Second Canadian Edition

METHODS IN BEHAVIOURAL RESEARCH

PAUL C. COZBY | CATHERINE D. RAWN

Methods in Behavioural Research

SECOND CANADIAN EDITION

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Dedication

To Kathleen D. Vohs,
For your mentorship and encouragement.
–C.D.R.

For Ingrid and Pierre.
–P.C.C.

About the Authors

Paul C. Cozby is emeritus professor of psychology at California State University, Fullerton. Dr. Cozby was an undergraduate at the University of California, Riverside, and received his Ph.D. in psychology from the University of Minnesota. He is a fellow of the American Psychological Association and a member of the Association for Psychological Science; he has served as officer of the Society for Computers in Psychology. He is executive officer of the Western Psychological Association. He is the author of *Using Computers in the Behavioral Sciences* and co-editor with Daniel Perlman of *Social Psychology*.

Catherine D. Rawn is senior instructor of psychology at the University of British Columbia, Vancouver. Dr. Rawn was an undergraduate psychology major at the University of Waterloo, and received her master of arts in social/personality psychology at the University of British Columbia. She continued at UBC and received her Ph.D. in social/personality psychology with a minor in quantitative methods. Her publications appear in journals such as *Teaching of Psychology* and *Personality and Social Psychology Review*. She regularly teaches undergraduates research methods, introductory statistics, and introductory psychology. She also facilitates professional development in teaching for graduate students and faculty.

Brief Contents

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Preface

Learning about and teaching research methods can be greatly challenging and incredibly rewarding. As a young learner, with each step I took toward participating in the research process, I realized I was learning an incredibly useful way to think about the world. The cover image of this second Canadian edition of *Methods in Behavioural Research* offers a metaphor for what this text aims to do: Illuminate core concepts and current issues to help readers navigate the path toward using research methods effectively. This path also can be viewed as depicting the process of research itself: Sometimes research investigations are clear and straightforward, but more often the path toward understanding an aspect of behaviour is winding and uncertain.

WHY A CANADIAN EDITION?

The second Canadian edition of *Methods in Behavioural Research* offers a Canadian perspective on conducting research in psychology. Three benefits emerge from a Canadian edition. First, by incorporating Canadian examples, researchers, and cultural references, this text will more effectively reach our students and instructors in Canada. I grew up reading texts brimming with American references. I can still recall the first time I realized—with great excitement—that I personally knew a researcher cited in my Canadian text. By highlighting the Canadian context of research, we can avoid subtle yet unnecessary barriers to the enlightening world of research methods. Second, a Canadian research methods text offers the chance to illuminate the rich Canadian research landscape while preparing readers to engage in it. Researchers across our country are conducting rigorous, interesting, impactful work; plenty of high-quality examples are available to incorporate. Third, a Canadian research methods text gives a voice to Canadian reviewers. I am thankful for the three rounds of peer reviews the Canadian editions have received so far. By incorporating most of their ideas and feedback each time, this text is becoming stronger. You are shaping the very text our students use.

Notably, I have maintained the features of previous American editions that have been appreciated by instructors and students, including clarity, brevity, and repetition of key ideas (e.g., operationalization, validity). Below is a summary of the text's features and major changes for the second Canadian edition.

ORGANIZATION

The organization generally follows the sequence of planning and conducting a research investigation. Chapter 1 gives an overview of the scientific approach to knowledge and distinguishes between basic and applied research. Chapter 2 discusses sources of ideas for research including reading the literature. Ethical issues are covered in depth in Chapter 3 and emphasized throughout the book. Chapter 4 highlights the fundamental features of experimental and non-experimental approaches to studying relationships among variables. Chapter 5 focuses on measurement issues, including reliability and validity. Observational research approaches, including systematic observation and content analysis, are described in Chapter 6. Chapter 7 explores sampling as well as the design of questionnaires and interviews. Chapter 8 adds depth to experimental design, and Chapter 9 helps readers prepare studies for data collection. Factorial designs are explored in Chapter 10. Chapter 11 features designs for special circumstances where random assignment is impossible (e.g., quasi-experimental designs). Chapters 12 and 13 introduce the use of statistics, including effect size and confidence intervals, to help students understand research results. Finally, Chapter 14 discusses generalization issues, meta-analyses, and the importance of replications. Appendices on writing research reports, conducting statistical analyses, and using *PsycINFO* to search for journal articles are included for reference.

