.

automatic processing
processing that requires very little awareness or mental effort to be performed – the function does not interfere with other automatic or controlled processes.

autonomic arousal
the response of the autonomic nervous system generally operating below the level of conscious awareness, and responsible for the fight-or-flight response.

autonomic nervous system
consisting of the parasympathetic and sympathetic branches) and responsible for the communication between the body's nonskeletal (visceral) muscles and the internal organs; glands that carry out bodily function.

aversion therapy
a form of treatment using classical conditioning to cause an undesired behaviour to create an unwanted response, thereby reducing the incidence of the behaviour.

avolition
occurs when a person lacks energy or is uninterested in their personal grooming, hygiene, work, school or other activities.

awareness
how conscious (aware) you are of internal and/or external event(s). Your level of awareness can varies in normal waking consciousness.

axon
the part of a neuron along which the electrochemical nerve-impulse is transmitted.

Babinski reflex
an inborn reflex in which the baby foot twists in and toes fan out when the sole of the foot is stroked from toe to heel.

Baddeley and Hitch's model of working memory
suggests that working memory is made up of the functional components of central executive and episodic buffer and the storage components of visuospatial sketchpad and phonological loop.

basal ganglia
located in the frontal lobes, they are involved in motor activity by integrating and smoothing movements using information from primary and secondary motor areas and the somatosensory cortex; also involved in learning skills.

behaviour modification
an application of operant conditioning to change a person's behaviour.

beta waves
typical brainwave pattern (high frequency (fast) and low amplitude (small)) during normal waking consciousness, associated with being alert, active, anxious and paying (selective) attention.

bimodal distribution
a distribution where two distinct populations are plotted on the same curve.

biofeedback
a scientifically based treatment that uses sensitive instruments to monitor and provide feedback/information about a person's heart rate, respiration rate, brainwaves, skin temperature, moisture on the skin and muscle tone in 'real-time' (i.e. as they happen). A person may use this information to consciously alter their readings whilst using relaxation techniques.

biological approach
an approach in psychology that explains a person's functioning in term of bodily structures, biochemical processes and genetics. Also known as biopsychology.

biological rhythms
the cyclical pattern of the body's physiological measurements over time.

biopsychosocial approach
taking a holistic approach to treating simple phobias including biological, psychological and sociocultural factors that contribute to causes and treatment of psychological disorders.

bipolar disorder
the occurrence of one or more hypomanic episodes, alternating with major depressive episodes and possibly periods of normal mood.

blinking reflex
an inborn reflex in which the baby closes both eyes to a puff of air or flash of lights.

Bobo doll
a large inflatable plastic doll named 'Bobo', approximately 1.5 metres, designed to spring back upright when knocked over, used by Albert Bandura in his research on social learning.

body
the physical being, including the brain; these entities (parts) can be physically measured in terms of size, weight, shape, density, occupy space and exist in time.

brain
organ of the body which controls thoughts , emotions, and motivations, and also motor responses

brain stem
part of the brain that connects the brain to the spinal cord

brain trauma
any form of organic (physical or chemical) damage to the brain.

brainwave activity
the electrical activity of the brain as detected, amplified and recorded by a electroencephalograph (EEG).

Broca's aphasia
a result from damage to Broca's area (located in left frontal lobe) and often surrounding areas that leads to difficultly in expressing messages in words or sentences but the ability to comprehend speech is largely unaffected. Typically, little speech is produced and what is produced tends to be slow, generated with considerable effort and poorly articulated.

Broca's area
the speech production centre of the brain.

capacity of memory
amount of information which is stored in either sensory, short-term, or long-term memory

case study
also known as 'single subject' research. An in-depth investigation of a single participant.

cataplexy
see muscle atonia.

categorical diagnosis
identification of a mental disorder in which the disorder is labelled; this is prone to lead to stereotyping

central executive
the functional component of working memory that is responsible for switching attention from task to task, deciding what material is to be retrieved from, or committed to long-term memory and for performing calculations and making linkages.

central nervous system (CNS)
comprises the brain and spinal cord.

cerebral cortex
outer layer of brain. Location of higher mental processes and complex behaviours.

cerebral hemispheres
large, wrinkled structures of the brain that are covered by the cortex

challenge
an assessment of that there is opportunity for personal growth or something might have a positive outcome.

change blindness
the failure to notice a large change (or changes) that occurs in full view in a visual scene. Usually occurs when the change occurs simultaneously with some kind of brief disruption in vision.

chronic sleep deprivation
not getting enough sleep over an extended period of time, long term sleep deprivation

chunking
the process of grouping items together to improve memory capacity – especially of short-term memory, and of committing to long-term memory.

circadian rhythm
biological rhythms that occur approximately once every 24 hours, for example the sleep-wake cycle and body temperature.

circuit formation
axons of new neurons growing out to target cells and form synapses with them.

circuit pruning
the elimination of excess neurons and synapses.

classical conditioning
reflexive response elicited by previously neutral stimulus through repeated association.

cognition
a broad term that relates to mental activities such as thinking, problem solving, language, reasoning and so forth. It entails our knowledge, beliefs, thoughts and ideas that we have about ourselves and our environment.

cognitive appraisal
the process through which people evaluate the meaning of a specific event with regards to its personal significance.

cognitive behavioural therapy (CBT)
therapy aiming to alter thoughts and behaviours associated with certain practices (for example gambling), and teach strategies for coping with the urges to practise destructive behaviours.

cognitive processes
the mental processes involved in acquiring, retaining and using knowledge. A major aspect of our cognitions involves attention, perception, memory, language and learning and linked with our conscious experience.

cognitive remediation therapy (CRT)
therapy focusing on improving schizophrenic patients' working memory, language abilities, problem-solving skills and attention.

commisurotomy
split-brain surgery

conclusion
in research refers to a statement of acceptance or rejection of the hypothesis tested.

confidentiality
participants in research must not be identified in terms of test results, study involvement or confidential data.

confounding variable
a variable other than the independent variable that has a systematic effect on the value of the dependent variable (it acts like a second, unwanted, independent variable).

consciousness
our awareness of your own thoughts, feelings and perceptions (internal events) and our surroundings (external stimuli) at any given moment.

consolidation
process in which the brain forms a permanent representation of memory

context-dependent cue
a clue to assist retrieval from long-term memory, due to the external environment in which learning took place.

continuous reinforcement
a schedule of reinforcement in which every response is reinforced.

continuum of awareness
the levels of awareness that can be experienced, from deep unconsciousness to heightened awareness, on a continuous scale including normal waking states and altered states of consciousness. It is presented on a continuous scale.

control group
the group in research which is not presented with the independent variable. The control group is used as a basis for comparison with the experimental group.

controlled processes
processes that require mental effort to focus attention on the required task. You are unable to complete another controlled process at the same time as they both require your full attention and therefore will interfere with each other.

corpus callosum
the thick band of about 200 million nerve fibres connecting the right and left hemispheres.

cortisol
hormone released by the adrenal glands

counterbalancing
the process in a repeated measures design designed to eliminate order-effects. Conditions A, B and C would be presented in a different sequence to different groups of participants.

critical period
narrow period of time in an animal's development when it must have a certain experience to ensure specific learning.

cue- dependent forgetting
see retrieval failure theory.

cued recall
recall assisted by clues, not involving the original items to be retrieved, e.g. being given an individual's initials to assist recall of their name.

daydreams
our private thoughts, feelings and imagined scenarios that occur when we shift our attention to internally while ignoring the external world. Daydreams tend to be visualised thoughts that are usually positive and pleasurable. They occur naturally and often and mostly considered an altered state of consciousness.

decay theory (memory)
the theory that memory traces (biological changes) will weaken and disappear if not revisited (LTM). This also applies to sensory memory – decay occurs rapidly and STM if maintenance rehearsal does not occur.

