→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

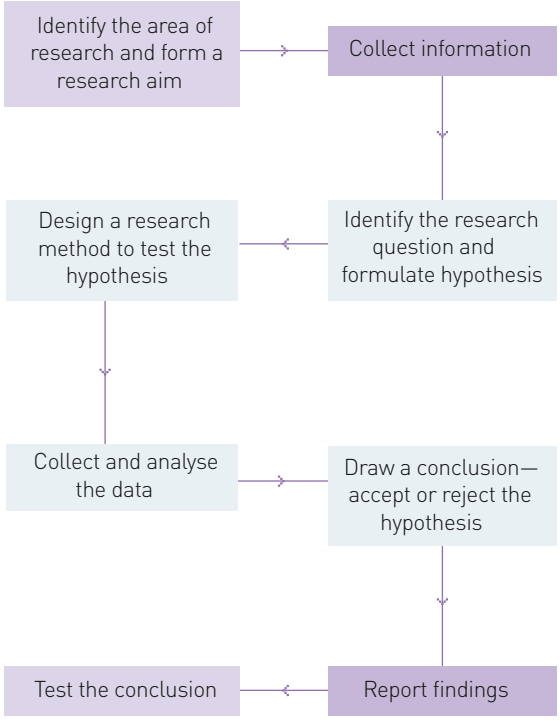
The scientific method

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 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'.

1.1 REVIEW

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.

WRITING A RESEARCH STATEMENT

1.1 INVESTIGATE

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.

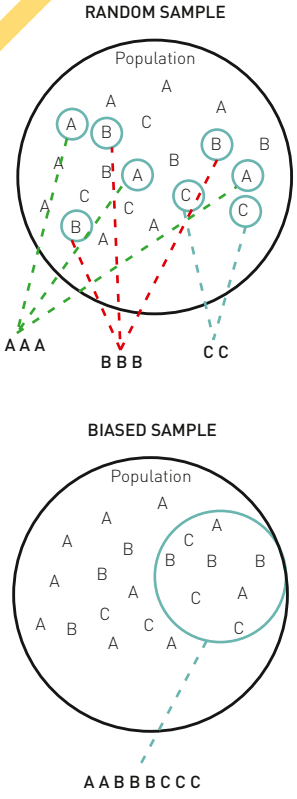


FIGURE 1.1 Personal characteristics are distributed in the random sample in the same proportions as in the population. The biased sample has certain elements over-represented (C) and under-represented (A).

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.

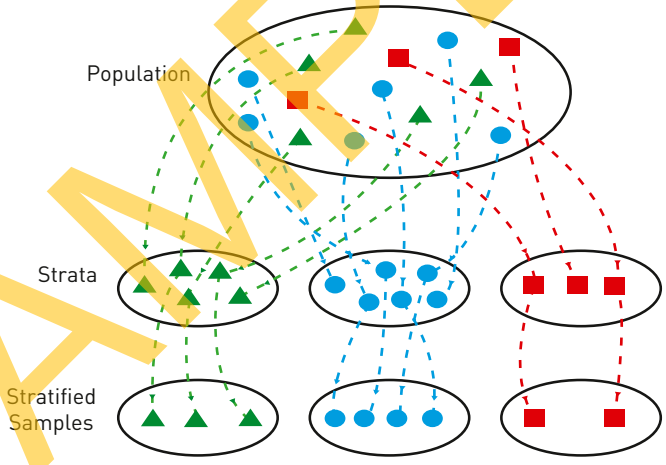


FIGURE 1.2 Stratified sampling involves dividing the population into distinct 'subgroups' and then selecting a separate sample from each subgroup in the same proportions as they occur in the population.

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?