FLEXIBILITY

Chapters are relatively independent to provide instructors maximum flexibility in assigning the order of chapters. For example, chapters on observational and survey research methods are presented in the middle of the book, but instructors who wish to present this material earlier or later in a course can easily do so. It is also relatively easy to eliminate sections of material within most chapters. This book is particularly useful for courses in which students conduct their own research projects. Chapters 4 and 9 highlight key concepts for conducting experimental and non-experimental research; I assign these early in my course to help students kick off their projects. More nuanced details (e.g., Chapter 10, factorial designs) are then saved until later in the course.

FEATURES

- ***Clarity.*** The second Canadian edition retains the strength of direct, clear writing. Concepts are described in different contexts to enhance understanding. Some chapters have been reorganized to enhance overall clarity and reduce redundancy.
- ***Decision-making emphasis.*** Distinguishing among a variety of research designs helps students understand when to use one type of design over another.
- ***Strong pedagogy.*** *Learning Objectives* are highlighted throughout each chapter and mirrored in end-of-chapter self-test *Review Questions*. End-of-chapter *Deepen Your Understanding* questions prompt students to apply material from the chapter, and also can be used as in-class activities. All boldface key terms are listed at the end of each chapter, with prompts that encourage students to test their knowledge. Each key term is defined in the Glossary at the end of the book.

NEW TO THE SECOND CANADIAN EDITION

- ***Features current controversies.*** The last three years have been pivotal for research methods. Major cases of fraud, controversial publications, and failures to replicate some high-profile studies have triggered an explosion of interest in improving our own and other sciences. I see no need to shield students from these controversies and "in-progress" improvements; consequently, I have featured them throughout this edition. Many new references are included to help instructors and students alike learn more about these hot ongoing debates.
- ***Current, Canadian context.*** Updated research examples have been carefully selected to help students interpret challenging concepts and complex research designs. Remaining outdated or difficult examples have been replaced by new research conducted in Canada and occasionally by Canadians working abroad. Thirty percent of research featured throughout this edition is Canadian, representing 37 universities plus partnering institutions from all provinces. Note that not every Canadian reference is indicated as such. Sometimes institutions are mentioned, but highlighting every reference would create a sense of artificiality that could distract from the main purpose of teaching research methods.
- ***Improved flow within chapters.*** The sequencing and hierarchy of headings within each chapter has been carefully reconsidered for logical flow. Adjustments were made in many chapters to enhance flow by ensuring concepts build on each other in a stepwise manner.

Some changes to specific chapters are outlined below.

- ***Chapter 1.*** A new figure offers an overview of the scientific process that is revisited in Chapters 9 and 14. Clarified and better organized discussion of the ideal process of science. Shifted focus of basic versus applied research to emphasize continuum. Changed examples to highlight these different approaches to the same topic.
- ***Chapter 2.*** Reorganized structure to improve flow. Moved *PsycINFO* search steps to Appendix D. Highlighted importance of references and in-text citations for situating new work in the context of existing research. A new table compares the usefulness of different search engines (e.g., GoogleScholar vs. *PsycINFO*).