declarative memory
a long-term memory store of personal experiences (episodic) and facts (semantic)

deep sleep
collectively stage 3 and stage 4 NREM sleep

delta waves
the typical brainwave pattern (a steady pattern of low frequency (slow) and high amplitude (large)) associated with NREM deep sleep.

delusions
persistent, false beliefs that are illogical or lack evidence to support them.

dementia
a neurological disorder affecting higher mental functions, and may be caused by disease or brain damage.

dendrite
the tree-like element of a neuron that receives information from other neurons.

dependent variable
the variable that is measured by the researcher to discover the effects of the independent variable.

depression
low, sad emotion, leading to feelings of misery and overwhelming problems.

descriptive statistics
describe the shape of the curve that graphs the distribution of data.

developmental plasticity
the ability of synapses to be modified as an infant or child.

dimensional diagnosis
identification of a mental disorder in which the disorder is described (especially in terms of severity); this is considered to reduce labelling and stereotyping

discriminative stimulus
in operant conditioning, Skinner's term for the pre-condition that indicates that a behaviour will be reinforced (D-B-C).

disease
a condition with a known cause, predictable course and standard protocols for treatment

disorder
a set of symptoms that interfere with daily functioning. Symptoms are reasonably consistent among patients but origins/causes may differ.

disorganised behaviour
the inability to organise behaviour or perform everyday routine tasks.

disorganised speech
the inability to organise ideas and speech in a meaningful way.

disorganised symptoms
category of symptoms associated with schizophrenia. Includes disorganised speech and behaviours.

distress
refers to a negative psychological response to a perceived stressor.

divided attention
refers to our capacity to perform two or more activities at the same time. This is generally only possible if the tasks can be performed with very little mental effort.

dopamine
neurotransmitter released when the reward pathway in the brain is activated. Stimulates feelings of euphoria and pleasure.

dopamine theory
popular theory that schizophrenia is caused by too much dopamine in the brain, or an overreaction of the dopamine receptor sites on the post-synaptic neurons.

double-blind procedure
an experimental design that ensures that neither researcher nor participants are aware of which participants are in the control group and which are in the experimental group. This eliminates both experimenter and participant expectations as possible confounding variables.

DSM-IV-TR
The Diagnostic and Statistical Manual of Mental Disorders – fourth edition Text revision. Published by the American Psychiatric Association (2000). The DSM-IV-TR was superseded by the DSM-5 in 2013.

DSM-5
The Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, published by the American Psychiatric Association. Published in May 2013. Formerly known as DSM-V. See also DSM-IV-TR.

duration of memory
amount of time that information remains in either sensory, short-term, or long-term memory

echoic memory
auditory memory in the sensory memory register

effective punishment
punishment administered in such a way as to reduce the likelihood of the behaviour recurring.

elaborative rehearsal
a process by which we give meaning to information and link it to other information in our memories.

electrocardiograph (ECG or EKG)
detects, amplifies and records the electrical activity of the heart muscles.

electroencephalogram
the recordings of the electrical activity in the brain

electroencephalograph (EEG)
a device that detects, amplifies and records electrical activity in the brain in the form of brain-waves.

electromyograph (EMG)
a device that detects, amplifies and records the electrical activity of heart muscles

electroocularg ram
the recordings of the electrical activity in the muscles that allow the eye to move.

electrooculargraph (EOG)
a device that detects, amplifies and records electrical activity in the muscles that allow the eye to move

emotion-focused coping
involves trying to reduce the negative emotional responses associated with stress such as embarrassment, fear, anxiety, depression, excitement and frustration by using strategies such as: meditation, relaxation, talking to a friend/family, ignoring the problem, distraction.

emotional development
the learning of types of emotions and how to deal with them throughout the lifespan.

emotional forecasting
in the primary appraisal phase, the person experiences an emotional response to the given situation. In the secondary appraisal phase, the person considers how they will feel when considering each different option.

emotional intelligence (Salovey and Mayer)
intelligence includes the ability to perceive, use, understand and manage emotions in both ourselves and in others.

encoding
the process of putting information into a form which will allow it to fit in with your personal storage system.

encoding specificity principle
associations are formed at the time of forming new memories and these will be the most effective retrieval cues.

enlarged ventricles
expansion of the hollow spaces in the brain, characteristic of dementia and schizophrenia.

environmental factors
physical, biological and social experiences and events that a person is exposed to during life.

episodic buffer
a theoretical component of working memory that acts as both a bridge and a filter (for auditory and visual information) between long-term memory and the central executive and storage components in working memory.

episodic memory
memory of personal experiences

episodic disorder
when symptoms from depression occur over a period of time (episodes) and then clear.

episodic memories
long-term memories of episodes or experiences in your life.

Epworth sleepiness scale
a measure to determine sleep deprivation.

ethical principles
the code of ethics designed to protect participants from psychological and physiological harm. These include: confidentiality; debriefing deception in research; informed consent; voluntary participation; withdrawal rights

eustress
refers to a positive psychological response to a perceived stressor.

exhaustion
the third stage of GAS (fight-or-flight response) where the body cannot continue to cope with the stressor and its resistance begins to drop; the body's resources are depleted and very tired. This can lead to life-threatening illness and death if the stress continues.

experience dependent learning
learning which occurs at any time during an individual's life as a result of experience.

experience expectant learning
occurs during sensitive periods and refers to experiences necessary for learning to occur.

experiment
research that aims to find cause-and effect relationships among variables.

experimental design
the system of research being used: independent groups; matched participants; repeated measures

experimental group (E-group)
the group of research participants which is exposed to the independent variable. The results are compared with the control group so that the effects of the independent variable can be determined.

experimenter effect
the outcome of an experiment being unintentionally (or even intentionally) influenced by the experimenter.

explicit memories
memories of facts, names, images, and events; also called declarative memories.

expressive aphasia
a common term that refers to Broca's aphasia.

external validity
criterion-related validity that refers to the extent to which results from this measure are comparable with other, established, measures of the variable.

extinction
when a response no longer occurs. In classical conditioning, extinction occurs when the conditioned stimulus is presented several times after the unconditioned stimulus (which acts as a reinforcer) has been withdrawn. In operant conditioning, the response will be extinguished after being shown several times without reinforcement.

extraneous variable
any variable other than the IV or DV—these may be confounding, controlled or neutral variables.

eyewitness testimony
evidence given by a person who saw a crime committed.

fight, flight or freeze response
also known as fight-or-flight response. An organism's survival response, readying the body for action. Stems from sympathetic nervous system.

fixed action pattern
An instinctive, inborn predisposition to behave in a certain way (also known as species specific behaviour)

fixed interval schedule
a schedule of partial reinforcement in which reinforcement occurs after a set time, no matter how many responses have been shown.

fixed ratio schedule
a schedule of partial reinforcement in which reinforcement occurs after a set number of responses, no matter how much time has passed.

flooding
actual exposure of patient to feared stimulus at a level greater than usual.

forebrain
part of the brain responsible for higher order thinking processes, includes cerebral hemispheres

forgetting
the inability to retrieve information; may refer to short-term or long-term memory.

forgetting curve
a graph showing loss of memory over time

fragile X syndrome
a genetic disorder in which the person has a high probability of mental retardation and delayed social skills.

free recall
recalling as much information as possible in any order, without cues.

frequency
in terms of brain waves, the number of brainwaves per second.

frontal lobe
the largest lobe of the brain. It has several functions, including initiating movement of the body, language, planning, judgement, problem solving, aspects of personality and emotions. It is extremely well developed in higher mammals.

functional magnetic resonance imaging (*f*MRI)
Functional magnetic resonance imaging (*f*MRI) is a procedure that uses harmless magnetic fields and radio waves to produce a computer-enhanced image of brain structure. It essentially works on the same basis as the traditional MRI with the distinction that it monitors blood flow and oxygen consumption to reveal areas of greater brain activity.

