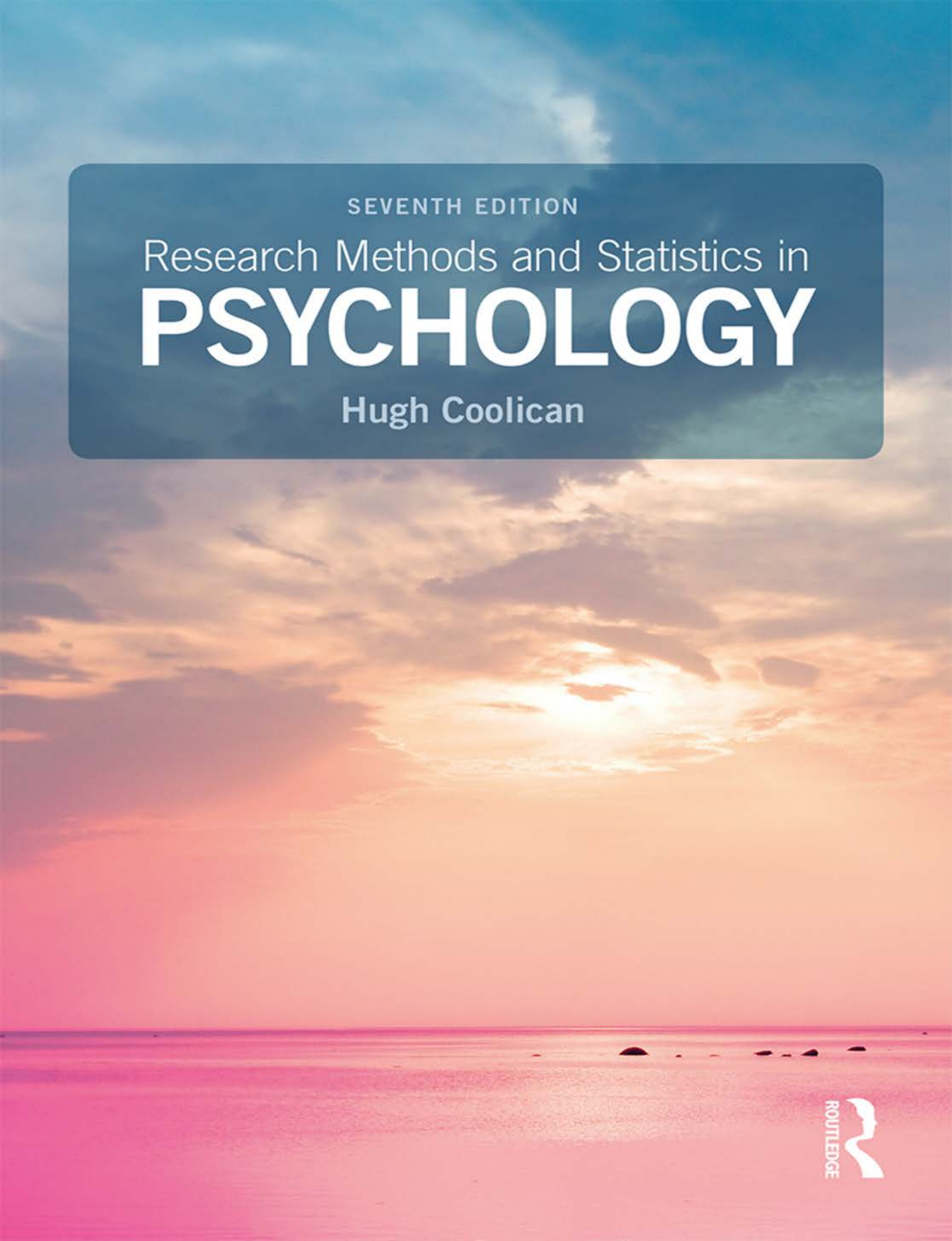
SEVENTH EDITION
Research Methods and Statistics in
PSYCHOLOGY
Hugh Coolican
ROUTLEDGE

Research Methods and Statistics in Psychology

The seventh edition of *Research Methods and Statistics in Psychology* provides students with the most readable and comprehensive survey of research methods, statistical concepts and procedures in psychology today. Assuming no prior knowledge, this bestselling text takes you through every stage of your research project giving advice on planning and conducting studies, analysing data and writing up reports.