- ***Chapter 3.*** Refocused section on scientific misconduct to include publication ethics. Updated major cases. New feature on disciplinary reform initiatives. Brief treatment of big data controversy.
- ***Chapter 4.*** Changed title to better reflect chapter's purpose. Improved flow to emphasize key role of operational definitions. Added more examples of confounds and third-variable problem. Updated examples.
- ***Chapter 5.*** Updated some brief examples, including replacing a fictional example.
- ***Chapter 6.*** Updated to feature technology-driven innovations in observation and archival methods.
- ***Chapter 7.*** Updated examples to feature recent controversies. New figure to clarify cluster sampling technique. Changes to headings improve organization.
- ***Chapter 8.*** Updated all major examples to feature recent research. Re-emphasized confounds with a controversial example. New figures illustrate contrast effects and Solomon four-group design.
- ***Chapter 9.*** Reframed chapter to facilitate the decision-making process when finalizing a design for data collection. Two new checklists help readers organize tasks and make final decisions.
- ***Chapter 10.*** Minor changes to enhance organization and clarity.
- ***Chapter 11.*** Changed title to better reflect content. Improved example and graphs of single case designs. New tables organize and compare all special-case designs as well as threats to internal validity. Elaborated on ways threats to internal validity can affect interpretation of experimental designs too.
- ***Chapter 12.*** Replaced all fictional data with real data to illustrate concepts throughout the chapter. Some reorganization to enhance flow.
- ***Chapter 13.*** New emphasis on problems caused by seeking statistical significance, including publication bias and file drawer problem. Explicitly addressed the appropriate interpretation of a *p* value. Reinforced disciplinary reform initiatives.
- ***Chapter 14.*** Thorough revision highlights current controversies and disciplinary reform regarding replication and generalizing beyond convenience samples. Expanded final section encourages readers to "generalize" knowledge beyond course, including revisiting what they have learned about the whole process of research.
- ***Appendices.*** Updated Appendix A to emphasize the importance of audience and the broader purposes of APA style conventions; replaced sample paper. Clarified and updated Appendix B, particularly regarding effect sizes. Moved Latin square construction online to make room for new Appendix D that offers tips on conducting a *PsycINFO* search.

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INSTRUCTOR RESOURCES

- ***Instructors Manual.*** Written by this text's author, this in-depth Instructors Manual offers numerous student activities and assignment suggestions as well as demonstrations, discussions topics, reference articles, and sample answers for questions in the text.

- ***Computerized Test Bank.*** Prepared by Chantal Merner of University of Windsor, the Test Bank contains over 700 multiple choice questions, each categorized according to Bloom's Taxonomy. The Test Bank is available within Connect and through EZ Test Online—a flexible and easy-to-use electronic testing system—that allows instructors to create tests from book-specific items. Test items are also available in Word (rich text format).
- ***Microsoft® PowerPoint® Lecture Slides.*** Prepared by Craig Blatz of Grant MacEwan University, these customizable PowerPoint presentations represent the key concepts in each chapter.

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—Catherine D. Rawn

1

Scientific Understanding of Behaviour

LEARNING OBJECTIVES

Keep these learning objectives in mind as you read to help you identify the most critical information in this chapter.

By the end of this chapter, you should be able to:

1. Explain reasons for understanding research methods.
2. Describe the scientific approach to learning about behaviour and contrast it with pseudoscience.
3. Define and give examples of the four goals of scientific research in psychology.
4. Compare and contrast basic and applied research.

What makes people happy? How do we remember things, what causes us to forget, and how can memory be improved? What are the effects of stressful environments on physical health and relationships? How do early childhood experiences affect later development? What are the best ways to treat depression? How can we reduce prejudice and war? Curiosity about questions like these is probably the most important reason many students decide to take courses in the behavioural sciences. Scientific research provides us with a way to address such questions and find answers. Throughout this book, we will examine methods of scientific research in the behavioural sciences. In this introductory chapter, we will focus on the ways in which knowledge of research methods can be useful for understanding the world around us. Further, we will review the characteristics of a scientific approach to the study of behaviour and the general types of research questions that concern behavioural scientists.

LO1 WHY STUDY RESEARCH METHODS?