GABA (gamma-amino butyric acid)
an inhibitory neurotransmitter imbalance of GABA is implicated in severe anxiety disorders. Also involved in arousal and sleep.

GAF
Global Assessment of Functioning: a subjective assessment by the psychologist of a patient's level of functioning. Expressed as a score out of 100, where 50 is 'normal'.

galvanic skin response
The physiological response that indicates the electrical conductivity of the skin.

gambling
any behaviour involving the risk of money or valuable possessions on the outcome of a game, which is determined by chance.

General Adaptation Syndrome (GAS)
a model developed by Selye to explain the biological processes involved in chronic stress. He suggested there were three stages: alarm, resistance and exhaustion. GAS is the body's way of adapting and dealing with a perceived stressor or stressors.

general intelligence or g (Spearman)
people's scores on most intelligence tests correlate with scores on other intelligence tests; g is the overlap generalisation drawing conclusions about a population as a result of research.

generalisation
a judgment about the extent to which the research findings can be applied to the population represented by the sample.

gene
the basic unit of genetic material located on the chromosomes.

genetic predisposition
the heritability factor that exists for some mental disorders such as schizophrenia, attention deficit hyperactivity disorder.

genetics
the study of heredity and the role of genes throughout an individual's life.

gerontology
the study of the biological, cognitive and psychosocial aspects of ageing.

glutamate
an excitatory neurotransmitter in the brain involved in learning.

graduated exposure
a form of treatment using gradually increasing levels of fear-provoking stimuli paired with induced relaxation, thereby reducing the incidence and level of phobic reaction to the stimulus.

gross motor skills
skills that use large muscle groups such as those used for walking or kicking a ball.

gyri
the bulges on the brain containing an enormous number of neurons and blood vessels.

hallucinations
experiences of perceptions, such as sight or sound, which are not present in reality. They can occur in each sense: auditory, tactile, visual, gustatory and olfactory

harm/loss
assessment during primary appraisal that damage has been done.

hereditary
the adjective from heredity and can be used instead of inborn, innate, inherited and genetic.

heredity
genetic inheritance—the genetic characteristics received from biological mother and father.

heritability
how much heredity contributes to intelligence; expressed as a coefficient from 0 to 1 where 0 means heredity has no influence and 1 means heredity has 100 per cent influence on intelligence.

hindbrain
the primitive parts of the brain, comprising the cerebellum, pons and medulla, adjacent to the spinal cord.

hippocampus
finger-sized curved structure that lies in the medial temporal lobes. It is responsible for consolidation of explicit (declarative) memories and acts to transfer these to other parts of the brain for storage as long-term memory.

histogram
graphical representation of how often each score appears in visual form to help gain a clearer picture of the data.

homeostasis
the state of balance in the body's metabolism.

HPA axis
refers to the hypothalamus, pituitary gland and adrenal gland which are part of the neuroendocrine system. These structures interact through a feedback system to regulate a number of functions such as a person's digestion, immune system, mood, emotions and their response to stress.

human genome
the full collection of our genes.

hyperkinesis
hyperactivity.

hypothalamus
structure in the forebrain that plays a major role in controlling emotion and motivated behaviours such as eating, drinking, and sexual activity

hypnogogic (hypnic) jerks
involuntary muscle twitches that cause us to jolt are common; usually experienced in Stage 1 NREM sleep (part of hypnogogic state).

hypnogogic state
the relaxed state that occurs during the transition from being awake to being asleep, often considered to be part of Stage 1 sleep.

hypnopompic state
the period between being asleep and waking up, a time when the brainwaves are predominantly alpha waves. Vivid images (hypnopompic images) are often seen during this phase.

hypothesis
a prediction of the outcome of research, stated in terms of the influence of changes in the value of the independent variable on the value of the dependent variable.

hypothetical propositions
hypothetical problems and abstract concepts that require complex thought.

ICD
International Classification of Diseases, published by the World Health Organisation. Current edition is the ICD-10.

iconic memory
a sensory register for the fleeting storage of visual information. It lasts about 0.3 seconds. It explains why we can see a moving picture from a series of still photos.

id
the primitive 'animal' urges from the unconscious in the Freudian personality model.

illusion
a phenomenon in which perceptions consistently differ from objective reality.

implicit memories
memories of skills, emotions, preferences and dispositions; also called procedural or nondeclarative memories. Processed in the amygdala and possibly the cerebellum.

inappropriate affect
symptoms refer to patients showing inappropriate emotional responses.

inattentional blindness
when entire objects or events go unnoticed without a visual disruption or significant change from one scene to the next, thus it not change blindness.

inborn reflexes
a set of unlearned automatic responses to certain stimuli that babies are born with.

independent groups design
allocates participants to E-group or C-group at random. Also known as between participants design.

independent variable (IV)
the variable that is manipulated by the experimenter who then measures resulting changes in the dependent variable.

infancy
a lifespan stage, between birth and childhood (approximately 0 to 2 years of age).

infantile amnesia
the fact that we have minimal declarative memories from our early childhood.

inference
assumed conclusions from the information provided in the data used to investigate a psychological (hypothetical) construct

inferential statistics
statistical techniques used to determine causative relationships and to make generalisations from samples to populations.

information-processing model
a model, based on the structure of a computer, that helps to explain how memories and thoughts are 'encoded' when the mind receives 'input' from the environment.

informed consent
the ethical basis for psychological treatment or experimentation, requiring that the subject (or client) is fully aware of all procedures and their likely and possible effects, and participates on a voluntary basis.

infradian rhythms
biological rhythms with cycles longer than 24 hours.

innate
inborn, hereditary.

intelligence quotient (IQ)
standardised score for an individual's intelligence as measured by a specific intelligence test. IQ scores are based on how much an individual's test score deviates from the mean score for the standardisation group.

intelligence tests
standardised measures of a person's general mental ability.

intelligence
the ability to learn from experience and adapt to the environment.

interference
difficulties in retrieving information from memory, caused by other material learned either previously (pro-active interference) or subsequently (retro-active interference).

interference theory
a theory of forgetting where one memory is interfered with by another memory.

internal reliability
the extent to which all the items in a research instrument contribute equally to the final score.

internal validity
the extent to which the results gained from a measure are truly due to the variable that it is thought to be measuring.

inter-rater reliability
the extent to which the same result is obtained by anyone administering the test.

interval data
data is measured on a scale where each step is the same value, but zero does not mean that the property does not exist e.g. shoe size or temperature in degrees celcius.

introvert
a person who gains emotional energy from within themselves; avoids the company of others and keeps to themselves.

K-complexes
brain wave patterns that consist of a sharp rise and fall in amplitude, lasting for about 2 seconds on the EEG. Indicative of stage 2 NREM sleep, occurring about once a minute although can be triggered by external stimuli (such as a loud noise).

Korsakoff's syndrome
a degenerative neurological syndrome often caused by thiamine deficiency, malnutrition and alcoholism.

lateral fissure
groove that separates the temporal lobe from the frontal and parietal lobes

Lazarus and Folkman's transactional model of stress and coping
a cognitive model focused on the transaction between an individual's perception of a stressor and the stressor itself. A person went through primary appraisal of the situation and then secondary appraisal. Then either/both emotion-focused coping or problem-focused coping strategies were used to deal with the stressor.

learning
a relatively permanent change in behaviour due to experience.

left visual field
visual stimuli on the left hand side of the stationary point that the person's eyes are fixated on.

lesion
damage to the brain which can be deliberate through surgery, or accidental through head injury or stroke.

levels-of-processing (Craik & Lockhart)
a model of memory storage which suggests that memory does not comprise any specific number of separate memory stores but instead comprises a continuous dimension in which memory is encoded. It is related to the ease with which it can be retrieved: the deeper the processing of information, the greater the chance of it being retrieved.

life expectancy
future number of years expected to live.