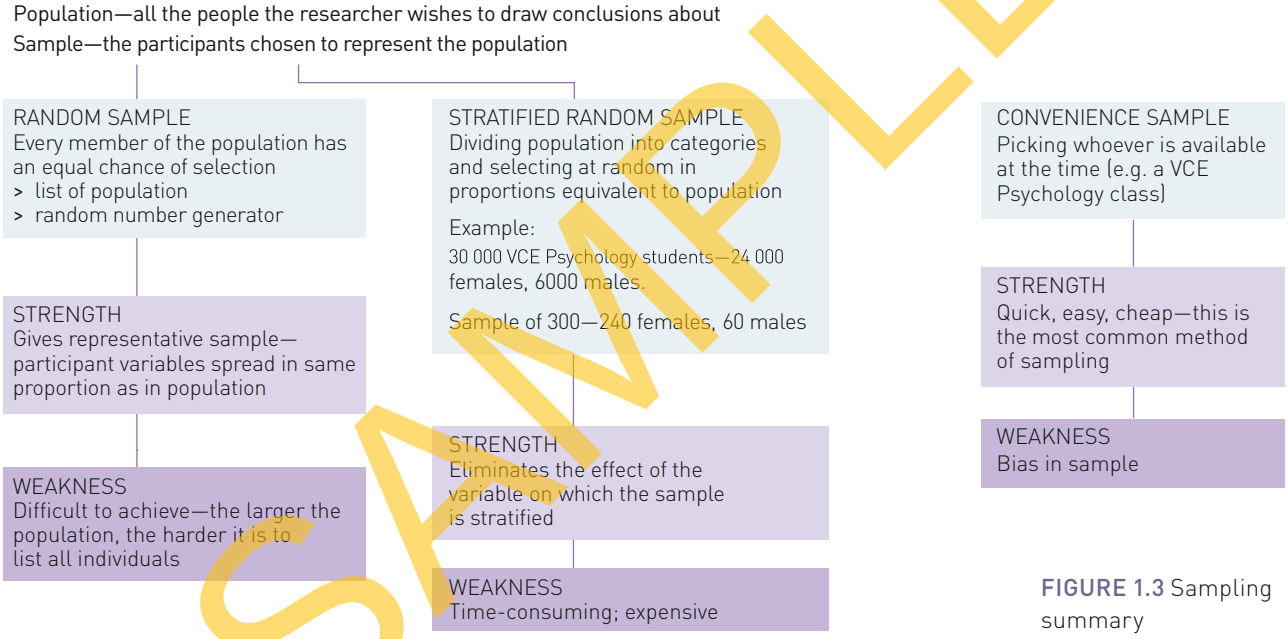


FIGURE 1.3 Sampling summary

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.

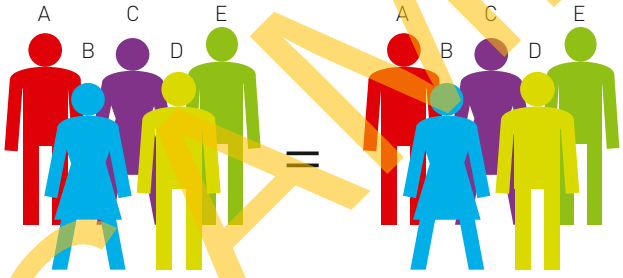


FIGURE 1.4 A repeated measures design involves using the same subjects in each condition of an experiment, e.g. giving a group of subjects a driving test with no alcohol, followed at a later time by the same test after a glass of wine.

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.

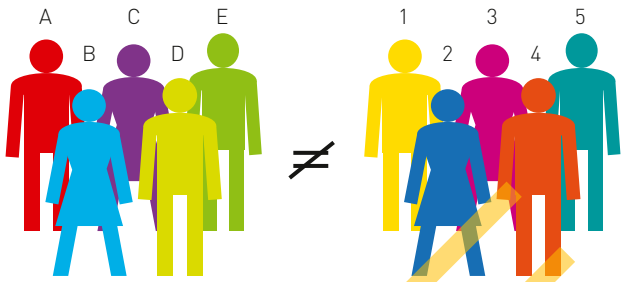


FIGURE 1.5 A matched pairs design involves using different but similar participants in each condition of an experiment. An effort is made to match the participants in each condition in important characteristics that might affect performance, such as driving ability or alcohol tolerance.

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.