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New features to this edition include:

- additional coverage of factor analysis and online and modern research methods;
- expanded coverage of report writing guidelines;
- references updated throughout;
- presentation updated throughout, to include more figures, tables and full colour to help break up the text;
- companion website signposted throughout the book to improve student usability;
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Hugh Coolican is a recently retired Principal Lecturer in Psychology at the University of Coventry, now holding the position of Honorary Teaching Fellow. He is also a Chartered Psychologist and an examiner and scrutineer for the International Baccalaureate.

PRAISE FOR THE PREVIOUS EDITION

"I recommend this book as essential reading at undergraduate level: the breadth and depth of the coverage is excellent, and the explanations given, and examples used, are clear, accessible and accurate. The latest edition also includes 'tricky bits' at the end of each chapter – things that students repeatedly have problems with and which are also relevant to improving their marks."

– David Tyfa, University of Huddersfield, UK

"The book presents a significant number of practical and valid examples of the use of statistics in psychology. However, the author also presents the material using language that transcends to other fields as well. The emphasis on exploration of data as a precursor to the application of inferential statistical methods is extremely useful for students and researchers alike."

– Adriana Espinosa, City College New York, USA

RESEARCH METHODS AND STATISTICS IN PSYCHOLOGY

Seventh Edition

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Routledge
Taylor & Francis Group
LONDON AND NEW YORK

Seventh edition published 2019
by Routledge
2 Park Square, Milton Park, Abingdon, Oxon, OX14 4RN

and by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

First edition published by Hodder and Stoughton 1990
Second edition published by Hodder and Stoughton 1994
Third edition published by Hodder and Stoughton 1999
Fourth edition published by Hodder Education 2004
Fifth edition published by Hodder Education 2009
Sixth edition published by Routledge 2014

British Library Cataloguing-in-Publication Data
A catalogue record for this book is available from the British Library

Library of Congress Cataloging-in-Publication Data
A catalog record for this book has been requested

ISBN: 978-1-138-70895-2 (hbk)
ISBN: 978-1-138-70896-9 (pbk)
ISBN: 978-1-315-20100-9 (ebk)

Typeset in Times New Roman
by Apex CoVantage, LLC

Visit the companion website: www.routledge.com/cw/coolican

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Preface

This book is for anyone starting out on a psychology course which contains a fair amount of hands-on practical research training and the writing up of psychological reports. It will be most useful for those studying for a psychology degree but will also serve students on higher degree courses in psychology (where methods knowledge may have become a little rusty), on other social sciences courses, on nursing degrees and in several other related disciplines. It should also be useful for A Level and IB students but especially for their tutors who may need to clarify research methods concepts and statistical knowledge.

The common factor is the need to understand how researchers gather data in a fair and unbiased manner and how they analyse and interpret those data. A feature that I'm sure all such readers would be pleased to find is a friendly common-sense approach that uses concrete examples to explain otherwise abstract and sometimes complex notions. In the past, this book has been praised for doing just that, and I truly hope it continues to do so.

A basic premise of the book has always been that people start out on research methods courses with many of the basic principles already acquired through their experience of everyday life. To some extent, the job of tutors and writers is to harness those concepts and to formalise and then elaborate upon them. Before you do psychology, you probably know just what a fair experiment would be, what an average is, what it means when people deviate a lot from an average and even the fundamentals of *statistical significance* – you can probably tell intuitively when samples of girls' and boys' reading scores differ by an amount that cannot be explained just by chance variation. Hence, you are not really starting out on something you know little about no matter how wary you may be of numbers and science.

One of the bonuses of studying research methods and statistics is that you greatly enhance what Postman, N. and Weingartner, C. (1971) referred to as your personal 'crap detection' system, to put it rather crudely. That is, a study of methods and statistics, at the very least and done properly, will enhance your ability to spot gross errors in the statistical arguments of advertisers, politicians and charlatans who try to use numbers or 'findings' to bamboozle you. There are several examples of such poor methods or data massaging in the book and hopefully you will later be able to argue 'Ah but, . . . ' at dinner parties and become everybody's best friend as you point out the flaws in the assumptions people make from 'findings' that have made the news.