Likert scale
a self-report scale of attitude measurement that evaluates the direction of a person's attitude and how strongly the person agrees/disagrees with favourable/unfavourable statements about attitude object, concept or person.

location of function
linking a location of the brain with a specific function.

longitudinal fissure
large groove that runs the length of the brain, separating the two cerebral hemispheres

longitudinal study
a form of repeated measures design, where the same participants are investigated over a period of time.

long-term memory
like the hard-drive in your computer, the information is encoded and stored, and as long as you know enough about the information (like the name of a document or a folder) then it can be retrieved.

magnetic resonance imaging (MRI)
magnetic resonance imaging (MRI) is a neuroimaging procedure that uses a harmless magnetic fields and radio waves to produce a computer enhanced image of brain structure.

maintenance rehearsal
a strategy for keeping information in short-term memory or for moving it into long-term memory by simply repeating information over and over, but not trying to form meaningful connections between the new information and other information which is already in memory.

mania
the feeling of euphoria, irritability, unrealistic beliefs and impaired judgments and behaviours.

matched participants design
a subject selection procedure which attempts to eliminate confounding variables by 'matching', on key characteristics, each individual in the experimental group with an individual in the control group.

maturation
a predetermined biological sequence of behaviour which occur at certain ages.

mean
the average of all the scores, calculated by adding up all the scores and dividing that total by the number of scores.

measures of central tendency
measures (mean, median and mode) that tell us how the data are clustered near the central point of the dataset.

measures of dispersion
measures that tell us about how scores are spread out (standard deviation and range).

measures of retention
re-learning, recognition, cued recall and free recall.

medial temporal lobe
the mid-temporal lobe, within the cerebrum and beneath the cerebral cortex.

median
the score that occurs exactly halfway between the lowest and the highest score.

medical approach to normality
diagnosing someone with a mental illness, in the same way a person may be diagnosed with a physical illness. A person's state of mental health is determined by a set of symptoms. If a mental illness is diagnosed, then treatment is required.

medical students' disease
the tendency for medical students to see, in themselves, some of the symptoms or characteristics of the disease they are studying.

meditation
a deliberately induced altered state of consciousness in which a person uses mental exercises to become highly focussed on a single thought, to the exclusion of others.

memory consolidation theory of sleep
sleep plays an important role in consolidating memories, a process which new memories are transferred into long-term memory.

memory
the mental capacity for retaining an image, concept or knowledge when the stimuli which created it no longer exist in consciousness. Memory may also refer to the storage system which retains such images.

mental disorders
exaggerated forms of thoughts, feelings and behaviours, implying the existence of a clinically recognisable set of symptoms and behaviours that usually need treatment to be alleviated.

mental health
a state of emotional and social well-being in which individuals realise their own abilities, can cope with the normal stresses of life, can work productively and can contribute to their community.

mental health problems
problems that cause emotional, cognitive and behavioural difficulties that affect relationships and functioning in everyday life.

mental illness
a mental disorder that affects one or more functions of the mind. A mental illness can interfere with a person's thoughts, emotions, perceptions and behaviours.

mental representation
a cognitive process where information is stored in memory for later retrieval and use.

metacognition
an understanding and use of the way a person thinks when solving problems, reasoning, planning and decision-making.

microsleep
a brief involuntary period of sleep that occurs in the midst of a wakeful activity - we tend to drift off and stop concentrating on what we are doing.

midbrain
connects the hindbrain with the forebrain and controls arousal levels, attention and consciousness; essentially comprises the reticular activating system (RAS).

migration
during developmental plasticity, the movement of newly formed neurons

mind
relates to our self-awareness, our ability to reflect, think and reason about ourselves and the world. In other words, it relates to consciousness—it is our awareness of ourselves and our environment.

mind–body problem
a much-debated and controversial question: Is the mind a separate entity to the body, including the brain? The mind–body problem asks what is the mind and what relationship it has with the brain (body).

mindfulness
a state of pure being in which a person deliberately pays attention to each thought and feeling, from moment to moment and without imposing judgment. Associated with some forms of meditation.

misinformation effect
questions asked in such a way as to provide information in the asking of the question, e.g. "Did you see the broken headlight?".

mnemonic device
a form of elaborative rehearsal where the information is connected to material already in your long-term memory. This can include visualisation, verbalisation, rhythm and rhyme.

mode
the most commonly occurring score in the dataset.

modelling
tendency for a person to copy the behaviour or attitude that is demonstrated by another person (also known as observational learning).

molecular genetics
genetic laboratory research using modern technology to map the coding of genes on chromosomes.

mood
an emotional state that can affect our perceptions, thoughts and behaviours.

mood disorder
when a mood is severe or persistent and disrupts a person's life or daily functioning.

moral reasoning
the thinking behind our ideas of what is right and wrong.

Moro reflex
an inborn reflex in which the baby throws head back, arches back, flings arms and legs out and then pulls them close into the centre of the body in response to a sudden noise or loss of support.

motion after-effect
the apparent motion of a stationary stimulus (object) following the extended viewing of a continuously moving stimulus. The stationary stimulus appears to move in the opposite direction.

motion detector neurons
specialised neurons that detect movement in certain directions.

motivated forgetting
(suppression and repression) occurs when a person has a reason to forget.

motivation
the drive to perform a behaviour which achieves a certain goal.

motor neurons (nerves)
neurons that communicate messages from the central nervous system to the particular muscles than an organism intends to move at any particular moment. Also referred to as efferent neurons)

multi-axial diagnosis
the system employed in the DSM-IV-TR of diagnosing conditions according to five axes

1. major psychological disorder
2. mental retardation and personality disorder
3. general medical conditions
4. psychosocial and environmental problems
5. GAF – global assessment of functioning

multi-store model of memory
describes three stores of memory—sensory memory, short-term memory and long-term memory—and how they interact with each other.

muscle atonia
the total relaxation of muscles to the point of paralysis when in REM sleep. Also known as cataplexy.

myelin
a white, fatty, waxy substance that coats some axons and insulates them, protecting them from electrical interference from other neurons. This increases the efficiency of transmission of nerve impulses.

myelination
a process in the brain whereby the axons of the neurons in a child's brain become covered in myelin, a white, fatty covering that insulates a neuron's axon and speeds transmission. This process continues until the early 20s

narrative chaining
a mnemonic device in which a story is created using the wordfs to be remembered as part of the story

natural environment
a setting that is familiar and where the experience normally occurs.

negative correlation
a correlation in which the two variables change in the opposite direction.

negative emotions
anger, anxiety, disgust, envy, fright, guilt, jealousy, sadness and shame.

negative reinforcement
(in operant conditioning) the removal, reduction or prevention of an unpleasant stimulus in response to a behaviour, increasing the likelihood that a behaviour will be repeated.

negative symptoms
refer to the removal of usual normal reactions, e.g. a loss of motivation.

neonate
newborn infant.

nerve
bundle of axons running together in the peripheral nervous system

neural adaptation
a process in which neurons decrease their sensitivity to a continuous stimulus and therefore reduce their signalling of an event. It often used to explain the motion after-effect.

neural connections
the connections formed between the brain's neurons.

neural pathway
bundles of neurons which provide connections between one part of the nervous system and another.

neurofibrillary tangles
an abnormal build-up of protein inside neurons. These are associated with the death of brain cells in patients with Alzheimer's disease.

neurons
nerve cells, responsible for communication within the body.

neuropsychology
a branch of psychology that studies the structure and function of the brain, taking the cognitive approach.

neurosis
a disorder in which a person experiences dysfunctional thinking but realises that the thinking is not rational.

neurotransmitters
chemicals that help the communication across nerve synapses.

neutral/irrelevant/benign
an assessment that an event (stressor) is of little or no personal importance or relevance to the person and therefore does not go beyond primary appraisal.