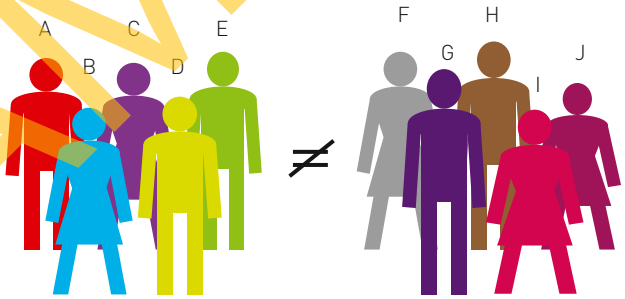


FIGURE 1.6 An independent groups design involves using different subjects in each condition of the experiment, e.g. giving one group of participants a driving test with no alcohol, and a different group of participants the same test after a glass of wine.

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

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.

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.

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.

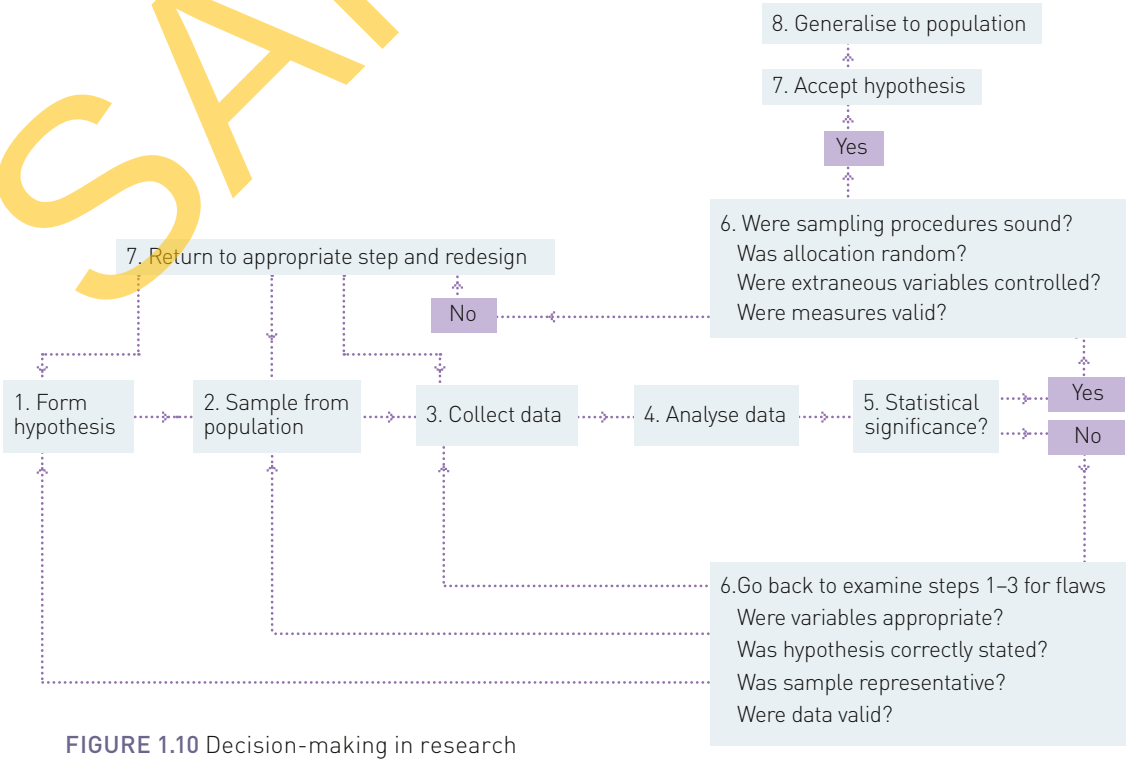


FIGURE 1.10 Decision-making in research

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.