Many people start psychology courses with a very strong fear of the statistics that may be involved. This is understandable if, for you, the world of numbers has always been something of a no-go area. However, statistics is one of the easiest

areas of maths (it must be, both my children said so, even the one for whom maths was a nightmare). You should not have to do a lot of by-hand calculating, unless your tutors are sadists! Psychological research is not about learning to do sums; it's about using statistical tools to summarise data and to show people that we have found a relationship between the data that supports a particular view or theory about how people work. Where you do have to calculate, be assured that the actual calculation steps for most procedures *never* extend beyond the basic capability of the average 11-year-old and can all be done on a £5 calculator.

In this seventh edition, there have been several changes. Whilst retaining the sixth edition's "Tricky bits" boxes, at the end of most chapters, I have now added, after that, a 'Further reading and links' box which takes you to many interesting and useful relevant Websites. As before, the 'Tricky bits' boxes contain notes on things that students typically and predictably have problems with – common misunderstandings, likely mistakes in handling data and, basically, tricky bits. Instructions for SPSS are compatible with V24 (used in this book) or the new V25. Qualitative methods have been thoroughly upgraded. The text now includes substantial coverage of internet research and even links to internet studies that you can be involved in online. There is a completely new chapter on factor analysis which is a popular technique used in the development of psychological measurement scales. For that chapter, and for all other chapters containing statistical calculations, the data sets used have been included on the revised ***Companion Website***.

Qualitative methods are integrated into general chapters (e.g. interviewing, observation and the quantitative–qualitative debate in Chapter 2) and two specialist chapters. The first edition was almost certainly the first general methods text in the UK to pay specific attention to qualitative methods. The two focused qualitative methods chapters deal with theory first and then practical application of several methods of analysis including thematic analysis, grounded theory, interpretive phenomenological analysis and discourse analysis. A full qualitative article, using thematic analysis, is available on the ***Companion Website***.

Contemporary issues covered include an evaluation of animal studies, the emerging controversy concerning prestigious journals' reluctance to accept articles which replicate previous studies and the more recent reproducibility 'crisis'. There are also several attempts to tackle 'psychology myths' such as what the Hawthorne studies really showed, how Zimbardo biased participants in his famous study and, more substantially, a debate on the much misused term 'ecological validity' which is extended on the ***Companion Website***. This website, introduced with the fifth edition, has been expanded with the data sets mentioned earlier, more exercises and with further issues such as the role and status of peer review.

I encourage feedback, queries and, yes, people just telling me I'm wrong about something – how else would we learn? You can email me at hughcoolican@coventry.ac.uk and I will attempt to provide a clear response. Finally I'd like to repeat something from the fourth edition preface. While you toil away, writing those inevitable research reports, just keep thinking that none of the truly fascinating ideas about human behaviour and experience and none of the wonderful insights about ourselves that can be gained on a psychology course would be possible without someone (many committed people in fact) doing exactly as you are doing – researching and writing reports. This is where psychology comes from. Doing methods is not meant to be a punishment or something to make the subject 'hard'. Without research, psychology just wouldn't exist!

Acknowledgements

My thanks for support in producing and sending this seventh edition to the editing team at Taylor and Francis including Ceri Griffiths, Ceri McLardy, Alex Howard and Helen Evans along with Autumn Spalding from the production company Apex CoVantage and the copy editor, Tara Grover Smith.

I would also like to thank two academic colleagues, Simon Goodman of Coventry University, who once again reviewed the qualitative chapters and provided valuable advice, and David Hughes at the University of Manchester who helped so much with the factor analysis chapter and who, along with his co-authors, Adrian Furnham and Mark Batey, permitted me to include their data set on the ***Companion Website***. Finally, and of course, thanks to Rama for tolerating me being upstairs for so long in the past 18 months.