Understanding research methods can help you become an informed consumer of products, services, health care, and news. Research is continually reported by news organizations, popular magazines, bloggers, and advertisers. Headlines claim "Study finds that lonely women use Facebook all the time," assert "When drugs and therapy don't cure depression, running will," and question "Do cellphones cause brain cancer?". Articles, television commercials, books, and websites make claims about the beneficial or harmful effects of particular diets or vitamins on one's personality, health, or sex life. Survey results are frequently reported that draw conclusions about our beliefs and attitudes. How do you evaluate such reports? Do you simply accept the findings because they seem scientific? Can you detect pseudoscientific claims (as we will explore later in this chapter)? A background in research methods will help you to read these reports critically, evaluate the methods, and decide whether the conclusions and headlines are appropriate.

Understanding research methods can give you a competitive edge in various career paths. Many occupations require the ability to interpret, appropriately use, and create sound research. For example, mental health professionals must make decisions about treatment methods, medications, and testing procedures–all of which require the ability to read relevant research literature and apply it effectively. Similarly, people who work in business frequently rely on research to make decisions about marketing strategies, ways of improving employee productivity or morale, and methods of selecting and training new employees. Educators must keep up with research on topics such as the effectiveness of different teaching strategies or programs to deal with special challenges that some students are facing. *Program evaluation* (discussed further later in this chapter) is a career that is centred on conducting research to evaluate the efficacy of government and other programs to ensure that funding is well-spent. Knowledge of research methods and the ability to evaluate research reports are useful in these and other careers.

Understanding research methods can help you be an informed citizen and participate in public policy debates. Legislators and political leaders at all levels of government often take political positions and propose legislation based on research findings. Research can also influence legal practices and decisions. For example, numerous wrongful convictions triggered the use of psychological research to inform police investigation and courtroom procedures (Public Prosecution Service of Canada [PPSC], 2011; U.S. Department of Justice, 1999;

Wells, 2001; Yarmey, 2003). In one case, Thomas Sophonow was wrongfully convicted of murder by a Manitoba jury in 1983. After serving four years of his life sentence, his conviction was overturned. In the inquiry to follow (Cory, 2001), a retired Supreme Court of Canada justice used psychological science as the basis of numerous recommendations to prevent the kind of wrongful conviction that Sophonow endured. One of the studies that influenced these recommendations was conducted at Queen's University and showed that people make fewer false identifications of suspects when they are presented with a set of photographs one at a time rather than simultaneously (Lindsay & Wells, 1985; see also Steblay, Dysart, Fulero, & Lindsay, 2001). Since the inquiry was published, police have been required to present photographs sequentially when asking eyewitnesses to identify a suspect (PPSC, 2011). Another way that psychologists influence judicial decisions is by providing expert testimony and consultation on a variety of issues, including domestic violence (e.g., *R. v. Lavallee*, 1990), risk for violence (e.g., *R. v. Berikoff*, 2000), and evaluation of hypnotically recovered memory evidence (e.g., *R. v. Trochym*, 2007).

Understanding research methods can help you evaluate the efficacy of programs in which you may choose to participate or that you may implement in your community. For example, there are programs to enhance parenting skills for parents of youth engaged in aggressive and antisocial behaviour (Moretti & Obsuth, 2009), to influence people to engage in behaviours that reduce their risk of contracting HIV, and to enable employees in a company to learn how to reduce the effects of stress. We need to be able to determine whether these programs are successfully meeting their goals, and the application of research methods helps us do just that.

METHODS OF ACQUIRING KNOWLEDGE

We opened this chapter with several questions about human behaviour and suggested that scientific research is a valuable means of answering them. How does the scientific approach differ from other ways of learning about behaviour? People have always observed the world around them and sought explanations for what they see and experience. In this quest, relying on intuition and authority can be helpful sometimes, yet can lead to biased conclusions. Science offers a way to avoid some of these biases while systematically seeking high-quality evidence.