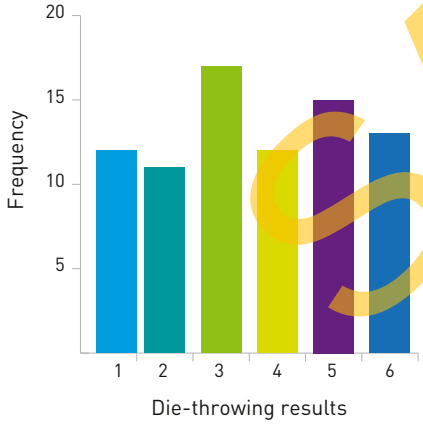


FIGURE 1.11 Histogram showing number of occasions each number was thrown in 80 rolls of one die

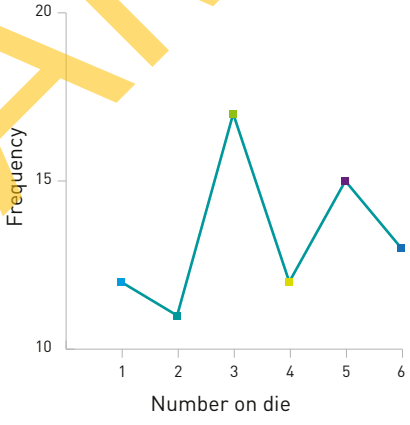


FIGURE 1.12 Frequency polygon showing number of occasions each number was thrown in 80 rolls of one die

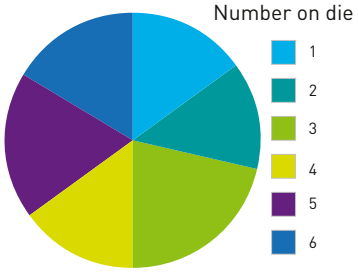


FIGURE 1.13 The pie chart makes it easier to register relative proportions.

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

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

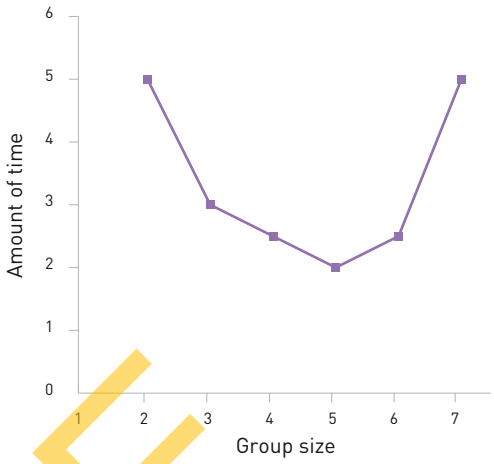


FIGURE 1.14 Time taken to complete class work for different-sized study groups

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.

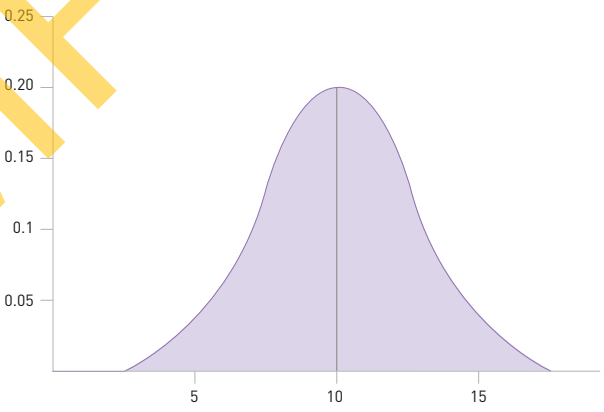


FIGURE 1.15 The normal (or bell) curve

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.