PART 1

Research methods and ethics

CHAPTER 1

Psychology, science and research

This introduction sets the scene for research in psychology. The key ideas are:

- Psychological researchers generally follow a *scientific approach*, developed from the 'empirical method' into the 'hypothetico-deductive method'. This involves careful definition and measurement, and the logic of testing hypotheses produced from falsifiable theories.
- Most people use the rudimentary logic of scientific theory testing quite often in their everyday lives.
- Although scientific thinking is a careful extension of common-sense thinking, common sense on its own can lead to false assumptions.
- Claims about the world must *always* be supported by *evidence*.
- Good research is *replicable*; theories are clearly explained and *falsifiable*.
- Theories in science and in psychology are not 'proven' true but are *supported* or *challenged* by research evidence. Much research attempts to *eliminate* variables as possible explanations. It also attempts to broaden the scope of a previously demonstrated effect or to find instances where the effect does not occur.
- Scientific research is a continuous and social activity, involving promotion and checking of ideas among colleagues.
- Research has to be planned carefully, with attention to *design*, *variables*, *samples* and subsequent *data analysis*. If all these areas are not thoroughly planned, results may be ambiguous or useless.
- Some researchers have strong objections to the use of traditional *quantitative* scientific methods in the study of persons. They support *qualitative methods* and data gathering, dealing with meaningful verbal data rather than exact measurement and statistical summary.

WHY PSYCHOLOGY AND SCIENCE?

If you are just starting to read this book, then you have probably started on a course in psychology and may have been surprised, if not daunted, to find your tutors talking about psychology being a 'science'. You will probably have found that you must carry out practical research exercises, make measurements, deal with statistics and write up your findings as a scientific report (or, just maybe,

you weren't surprised at all). Many people cannot divorce from their concept of 'science' images of Bunsen burners, retort stands, white coats, complicated mathematical formulae and really unpleasant smells.

Rest assured the psychological 'laboratory' contains none of these things and shouldn't really involve you in difficult maths. There is the use of statistics for sure but (a little later on) I hope to assure you that all statistical calculations can be carried out on a cheap calculator or phone and, anyway, there are computers to do any serious number crunching.

The main point to put across right here and now, however, is that science is *not* about retort stands and white coats. It is a *system of thought* that leads us to a rational explanation of how things work in the world and a process of getting closer to truths and further from myths, fables and unquestioned or 'intuitive' ideas about people. A further point, and one which is central to the approach of this book, is to emphasise that you already do think scientifically even if you thought you didn't (or not very often). We will return to that point too in a moment.

This book, then, is about the ways that psychologists go about establishing evidence for their theories about people. It's about how they do research and the advantages and disadvantages involved in the use of alternative methods. In this chapter, we will discuss the reasons why psychology uses the scientific method and ask, what *is* science and what is scientific thinking? We will also briefly introduce a vein within psychological research that largely rejects traditional scientific methods, especially the attempt to measure or predict behaviour, seeing this as a way of dehumanising the person.

ISN'T A LOT OF PSYCHOLOGY JUST SIMPLE INTUITION?

But first let's address those readers who are disappointed because they thought that, after all, psychology is not a physical science and we all know so much about people already; surely a lot of it is plain common sense or pure intuition? Intuition is often seen as a handy short cut to truth.

Well let's look at something that will be intuitively obvious to most people. Ever since the arrival of text messaging, parents and teachers have knowledgeably complained that what they see as the ugly use of text abbreviations or *textisms* ('gr8', 'ur' and so on) will have an inevitably detrimental effect on the user's standard of English. The media overwhelmingly assume a negative effect of texting on standard English (Thurlow, 2006). Indeed my own university psychology department banned the use of text language in emails in the interests of maintaining English standards. So we 'know' that text language is bad for young people's English . . . or do we?

Plester, Wood and Bell (2008) did not rely on this kind of intuitive knowledge and instead conducted *empirical research* – a term to be explained in a short while but meaning that they looked for *evidence* – valid facts about text messaging. They found, contrary to popular opinion on the matter, that children aged 11–12 who used more textisms produced *better* scores on a test of verbal reasoning ability – a measure that is strongly related to Key Stage 2 and 3 English scores. In addition the researchers found that the better these children were at translating text messages the better they were at spelling. There was also a similar and strong relationship between writing ability and the use of

textisms. A lot of psychological studies do in fact tend to corroborate what we already might have believed but I really like studies such as this one where what was 'obvious' turns out to be quite wrong. Results like these teach us to always *check the evidence* and not to just trust our intuitive guesses (that *feel* like fact).