Intuition

Many of us have heard about someone who, after years of actively pursuing a long-term partner, stops looking for love. Then within a very short period of time, this person happens to find the love of his or her life. This observation contributes to a common belief that love arrives just when one is not looking for it.

Such a conclusion seems intuitively reasonable, and people can easily create an explanation for this event (see Gilovich, 1991). Perhaps stopping the hunt reduces a major source of stress, then the stress reduction increases confidence in social interactions, making people more desirable to potential partners.

This example illustrates the use of **intuition** based on anecdotal evidence to draw general conclusions. When you rely on intuition, you accept unquestioningly what your personal judgment or a single story about one person's experience tells you about the world. The intuitive approach takes many forms. Often, it involves finding an explanation for our own or others' behaviours. For example, you might develop an explanation for why you keep having conflicts with a co-worker, such as "that other person wants my job" or "having to share an office puts us in a conflict situation." Other times, intuition is used to explain intriguing events that you observe, as in the case of concluding that no longer looking for long-term love increases the chances of finding it.

A problem with intuition is that many cognitive and motivational biases affect our perceptions, and so we are likely to draw erroneous conclusions about cause and effect (cf., Gilovich, 1991; Nisbett & Ross, 1980; Nisbett & Wilson, 1977). So why do we believe that no longer looking for love leads to finding love? Most likely it is because of a cognitive bias called *illusory correlation* that occurs when we focus on two events that stand out and occur together. When a decision to stop looking is followed closely by finding a long-term mate, our attention is drawn to the situation, but when a decision to stop looking is *not* closely followed by finding a long-term mate, we don't notice this non-event. Therefore, we are biased to conclude that there must be a causal connection when in fact no such relationship exists. Such illusory correlations are also likely to occur when we are highly motivated to believe in the supposed causal relationship. Although this way of thinking comes naturally, it is not scientific and can lead us to make inaccurate assumptions. A scientific approach requires much more rigorous evidence before drawing conclusions.

Authority

When we make a decision based on **authority,** we place our trust in someone else who we think knows more than we do. For example, people tend to trust a physician's recommendations, particularly when they view that physician as being a specialist in that area (Barnoy, Ofra, & Bar-Tal, 2012). Such blind trust in medical authority is problematic. Ample research has shown that many health care workers (and patients alike) are prone to drawing incorrect conclusions from health-relevant statistics (e.g., when assessing survival rates versus length of life after cancer diagnoses; Gigerenzer, Gaissmaier, Kurz-Milcke, Schwartz, & Woloshin, 2007). Similarly, many people readily accept anything they encounter from the news media, books, government officials, or religious figures. They believe that the statements of such authorities must be true. Advertisers know this and therefore use endorsements by authorities to sell products. The problem, of course, is that the statements by the authority may not be true. The scientific approach rejects the notion that one can accept on faith the statements of any authority; again, more evidence is needed before we can draw scientific conclusions.