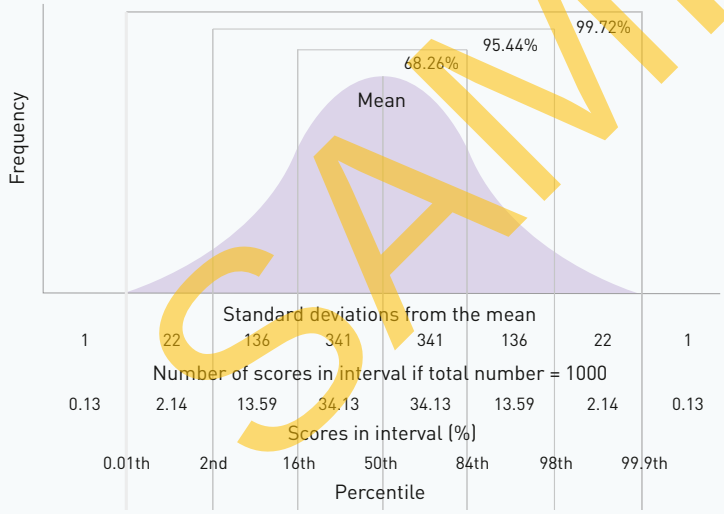


FIGURE 1.16 Distribution in a normal curve, showing percentiles by standard deviation

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).

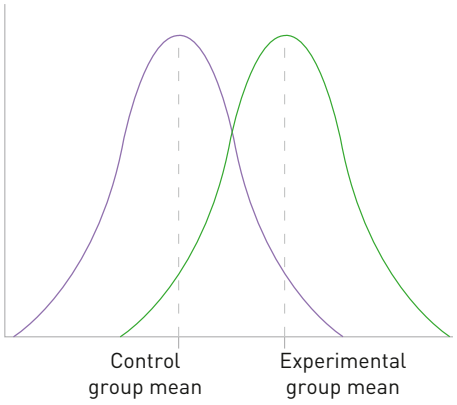


FIGURE 1.17 While the control group and the experimental group have different means, the significance of the difference depends on the sample size.

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.

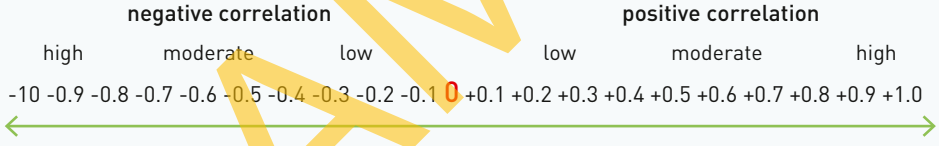
3 Myra has a theory that driving a car becomes an automatic process at an earlier age for boys than for girls. She asks 200 volunteer participants from München University to undertake a task in which they drive a manual car around an obstacle course while they were reciting the 5, 7 and 9 times tables 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.



- **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.

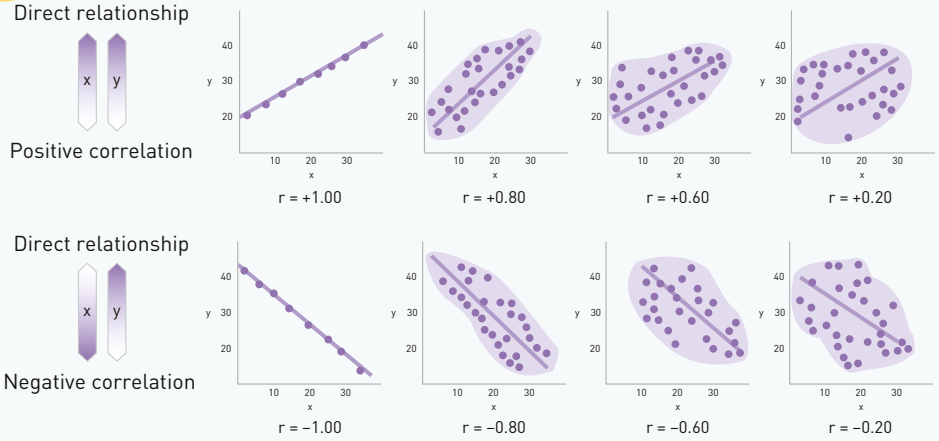


FIGURE 1.18 Scatter diagrams showing relationship and correlations. The scatter diagrams show various strengths and directions of correlation, from perfect positive correlation to perfect negative correlation.