WHY CAN'T WE TRUST INTUITION?

We can't trust intuition because it depends too much on myth, stereotype, prejudice and received but unchecked wisdom. In addition, when confronted with a new problem intuition is very vulnerable to our tendency to stick with what we know. Try these three problems and don't read any further until you have had a think about them.

PAUSE FOR THOUGHT

1 Imagine a rope placed around the circumference of the Earth (and please try to ignore hills, mountains and lakes). Suppose we now want to lift the rope so that it is 1 metre above the Earth all the way around. About how much more rope would we need?
2 Take a piece of paper and fold it over on itself three times. The paper is now a bit thicker than it was before. We can't physically fold a piece of paper more than about seven times but just imagine folding it over on itself another 50 times. How thick would the paper now be?
3 What percentage of UK land is built on?

The answer to the first question is just over 6 metres! How can that be you say because the Earth is so huge. The trouble here is that because part of the problem involves a massive size, we think the answer must be massive . . . but it isn't. If you'd like to check out the calculation then take a look at p. 30; having promised no awkward maths, it would be unwise to put formulae into the main text right now!

The same process happens with the second question in the opposite direction. We know paper is very thin so we assume the answer is a relatively small number. In fact the paper would be thick enough to stretch from the Earth to the Sun . . . and back again . . . and back again with a bit left over! If you take a piece of paper to be 0.1 mm thick[1] then double this thickness 53 times (using Excel, for instance), you'll get a huge number of millimetres which you can then divide by 1,000,000 to get kilometres. If you now convert the distance, it is about 280 million miles!

The answer to the third question is just 5.9%. I suspect your estimate would have been a lot higher. In fact in an Ipsos Mori survey people were told that 'Continuous Urban Fabric' (CUF) is where over 80% of an area of land is covered by artificial surfaces – mainly roads and buildings. Respondents estimated on average that 47% of the UK fitted this description whereas the true figure is just 0.1%. If the UK was considered as a football pitch people estimated that almost half of the pitch was CUF whereas the actual figure is equivalent to the tiny quarter circle

from which corner kicks are taken. The problem here might be that people tend to think from their own perspective (mostly urban) rather than from a more global position (Easton, 2018).

What has all this to do with psychology? Well, the problem we're dealing with here is that intuition, or 'common sense', gives us 'obvious' answers which are incorrect so we can't rely on it for developing a system of psychological knowledge.

Intuition is an even poorer help when issues are much more personal to us. Ritov and Baron (1990) asked participants a hypothetical question. 'Imagine there is a flu epidemic during which your child has a 10 in 10,000 chance of dying. There is a vaccine which will certainly prevent the disease but it can produce fatalities'. They asked participants to decide the maximum level of risk of death from the vaccine that they would accept for their child. Participants generally would not accept a risk higher than 5 in 10,000. In other words, participants were willing to submit their child to a 1 in 1,000 chance of dying from flu rather than take the lower (1 in 2,000) risk of death from the vaccine. This is 'magical thinking'. Perhaps people thought that they would rather 'chance' their child than that any positive decision they made could be linked to their child's death even though *not* acting carried double the chance of fatality! Something very similar happened for real in the UK from the late 1990s when flimsy evidence, eventually declared fraudulent by the *British Medical Journal* (Deer, 2011), that the MMR jab might be a cause of early autism led parents to avoid it, contributing to a significant rise in cases of measles. Uptake dropped from 92% in 1996 to around 85% in 2006, compared with about 94% for other vaccines (McIntyre and Leask, 2008). By 2011 uptake had risen to 90% (HPA, 2011). There has never been any genuine evidence that the MMR jab can cause autism.

Whereas many of us are reluctant to give up 'truths' which turn out not to be such, the situation is far more extreme with conspiracy theorists. You probably know of some of these theories – that men never did really land on the moon, that 9/11 was organised by the US government. As Francis Wheen writes in *Strange Days Indeed* (Harper Collins, p. 274), 'Scientists test their hypotheses, whereas conspiracists know the truth already, and skip nimbly round any facts that might refute it'. Many people are convinced that their 'intuition' tells them reliable truths about the world and about people. Psychologists aren't.