neutral stimulus (NS)
(in classical conditioning) the name given to the conditioned stimulus before it becomes conditioned. It is referred to as a neutral stimulus while it fails to produce a response.

night terrors
frightening episodes, occurring in stages 3 and 4 of NREM sleep, where a person wakes, often screaming, in sheer terror but rapidly returns to sleep and has no recollection of the event the next morning. Common in young children (ages 3 to 6).

nominal data
data that has qualitative value rather than quantitative value, where there is no ranking or ordering of the values implied.

non-rapid eye movement sleep (NREM sleep)
one of two phases of sleep, characterised by little or none rapid eye movement, and often divided into four stages of NREM sleep that are determined predominately by predominant brain wave patterns.

norepinephrine
neurotransmitter responsible for arousal, mood and impulse control.

normal
a behaviour that is accepted within the society and culture and is typical for the specific situation or context.

normal curve
the 'bell curve' of a normal distribution of a characteristic in a population. Mean, median and mode are all the same score and three standard deviations above and below the mean includes 99.74% of the population.

normal waking consciousness
the states of consciousness we experience when we are awake and aware of our thoughts, feelings, and perceptions from internal events and the surrounding environment. During normal waking consciousness, we experience a real sense of time and place. Our experience during normal waking consciousness creates our reality and a baseline to judge all other states of consciousness.

normality
state of being normal, defined in terms of the frequency with which a behaviour or characteristic occurs within the population. A set of data is collected, and measures of central tendency (mean, mode and median) and range are calculated to determine the average behaviour or characteristic.

norms
standardised scores representing the conversion of test raw scores into scores that can be compared with the performances of the wider population.

objective data
data that are measured according to identifiable external criteria.

objective measurement
physical measurement that is free of bias, such as height.

observational learning
where a person learns by watching the behaviour demonstrated by another. Originally called social learning theory.

observational studies
research in which there is no manipulation of the independent variable by the researcher.

occipital lobe
the cerebral cortex at the rear of the brain. It is the location of the primary visual cortex and association areas involved with integration of visual stimuli.

old age
a lifespan stage, after middle adulthood (approximately 65+ years of age).

operant conditioning
a type of learning in which behaviour becomes controlled by its consequences.

operationalization
quantification of a variable.

operational definition
a variable defined in a way that describes how it can be quantified.

optic chiasm
the point at the base of the forebrain where the optic nerves from each eye meet and cross over.

optic nerve
the two tracts of neurons that transmit visual information from the eyes to the occipital lobes of the brain.

order effects
changes in results caused by the sequence of performing tasks in a test; often ascribed to practice- or boredom-effects.

ordinal data
data that has a definite sequence, but the gap between one level and the next is not constant e.g. the ages of persons in a room.

organic amnesia
memory loss caused by biological, physical or chemical damage.

orienting response
turning the head (or body) towards a sight or sound or other stimulus.

overlearning
a means of strengthening memory by learning again what is already well-known.

parallel form reliability
used to assess the consistency of the results of two tests constructed in the same way from the same content domain. The property is measured before the treatment with the independent variable (pre-test) and again, with a parallel form, after the treatment (post-test).

paranoid schizophrenia
a form of schizophrenia characterised by delusions of grandeur or persecution.

parasympathetic nervous system
a branch of the autonomic nervous system, responsible for maintaining our day-to-day functioning and for most of the automatic functions of the body such as digestion, heart rate, breathing and some glandular functions.

parietal lobes
the location of the primary somatosensory cortex in the brain. The parietal lobes enable a person to perceive their own body and to perceive where things are located in their immediate environment.

partial reinforcement
any schedule of reinforcement in which not every response is reinforced.

partial sleep deprivation
having some sleep in a 24 hour period but not getting enough to meet your needs; may occur for just during one night or for several nights and can lead to serious consequences.

participant effects
characteristics of the participants becoming a confounding variable and influencing the value of the dependent variable

participants' rights
ethical considerations including the right to informed consent, debriefing and withdrawal rights.

percentile
a score that indicates the percentage of people who have obtained the same raw score as a particular examinee on a psychometric test.

perception
the processes involving the way the brain organises and interprets sensory information.

peripheral nervous system (PNS)
communicates information from the body to the central nervous system (for example aches and pains) and to the body's organs, glands and muscles.

personality
lasting and distinctive behaviours, thoughts, motives and emotions that typify how we react and adapt to other people and situations.

philosophy
a discipline that tries to understand behaviour by using logic and reason rather than observation and experimental research methods.

phobia
an irrational fear of a specific object or situation.

phobic disorder
fear of something that interferes with a person's ability to function in day-to-day life.

phonemic processing
encoding according to the sound of a word – e.g. by finding a rhyme or by rhythm.

phonological loop
a storage system for auditory information in working memory.

photographic memory
the ability to recall sharp, detailed images of a picture or notes from a page after viewing them for a short period of time. This is a very rare phenomenon.

photoreceptors
a layer of specialised nerve cells that detects visual stimuli. They make up the retina located at the back of the eye and converts (tranduces) visual light energy (electromagnetic radiation or light waves within our visual spectrum) into electrochemical energy (nerve impulses).

physical exercise
refers to an activity that requires exertion with the purpose of improving fitness or health.

physiological measurement
the observation of a measurable bodily (physical or physiological) response (such as heart rate, brainwave activity and galvanic skin response).

placebo
"I shall please"; a variable other than the independent variable that causes a change in the value of the dependent variable due to the participant's belief that it will have an effect.

placebo effect
refers to the participants' behaviour being influenced by their expectations of how they should behave, caused by the belief that they have received some treatment.

plasticity
the ability of the brain's synapses to be modified.

pleasure principle
a psychoanalytic concept developed by Freud, that states that the governing principle of the id drives a person to act impulsively to achieve instant gratification of their desires for food, drink, sex, comfort and aggression.

pneumograph (RESP)
measures abdominal/chest movement and respiration rate.

polysomnogram
a continuously moving chart that displays data collected simultaneously from EEG, EOG, EMG and any other devices .

Pons
part of the brain stem responsible for sleep and arousal

population
the group of people about whom we wish to draw conclusions.

positive correlation
a correlation in which the two variables increase or decrease in parallel with each other.

positive emotions
happiness, pride, love, relief, etc.

positive reinforcer (positive reinforcement)
a consequence that strengthens a behavioural response by providing a pleasant or satisfying outcome.

positive symptoms
those experiences or behaviours that occur in addition to the person's usual functioning, for example experiencing delusions.

positron emission tomography (PET)
measures the volume and location of blood flow in the brain by tracking a radioactive substance (for example radioactive glucose) that has been injected into the person's bloodstream.

post-synaptic neuron
a neuron which receives information from another neuron.

post-traumatic stress disorder (PTSD)
a condition where victims of trauma suffer symptoms such as sleep disturbances and flashbacks.

preconscious
(Freudian) memories that are just underneath the level of conscious awareness but that can easily be retrieved.

predictive validity
the extent to which a test predicts performance on another similar test long after the first test was taken.

presynaptic neuron
a neuron which transmits information to another neuron.

primacy effect
the tendency for superior recall of words that occur at the start of a list.

primary appraisal
is the initial evaluation process where the person determines whether the event (stressor) is a threat or a challenge.

primary auditory cortex
located in the upper part of the temporal lobe. Receives sounds from the ears.

primary motor cortex
located at the rear of each frontal lobe. Responsible for movement of the skeletal muscles of the body.

primary somatosensory cortex
located at the front of each parietal lobe. Processes sensations such as touch, pressure, temperature and pain from the body.

primary visual cortex
located in the occipital lobes. Processes information from the eyes.

proactive interference
when previously learnt material inhibits our ability to encode and store new material.