The Scientific Method: Be Skeptical, Seek Empirical Data

LO2

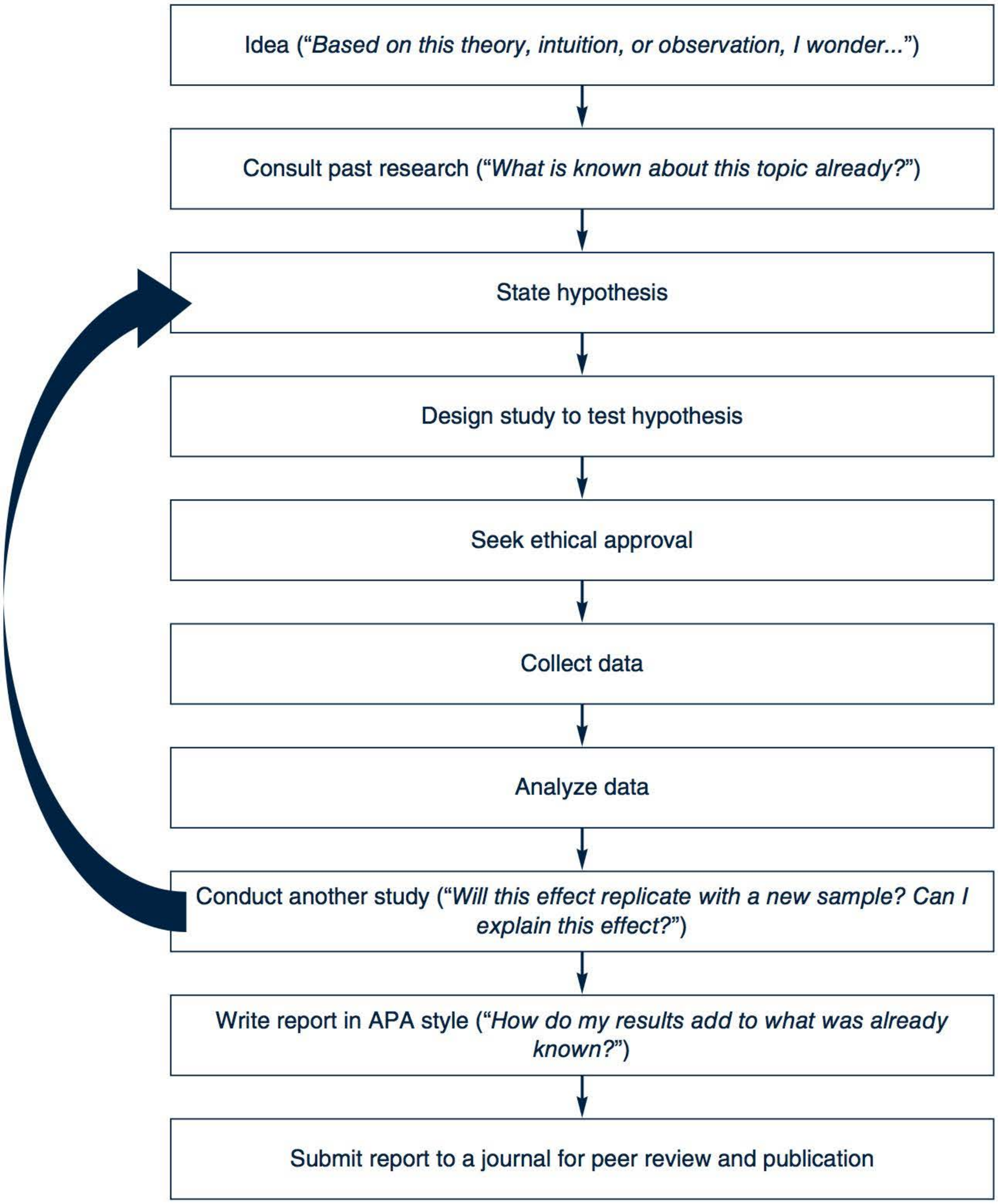
The scientific method of acquiring knowledge includes both intuition and authority as sources of ideas about behaviour. However, taking a scientific approach means avoiding the unquestioned acceptance of anyone's intuitions—including one's own. Ideas must be evaluated on the basis of careful logic and results from structured investigations. Throughout this book, we invite you to try out a mindset of **scientific skepticism** (if you haven't already!). Recognize that our own ideas are just as likely to be as wrong as anyone else's, and question other people's pronouncements of truth, regardless of their prestige or authority.

If scientific skepticism involves rejecting intuition and the blind acceptance of authority as ways of knowing about the world, how does knowledge develop? The fundamental characteristic of the scientific method is **empiricism:** knowledge is based on structured, systematic observations. The process of conducting research is complex and involves many steps. In its basic form, a scientist develops a *hypothesis* (an idea that might be true; see Chapter 2), then carefully collects data to evaluate whether that hypothesis accurately reflects the nature of the world. See Figure 1.1 for an overview of the many steps involved in conducting research. Although these steps may seem daunting, the scientific method includes a number of useful rules for developing theories and hypotheses, designing studies, collecting and evaluating data, and writing up results for publication. We will explore many of these rules together throughout this book.