SCIENCE – NOT A SUBJECT BUT A WAY OF THINKING

Many students who choose psychology are put off by the idea of 'science' being applied to the study of people. People who are interested in people are not usually terribly interested in laboratory equipment or procedures. However, what we need to be clear about here is that science is not a body of technical knowledge or a boring 'subject' but simply a *way of thinking* that leads us towards testable explanations of what we observe in the world around us. It doesn't deliver the 'truth' but it does provide us with reasonable accounts of what *might* be going on. A proposition about what *might* be going on is a theory. Science is about testing theories to see which one is most likely to be true. *It is a thought system that we all use in our everyday lives*. It is no different from the logic that is used in the following 'everyday' example.

PAUSE FOR THOUGHT

Imagine that you have a younger brother and that you've been given the task of taking him to the doctor with a rash that he seems to get each week on Monday. The doctor takes one look and asks, 'Does he eat broccoli?' 'Yes', you answer, 'He doesn't like it so he just has to eat it on Sundays when we have a roast dinner with our Gran'. The doctor feels fairly sure that the rash is an allergy. The obvious move now is to banish broccoli from his diet (brother is ecstatic) and watch for the rash. Four weeks later the rash has not re-appeared. The broccoli theory looks good.

Has this 'proved' that broccoli was the problem? Well, no, and here is a point that will be repeated many times in different ways throughout this book. Contrary to popular 'common sense' (and this is not true just for 'soft' psychology but for all sciences, no matter how hard), *scientific research does not prove theories true*. Listen to scientific experts being interviewed in the media and you will hear them use phrases such as 'all the evidence so far points towards . . .' or 'the evidence is consistent with . . .', no matter how hard the interviewer pushes for a definitive answer to questions such as 'Do power lines cause childhood leukaemia?'. Research supplies *evidence* which might support or contradict a theory. If your brother's rash disappears, then we have *support for* (not proof of) the broccoli allergy theory. We don't have proof because it could have been the herbs that Gran always cooks along with the broccoli that were causing the rash. There is always another possible explanation for findings. However, if the rash remains, then we have, as we shall see, a more definite result that appears to knock out the broccoli theory altogether, though again, there is the outside possibility that your brother is allergic to broccoli *and* to something else that Gran always includes in the Sunday meal. By taking out one item at a time though, and leaving all the others, we could be pretty certain, eventually, what specifically causes the rash. This is how we test theories.

NEVER USE THE TERM 'PROVE'

So a scientific test never 'proves' a theory to be true. If ever you are tempted to write 'this proves . . .' always cross out the word 'proves' and use 'suggests' instead. The word 'proof' belongs in mathematics, where mathematicians really *do* prove that one side of an equation equals the other, or in detective stories – where the victim's blood on the suspect's shoes is said to 'prove' their guilt. Of course it doesn't. There is always a perhaps stretched but possible innocent explanation of how the blood arrived there. The victim could have previously borrowed the suspect's shoes and cut himself shaving. In psychology, as for detective work, if theories are speculative explanations, then 'evidence' can only ever support or challenge, not 'prove' anything. We *know* that the suspect committed the crime if we see unambiguous footage of the incident. However, we do not now talk of 'evidence' to support a theory since the suspect's guilt is no longer theory – it is fact (but even then it could have been the suspect's twin on the footage!). That a gearbox has been silenced with sawdust is but a theory until we open it up and actually find some – now we have a fact.

KEY TERMS

Findings
Outcomes of a study (e.g. means, results of statistical tests) before any interpretation is made of them in terms of background theory or expectation (see Box 1.1).

Conclusions
A summary of what findings might mean in terms of overall theory and/or proposed relationships between variables (see Box 1.1).