probability (p-value)
the likelihood that a result would be achieved by chance alone. (Considered significant if $p \leqslant .05$.)

problem-focused coping
involves trying to reduce the negative situation by using practical ways to deal with the stress such as seeking information, evaluating pros and cons of the situation.

procedural memory
one aspect of implicit memory. Memory for how to perform particular tasks, skills, or actions.

proliferation
the first stage in the development of the nervous system, where cells destined to become neurons multiply.

prosopagnosia
the inability to recognise faces.

prospective memory
remembering to do things in the future.

protective factors
factors in a person's life, such as stable life, good family, strong social network, that help to face stressors with greater resilience.

pruning
the loss of a number of overabundant neural connections usually formed in infancy and childhood.

pseudoforgetting
where memory is thought to have been forgotten but it was never encoded and stored in the first place.

pseudoneglect
a tendency to display a leftward attentional bias (the left side of space tends to be looked at for longer than the right) that is found in most normally functional people.

psychoactive drugs
chemical substances that affect the nervous system and brain activity. As a result, they impact on our consciousness by altering thoughts, feelings, perceptions and behaviours.

psychoanalysis
a set of techniques, based on the theories of Sigmund Freud, for treating patients with psychological disorders, where patients are encouraged to talk about their experiences from childhood, with the intention of tapping into their unconscious wishes, fears, thoughts and feelings.

psychoanalytic theories
theories that emphasise that development is about analysing symbolic meanings of behaviours, including motivation, and trying to determine how the inner mind works.

psychodynamic model
a model, based on the work of Freud that proposes that the development of phobias is due to unresolved conflicts that arise during the phallic stage of a child's development.

psychodynamic psychotherapy
therapy that looks at current behaviours and attempts to find underlying reasons for it.

psychoeducational approaches
educate about illness. They are not treatments.

psychological construct
is a hypothetical concept. It is created to explain phenomena that are believed to exist or occur, but cannot be directly observed or measured. Consciousness is a psychological construct - it is believed to exist and descriptions are 'constructed' to explain it.

psychological dysfunction
occurs when there is a breakdown in the way a person thinks, feels and behaves.

psychology
the systematic study of behaviour in order to infer the working of the mind.

psychometric test
a standardised measure of a selected aspect of an individual's behaviour, used to identify individual differences in psychological functioning among people.

psychopharmacology
a branch of psychology that focuses on the physical and behavioural effects of various illegal and legal drugs on brain activity.

psychophysiology
a branch of psychology that examines the relationship between physiological (body) activity and psychological (mind) processes. It generally uses human subjects, and explores emotion, vision, hearing and other processes.

psychosis
a disorder in which a person experiences dysfunctional thinking and does not realise that the thinking is not rational—the person has lost touch with reality.

psychotherapy
treatment protocols for addressing mental health disorders by non-chemical interventions.

puberty
a period of rapid skeletal and sexual maturation in humans. It brings a number of hormonal and physical changes.

punch drunk
the ongoing effect of severe hits to the head which leads to brain impairments such as poor memory, permanently slurred speech, and other cognitive deficits.

punisher (punishment)
(in operant conditioning) any event that reduces the likelihood of a particular response occurring over time.

***p*-value**
the probability that the difference in results is due to chance.

qualitative data
descriptions of the characteristics of what is being studied.

quantitative data
measurements (numerical information) about the variables being studied.

questionnaire
a form of self-report survey

random allocation
a subject selection procedure where all participants who have been selected for an experiment have an equal chance of being in the E-group or C-group.

random ratio schedule
a reinforcer is given after a number of random response, but each outcome from a response is independent

random sampling
a sampling procedure in which every member of the population has an equal chance of being selected.

range
the difference between the highest score and the lowest score in the dataset.

rapid eye movement sleep (REM sleep)
one of two phases (REM and NREM) of sleep, characterised by rapid eye movement.

ratio data
measurements that represent quantities in terms of equal intervals and an absolute zero point of origin.

reality principle
a psychoanalytic concept developed by Freud, that states that the governing principle of the ego compels a person to defer instant gratification when necessary.

recall
retrieval of stored information using minimal cues.

recency effect
the tendency for superior recall of words that occur at the end of a list due to them still being in short-term memory.

receptive aphasia
a misleading term for Wernicke's aphasia because the difficulty is not just limited to understanding language - the same problem makes it hard to produce meaningful language.

recessive gene
a gene whose characteristics will only be displayed if the paired gene is also recessive (not dominant).

recognition
a process of retrieval which requires identification of a correct response from a set of alternatives.

reconsolidation
resetting of memory when it has been retrieved from long-term memory and then altered before going through the consolidation process again—a form of neural plasticity.

reconstructive memories
memory built up by remembering what we remembered previously and believing that this is the memory of the original event.

reflex action
simple, automatic response to a sensory stimulus

rehearsal
repetition of material in memory in order to reinforce encoding of material.

reinforcer (reinforcement)
any event that strengthens the likelihood of a particular response occurring over time.

relaxation
calming of the body and mind, reflected in changes in brainwave activity, heart-rate, respiration rate, blood pressure and temperature. This is often done through breathing exercises and systematic muscle relaxation techniques. Distinct from meditation which is focused.

relearning
learning again something that has already been committed to memory. This is also the most sensitive measure of retention.

reliability
the extent to which a measure could be expected to produce the same result with the same subject(s) under the same conditions on other occasions.

REM rebound
The significantly larger amount of time spent in REM sleep than usual that follows a period of being deprived of REM sleep.

remember
the general and popular term covering all forms of retrieval from memory.

reorganisation
a reordering of neural connections so that an existing part of the brain adopts a new function.

repeated measures design
a subject selection procedure where each participant is part of both the E-group and C-group. Also known as within participants design.

repression
a psychological process which automatically and unconsciously prevents emotionally distressing memories from coming into our conscious awareness.

reproduction (of learnt behavior)
learner generates behavior previously learnt in the process of observational learning

resistance
the second stage of Selye's general adaptation syndrome (GAS). It is considered the adaptive stage because even though heart rate and respiration rate return to almost normal, blood glucose levels and stress-related hormones such as adrenalin and cortisol continue to circulate through the body keeping it ready for action.

response cost
a form of punishment that occurs when something desirable is removed (for example removing a mobile phone if misused).

restorative (restore and recovery) theory of sleep
sleep allows us to recharge our bodies, recover from the physical and psychological work during the day and allow our body's growth processes to occur.

retention
learning stored in memory

retina
a layer of photoreceptors located at the back of the eye that detect visual stimuli

retrieval
the process of getting information back from long-term memory to be used in working memory.

retrieval cues
mental reminders or prompts that we create to assist our recollection later on.

retrieval failure theory
inability to retrieve material due to an absence of the right cues or a failure to use them.

retroactive interference
when newly acquired material inhibits our ability to retrieve previously learned material.

retrograde amnesia
inability to recall previously stored memories. This is a problem with retrieval.

reward pathway
is responsible for our feelings of motivation, reward and behaviour; it makes us feel good when we participate in behaviours such as eating, drinking, drugs or gaining money. The pathway involves the ventral tegmental area (VTA), the nucleus accumbens and the neurons that connect those brain structures with the prefrontal cortex.

reward
a consequence that causes a behaviour to be repeated.

right visual field
visual stimuli on the left-hand side of the stationary point on which the person's eyes are fixated.

rooting reflex
an inborn reflex in which the baby turns head, opens mouth and begins sucking when cheek is stroked.

salience
personal relevance—a way to improve encoding, storage and retrieval of material.

sample
the members of the population that have been chosen to take part in the research in order to represent the population.

savings score
the percentage of time (or trials) saved when re-learning, calculated as
$\frac{T_1 \times T_2}{T_1} \times 100\%$

sawtooth waves
associated with REM sleep; a special type of theta-like brainwave pattern that resemble the blade of a saw that may be found amongst the random and fast beta-like waves, especially when there is a burst of rapid eye movement.