Thousands of individual scientists worldwide—in disciplines as varied as psychology and physics—use the scientific method to understand the world. Regardless of the topic being studied and the specific procedures used, there are some broad characteristics that guide the ideal process of scientific inquiry (Goodstein, 2011; Merton, 1973). It is important to note at the outset that scientists are human and science is an imperfect enterprise. These ideals are not meant to be a fully exhaustive list. Moreover, they are not always perfectly reflected in reality, and they are often met with counterpressures, such as the pressure to publish many studies to build a career as a scientist. Yet the majority of scientists across various disciplines agree that the following four norms (Merton, 1973) should characterize scientific inquiry at its best (Anderson, Ronning, DeVries, & Martinson, 2010).

1. *Universalism:* Scientific observations are systematically structured and evaluated objectively using accepted methods of the discipline. By relying on empiricism in this way, we expect that scientists can conduct research to test any idea, other scientists can disagree, and the research reported from both sides can be objectively evaluated by others to find truth.

FIGURE 1.1 Overview of the process of conducting research, scientist's perspective *Ask your instructor to identify which step in this process is most or least fun for him or her. Which do you think will be most fun for you?*



2. *Communality:* Methods and results are to be shared openly. One major benefit to open reporting is that others can **replicate** the methods used to check whether they obtain the same results (see Chapter 14 and Collaboration, 2013). Replications help to ensure that effects are not just false positives or random flukes (see Chapter 13). Another major benefit to open reporting is that the results of many studies can be combined

in *meta-analyses,* which are studies that combine results from many studies of the same phenomenon to examine the overall effect (see Chapter 14). No single study provides a perfectly accurate answer to a complex question; a meta-analysis is an important tool in the search for knowledge that relies crucially on communality (see Braver, Thoemmes, & Rosenthal, 2014; Cumming, 2014). Some researchers have begun posting data sets and full study procedures online after a study is published for others to use.

3. *Disinterestedness:* Scientists are expected to search for observations that will help them make accurate discoveries about the world. They develop theories, argue that existing data support their theories, conduct research to evaluate propositions of their theories, and revise their theories as needed to more accurately account for new data. Scientists should be rewarded for their honest and careful quest for truth, and ideally are not motivated primarily for personal gain.
4. *Organized skepticism:* All new evidence and theories should be evaluated based on scientific merit, even those that challenge one's own work or prior beliefs. Science exists in a free market of ideas in which the best ideas are supported by research, and scientists can build upon the research of others to make further advances. Of all the ideals, organized skepticism is the one that most directly underlies the practice of **peer review.** Before a study is published in a scientific journal, it must be reviewed by other scientists who have the expertise to carefully evaluate the research and recommend whether the research should be published. This review process, although imperfect, helps to ensure that research with major flaws in theory, methodology, analyses, or conclusions will not become part of the scientific literature.

Science as a Way to Ask and Answer Questions

The main advantage of the scientific approach over other ways of knowing about the world is that it provides an objective set of rules for gathering, evaluating, and reporting evidence. In its ideal form, science is an open system that allows ideas to be refuted or supported on the basis of available evidence. Researchers are only interested in **falsifiable** ideas. If an idea is falsifiable, then it can be either supported or refuted using empirical data (Popper, 1968). Sometimes, scientific evidence is not obtainable, as, for example, when religions ask us to accept certain beliefs on faith. It is possible to design a study to test whether belief in god(s) increases peoples' willingness to help others; however, it is not possible to design a study to test whether such a god (or gods) exists. The former idea is falsifiable; the latter is not. Many of Freud's ideas were unfalsifiable, and therefore fell out of favour as psychology distinguished itself as a science. For example, the idea of repression is unfalsifiable: How can we ever prove or disprove that someone has buried a memory deep in the unconscious mind where it can never be accessed? Only ideas that are falsifiable—where data can reveal whether they are truth or fiction—can be tackled by science. Some ideas, even some very good ideas, may prove to be false if empirical research continually fails to provide support for them. If an idea is falsified when it is tested, science is also advanced because this result will spur the development of new and better ideas.