Ethical considerations in psychological research with human participants

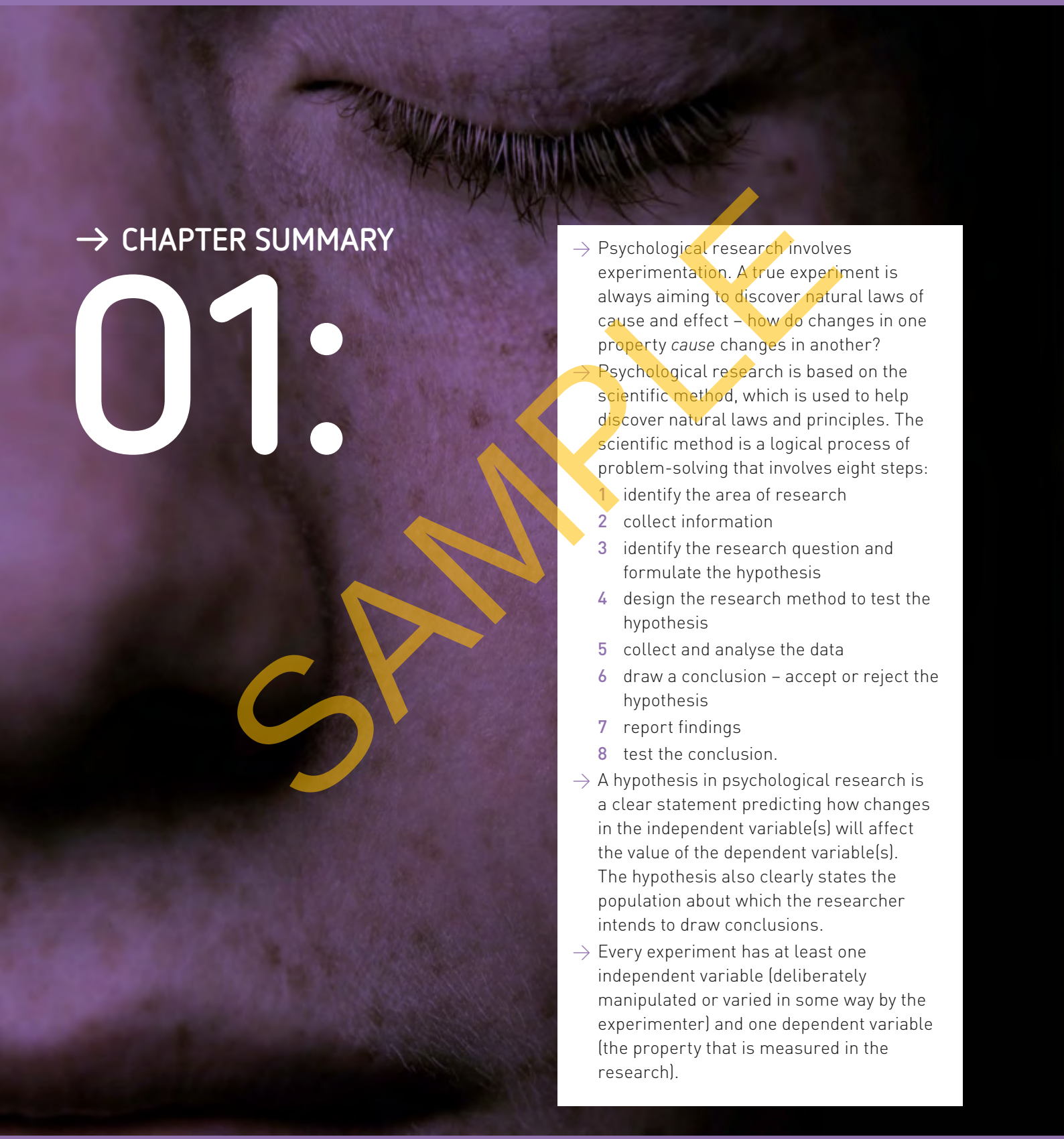
The Australian Psychological Society publishes a 'Code of Ethics' for psychologists and this has been adopted by the Psychology Board of Australia to apply to all psychologists in Australia.

- **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 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?

1.9 REVIEW



→ 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.		