scatter diagram (scatter plot)
a diagram that shows the values of the two variables for each. participant in the sample by representing the intersection of those two values with a dot on a graph.

schedules of reinforcement
frequency and manner in which a response is reinforced or punished.

scientific method
the structured process that is used in all psychological research (see Chapter 1)

schizophrenia
a psychotic disorder, characterised by disturbances and disorganisation of thoughts, unusual emotions and behaviours. Schizophrenia involves loss of touch with reality.

scientific method
a logical process of problem-solving applied in all sciences.

secondary appraisal
the second stage where the person considers what options are available to them and how they will respond to the event (stressor). This appraisal is made at a more conscious level.

selective attention
refers to the limitations placed on how much we can focus on at any given moment. It is usually difficult to attend to more than one event at the same time, especially if this requires a great deal of mental effort.

self-control
the ability to monitor and direct personal behaviours and responses.

self-help groups
groups where members meet often and all share a similar problem such as gambling. Members of these groups focus on discussing their issues. These groups usually do not have professionally trained leaders.

self-rating scale
an attitude measure that asks a person to indicate the strength and direction (agreement/disagreement) on an attitude object, concept or person.

self reports
statements and answers to questions made by the participants concerning their thoughts and feelings.

semantic memory
long-term storage of facts that are not characterised by any particular personal context in which the individual acquired the facts. Semantic memories are general knowledge—for example knowing that Canberra is the capital of Australia.

semantic network theory
the idea that items in long-term memory are stored in a hierarchical pattern of nodes (concepts) with links between related nodes.

semantic processing
using the meaning of information or a word in order to encode it into memory.

sensation
the process where the structures of the eye receive information about the environment and transmit that information to the brain.

sensitive periods
periods in time which are particularly suited to learning things due to the nature of the growing brain.

sensory memory
according to the multi-store model of memory, the sensory memory is the store for incoming, fleeting sensory information.

sensory neuron
a neuron that carries information from the body and from the outside world into the central nervous system

serial position effect
in immediate free recall, items at the beginning or end of a list are remembered better than those in the middle. The serial position effect comprises the primacy effect and the recency effect.

serial recall
recalling information in the order in which it was presented.

serotonin
neurotransmitter

shaping
a procedure in which a reinforcer is given for each response that is closer and closer and eventually leads to the desired response. Also called 'the method of successive approximations'.

short-term memory
according to the multi-store model of memory, the short-term memory is a store which receives information from the long-term and sensory stores; it has a limited capacity of 7+ 2 pieces of information, and a duration of approximately 12-20 seconds.

side-effects of punishment
the tendency of the person being punished to show aggression, resent the punisher or withdraw completely.

single-blind procedure
an experimental design in which either the participants or the researcher does not know which participants are in the experimental group.

single photon emission computerised tomography (SPECT)
an imaging technique that detects gamma rays (radiation) and uses a number of 2D images to create a accurate 3D image.

single-blind procedure in the experimental process
allocating participants to groups in such a way that they do not know whether they are in the E-group or C-group.

Skinner box
an enclosed chamber with a device to deliver reinforcers (food etc.) and a mechanism which an animal can manipulate in order to escape.

sleep
a dynamic process of different stages of consciousness from 'feeling drowsy' through to 'sound asleep' and not being aware of anything.

sleep debt
The difference between the amount of sleep you should be getting and the amount you actually get.

sleep deprivation
not getting the amount of sleep needed; may involve partial or total loss of sleep.

sleep deprivation psychosi
the experience of being depersonalised with a loss of sense of personal identity and increased difficulty with coping with other people and the environment, usually occurs at day 6 of total sleep deprivation

sleep laboratory
a place used for scientific research on sleep that usually resembles a bedroom.

sleep spindles
brain wave patterns that consist of rapid bursts of high frequency, often associated with stage 2 NREM sleep but can be found in stage 3 and 4 NREM sleep.

sleep talking
verbalising in our sleep, a common occurrence that can occur in NREM and REM sleep.

slow wave sleep
collectively stage 3 and stage 4 NREM sleep

social causation hypothesis
states that people who live in lower socioeconomic areas experience higher levels of stress, thus increasing the likelihood of developing schizophrenia.

social drift hypothesis
states that people with schizophrenia may experience personal difficulties which impair their work and as a result they may fall into a lower socioeconomic category.

social learning theory
describes the way in which people acquire certain behaviours by watching and learning from their role models. The initial focus of observational learning.

social phobia
(also known as social anxiety disorder) can involve fear of other people or social situations.

social support network
refers to the network of family, friends, neighbours and community members that are available during difficult times to provide emotional, physical and financial assistance.

sociocultural perspective
an approach that focuses on how people's beliefs, values and traditions influence their thoughts, feelings and behaviours.

soma
cell body of a neuron. Controls metabolism and maintenance of the cell.

somatic nervous system
the division of the peripheral nervous system that carries sensory information into the central nervous system, and also carries motor commands from the central nervous system to the skeletal muscles

somatosensory cortex
located in the parietal lobe, receives information from the sense receptors in the body.

somnambulism
sleep walking

somnambulists
sleep walkers, occurs in stage 3 & 4 NREM sleep and usually perform routine tasks.

spatial neglect
a disorder in which the person affected systematically ignores stimuli on one side of their body. Spatial neglect occurs after brain damage usually in the posterior region of their right parietal lobe and results in the person ignoring stimuli on their left side.

species specific behaviour
An instinctive, inborn predisposition to behave in a certain way (also known a s fixed action pattern)

specific phobia
fear of specific objects or situations, illness, injury, disease or death.

spinal cord
the bundle of nerve fibres connecting the brain with the peripheral nervous system.

spiral illusion
an example of the motion after-effect, in which a stationary object appears to move in the opposite spiralling direction after an extended viewing of a moving spiral in the one direction.

split-brain
occurs after brain surgery (known as a commisurotomy) in which the corpus callosum is severed. The two sides of the brain are still connected at the subcortical (deeper) level but the two hemispheres are separated.

split-half reliability
compares examinee's scores on two halves of a test.

spontaneous recovery
the reappearance of an extinguished response after a rest period.

standard deviation
a measure that tells us how far, on average, scores are different from the mean.

standardisation
proscribed, uniform procedures for administering and scoring a psychometric test.

standardised instructions and procedures
the system of using the same words, actions and materials despite being administered by different researchers. A process of eliminating possible confounds.

state-dependent cue
a clue to assist retrieval from long-term memory, due to the internal environment (mood-state or physical condition) in which learning took place.

states of consciousness
An individual's level of awareness of internal events (thoughts, feelings and perceptions) and external surroundings. An individual experiences a range of different states of consciousness throughout the day.

statistical significance
a result is called statistically significant when the likelihood of a finding occurring by chance is less than 5 in 100 (probability less than 5%; $p < 0.05$).

stepping reflex
an inborn reflex in which the baby makes rhythmic stepping movements when held upright with feet touching a surface.

stimulus discrimination
when an organism responds to the conditioned stimulus but not to any stimulus which is similar to the conditioned stimulus.

stimulus generalisation
when an organism responds to a stimulus that is similar to the conditioned stimulus.

storage
maintaining encoded information in a memory store.

stratified sampling
a sampling process by which the effects of a certain variable can be eliminated as a possible confound in an experiment.

streams of consciousness
a analogy, termed by James, that explained consciousness as an ever-changing stream of thoughts that can shift smoothly and effortlessly from one moment to the next, just like water flowing in a stream.

strength of correlation
the strength of the relationship between two variables.

stress
a psychological and physical response to internal or external sources of tension (stressors) that challenge a person's ability to cope. These can be real or perceived.

stressor
a source of tension that challenges a person's ability to cope.