1.1 FINDINGS AND CONCLUSIONS

Be careful always to distinguish between '**findings**' and '**conclusions**'. Findings are what actually occurred in a study – what the results were. Conclusions are what the researcher may conclude as a result of considering findings in the light of background theory. For instance, the fact that identical twins' IQs correlate quite highly is a *finding*. From this finding a researcher might *conclude* that heredity *could* play a big part in the development of intelligence. This is not the only possible conclusion, however. Since identical twins also share a very similar environment (they even have the same birthday and sex compared with other pairs of siblings), the finding could *also* be taken as evidence for the role of the environment in the development of intelligence. Archer (2000) produced a *finding* that, contrary to expectation and across several countries, females in partnerships used physical aggression slightly more than did their male partners. What we could *conclude* from this is *perhaps* that most males, knowing their own strength, restrain their impulses. However, we do not *know* this until we conduct further research. We *do* know that some males do *not* restrain their impulses. In cases of serious injury most perpetrators are male. Findings should always be clear, unambiguous and subject to little if any argument. Conclusions, on the other hand, are very often contentious and disputed. Thinking back, your brother's lack of a rash was a finding; the assumption that broccoli caused it was a conclusion.

THINKING SCIENTIFICALLY – WE CAN ALL DO IT

I claimed above that people use the logic of scientific thinking in their everyday lives. The difference between ordinary and professional scientific thinking is just a matter of practice and the acquisition of some extra formal concepts and procedures. The study of psychology itself will tell you that almost all children begin to seriously question the world, and to test hypotheses about it, from the age of around 6 or 7. The logic that you will need to cope with science, and all the concepts of methods and statistics in this book, are in place by age 11. Everything else is just more and more complicated use of the same tools. We use these tools every day of our lives. We used the brother's rash example above to demonstrate this. As a further 'normal life' example suppose you find that every morning when you go to your car you find the mirror has been twisted round. You suspect the paper boy. You could of course get up early and observe him but let's suppose this is such a quiet spot that he would just see you and not do it. A simple test would be to cancel the paper one day. If the mirror is then not twisted you can assume *either* it is him *or* a very remarkable coincidence has occurred and the real culprit also

happened to have a day off. This is very close to the thinking in significance testing which we will encounter in Chapter 16. In experiments we often have to choose between one of two possibilities: did the experiment work or was there just a huge coincidence? Our judgement is based on just how unlikely the coincidence would be.

KEY TERM

Hypothesis testing
Research that analyses data for a predicted effect.

PAUSE FOR THOUGHT

Most people fairly frequently use the basic logical principles that underlie all scientific thinking, such as the logic of **hypothesis testing** which we will explore in more detail shortly. They are usually quite capable of generating several basic research designs used in psychology without having received any formal training. To show that you can do this try the following:

1 Try thinking of ways to test the proposal that '*Heat makes people aggressive*'.
2 With student colleagues, or alone, try to think of ways to gather evidence for this idea. If you do the exercise alone, try to think of one method, fill in all details, then try to think of a completely different approach.
3 Some suggestions appear in Table 1.1. (The suggestions that students in workshops produce in answer to this question usually predict most of the lecture topics in the 'research designs' section of a first-year course in research methods!)

Suggested designs for testing the theory that heat makes people more aggressive	**Methods used (which we will learn more about in Chapters 2–7)**
Have people solve difficult problems in a hot room then in a cold room; measure their blood pressure.	Repeated measures experiment; very indirect measure of aggression. (Chapter 3)
Have one group of people solve problems in a hot room and a different group solve them in a cool room. Have them tear up cardboard afterwards and assess aggression from observation.	Between groups (independent samples) experiment; aggression assessed from direct observation of behaviour but coding (see page 155) will be required. (Chapter 3)
Observe amount of horn-hooting by drivers in a city on hot and cold days.	Naturalistic observation. (Chapter 6)
Put people in either a hot or cold room for a while, then interview them using a scale to measure aggression.	Between groups (independent samples) experiment; dependent variable is a measurement by psychological scale. (Chapter 8)
Approach people on hot and cold days, and administer (if they agree) aggression scale.	Between groups quasi-experiment (Chapter 5); aggression is defined as measured on a psychological scale.
Check public records for the number of crimes involving aggression committed in hot and cold seasons in the same city.	Use of archival data, a kind of indirect observation. (Chapter 6)

Table 1.1 Possible ways to test the hypothesis that heat makes people more aggressive