Stroop effect
a process using colour names written in contrasting colours of ink, demonstrating the difficulty in suppressing an implicit memory when an appropriate stimulus cue is presented.

structural processing
encoding according to physical features of the word to be remembered e.g. long or short, starts with consonant or vowel, upper case or lower case.

structuralist approach
an approach in psychology focused on investigating the perception of vision, hearing and touch through the systematic observation of experience.

stupor
little or no response to their surroundings and reduced body movement.

subjective
open to bias.

subjective data
information about the variables being studied based on opinion, with no external yardstick by which they are measured.

subjective measurement
a personal evaluation that could be bias or difficult to compare with other measurements, such as reporting feelings.

sucking reflex
an inborn reflex in which the baby automatically sucks (draws in with mouth) when an object touches the mouth.

superego
the moral component of the Freudian personality model. It operates at conscious, pre-conscious and unconscious levels.

suppression
(motivated forgetting) conscious refusal to allow memories to occur.

survival (adaptive and evolutionary) theory of sleep
Sleep serves as a means to increase an animal's chances of survival in its environment - it allows us to adapt to our environment and depends on how much food we need, how available it is (we may need to conserve energy) and how safe it is when we sleep. These sleep requirements have evolved over time in order for the species to hunt food, hide and conserve energy.

swimming reflex
an inborn reflex in which the baby makes coordinated swimming movements when placed in water.

symbolic thoughts
mental images that represent objects and functions.

sympathetic nervous system
a branch of the autonomic nervous system that activates the fight-or-flight response.

synaesthesia
a cross-modal experience when stimulation of one sensory modality (system) automatically triggers a perception in a second sensory modality or cognitive process in the absence of a direct stimulation to this second modality.

synaesthete
a person who experiences synaesthesia.

synaptic transmission
the process of neurons communication with other neurons.

synapse
the connection between two neurons.

synaptogenesis
the process of moulding or forming new synapses.

syndrome
a particular profile of symptoms. The origins and clinical severity may vary e.g. dyslexia.

syntax
verbal communication that does not use the grammatical rules.

systematic desensitation
a process of treating a phobia by introducing stimuli that are more and more fear-provoking while simultaneously invoking relaxation.

tardive dyskinesia (TD)
a disorder where the person will experience uncontrollable movements of any body part, including the face and tongue.

temporal lobe
the part of the forebrain beneath the temporal plate of the skull, at the side of the head above the ears. Contains Wernicke's area and the primary auditory cortex.

test standardisation
where administration of a test is uniform for all examinees at any given time or setting.

test–retest reliability
the extent to which a test produces the same result if readministered to the same person under the same conditions at a different time.

thalamus
a structure which is shaped like two eggs beneath the cortex; it processes incoming sensory information and transmits it to other, higher parts of the brain for further processing. It also directs attention to specific sensory systems.

the hat phenomenon
a feeling of tightening around the head as though a hat that is too small is being worn that usually occurs during day 4 of total sleep deprivation.

theta waves
The typical brainwave pattern (medium frequency and mixed amplitude (some high, some low)) during the early stages of sleep.

thiamine
vitamin B1.

threat
an assessment that there may be a future harm or a loss.

three-phase model
in operant conditioning, the D-B-C (A-B-C) model

time orientation
the ability to correctly perceive the speed at which time passes.

tip-of-the-tongue phenomenon
the feeling that something we know is just not available to be recalled from memory. An indication that some forgetting is due to retrieval failure.

token economy
a form of behaviour modification in which tokens are earned for performing target behaviours and these tokens can be exchanged later for some reward.

tonic neck reflex
an inborn reflex in which the baby turns head to the right and forms fists when placed on back.

total sleep deprivation
going without sleep for an entire 24 hour period; may occur for just during one night or for several nights and can lead to serious consequences.

tracking
the moving of the eyes to follow (track) an object.

transactional model of stress and coping (Lazaras and Folkman)
focuses on the cognitive component of stress. Stress is regarded as a 'transaction' between the person and the environment where the person's individual interpretation determines how to deal with the situation. The person goes through primary appraisal (initial recognition of the potentially stressful situation) then secondary appraisal (person considers their options). Both stages involve emotional forecasting (predicts what feelings the situation will produce).

transcranial magnetic stimulation (TMS)
a non-invasive technique that allows researchers to stop or start activity in a specific area of the brain.

transduction
the conversion from one energy form to another.

treatment
the treatment is the variable that the experimental group participants receive and members of the control group do not (another term for IV).

twin studies
a type of family study used to compare similar characteristics between twins.

ultradian rhythm
a biological rhythm that is shorter than 24 hours, such as NREM/REM sleep cycle

unconditioned response (UCR) (classical conditioning)
the response that occurs automatically when the unconditioned stimulus is presented. The UCR is a reflexive or involuntary response as it is predictably caused by an UCS.

unconditioned stimulus (UCS) (classical conditioning)
any stimulus which consistently produces a particular naturally occurring automatic response (e.g. the food in Pavlov's experiments).

unconscious
thoughts and memories that are deeply hidden but in Freudian theory cause desires that are hard to control.

unilateral temporal lobectomy
removal of one temporal lobe

unipolar depression
when a person experiences depressive symptoms alone but at some point returns to their usual state of functioning.

validity
the extent to which an instrument measures what it is supposed to measure.

variables
describable or quantifiable properties measured in research, they may be independent; dependent; confounding; controlled and extraneous

variable interval schedule
in operant conditioning, responses are reinforced after intervals of time that vary around a set mean, irrespective of the number of responses.

variable ratio schedule
in operant conditioning, responses are reinforced after numbers of responses that vary around a set mean, irrespective of the elapsed time.

variance
a measure of how much, on average, scores in a dataset differ from the mean.

ventral tegemental area (VTA)
located in the midbrain and has a role in learning through operant conditioning. Part of the reward pathway in the brain.

vicarious conditioning
where an observer learns a behaviour by observing its consequences for another person (observational learning).

video monitoring
now a common method used in sleep laboratories and in the person's own home to observe sleep. It uses infrared cameras (or cameras in a room lit with infra red light) that operate silently to allow footage to be seen and taped in the dark without disturbing the sleeping participant.

visual acuity
the clarity or sharpness of vision.

visual agnosia
inability to recognise the faces of familiar people but can recognise the same people by the sound of their voice.

visuospatial sketchpad
the storage system for visual information in working memory.

von Restorff effect
when a word stands out in a list of other words, it is more easily remembered. This may be due to length of word or other structural characteristic.

voluntary behaviours
actions that are controlled by the person or animal performing them.

voluntary participation
taking part in research without pressure or by deception.

vulnerability theory
theory relating to schizophrenia that describes how biological, psychological and sociocultural factors interact and influence a patient's vulnerability.

waterfall illusion
an example of the motion after-effect, in which a stationary object appears to move in the opposite direction after extended viewing of a waterfall (or similar moving stimuli).

Wernicke's aphasia
results from damage to Wernicke's area, located in the left temporal lobe near the parietal lobe boundary, that causes difficulty in understanding written and spoken language and producing written and spoken language that makes sense to others. Speech is fluent but does not make sense.

Wernicke's area
part of the left temporal lobe, responsible for language reception and interpretation and for creation of grammatically correct speech.

withdrawal rights
the right of participants to leave a study at any stage, including the right to withdraw their results after the study has been completed, regardless of the possible effects on the results.

word salad
a jumble of meaningless words and phrases; commonly seen in schizophrenic states and Wernicke's aphasia.

working memory
the mental work that is occurring at any one time, including retrieving information, problem-solving, and comprehending sounds and visions. Working memory draws on information from your sensory and long-term memories.

Yerkes–Dodson law
this law states that a person's performance increases with physiological and psychological arousal—but only to a certain point. When the levels of arousal become too great, the performance of the person decreases.

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