Our emphasis on science is not meant to imply that intuition and authority are unimportant; indeed, scientists often rely on them for research ideas. There is nothing wrong with accepting the assertions of authority as long as we do not accept them uncritically as scientific evidence. Likewise, there is nothing wrong with having opinions or beliefs as long as they are presented simply as opinions or beliefs. When we take on the scientific mindset, we should always ask whether the assertion or opinion can be tested scientifically, or whether scientific evidence exists that relates to the opinion. For example, opinions on whether exposure to video game violence increases aggression are only opinions until scientific evidence on the issue is gathered—and indeed such research has demonstrated this causal link (Anderson et al., 2010).

Truly embracing scientific skepticism will mean questioning the claims of scientists themselves. Scientists can become *authorities* when they express their ideas. Because someone claims to be a scientist, should we be more willing to accept what he or she has to say? Consider the person's credentials. Does he or she have an established reputation in the field? A position at a reputable institution? Who funds the person's research? You might be somewhat skeptical when research funded by a drug company supports the effectiveness of a drug manufactured by that company. Similarly, when an organization with a particular socio-political agenda funds the research that supports that agenda, you may be skeptical of the findings and closely examine the methods of the study.

As you practise scientific skepticism and learn more about scientific methods, you may increasingly question claims reported in the media. The reputable website www.snopes.com can be helpful for evaluating urban legends and scams often circulated online (e.g., that you can earn cash by buying a $2 kit from Google and posting links online). Be vigilant for **pseudoscience,** which uses scientific terms to make claims look compelling, but without using scientific data. Ranging from astrologers to some marketers, pseudoscientists ask you to purchase products and experiences to improve your life without appropriate evidence to back up their claims. Detecting pseudoscience can be challenging. Figure 1.2 lists some of the many warning signs suggesting that a claim is pseudoscientific. For example, consider the claim that people can learn complicated material (e.g., a second language) while sleeping. Before reading further, try visiting the

- Claims are not falsifiable.
- If tests are reported, methodology is not scientific and accuracy of data is questionable.
- Supportive evidence is anecdotal or relies heavily on authorities who are "so-called" experts in the area of interest. Genuine, peer-reviewed scientific references are not cited.
- Claims ignore conflicting evidence.
- Claims are stated in scientific-sounding terminology and ideas.
- Claims tend to be vague, rationalize strongly held beliefs, and appeal to preconceived ideas.
- Claims are never revised to account for new data.

FIGURE 1.2 Checklist for detecting some warning signs of pseudoscience

website www.sleeplearning.com with a *scientifically skeptical* mindset, and using Figure 1.2 to detect evidence of pseudoscience.

The authors of the website imply their claim is based on science: "Latest research proves there is a link between sleep and learning." Such a vague and non-directional claim is actually consistent with copious evidence that sleep helps consolidate waking memories (Rasch & Born, 2013). To their credit, this website paraphrases and quotes from some of these studies, but a major problem remains: Missing is evidence that listening to recordings (like their product) during sleep can produce complex, long-term learning. Without any supporting evidence, this website claims that you can "master another language, cram up on any subject," and more while sleeping. Research that is somewhat relevant (along with other non-scientific features such as testimonials) is used deceptively to increase the website's credibility while it leaps to a pseudoscientific claim. Other websites will offer more subtle examples of pseudoscience. A general rule is to be highly skeptical when scientific assertions are made that are supported by only vague or improbable evidence.

GOALS OF SCIENTIFIC RESEARCH IN PSYCHOLOGY

LO3

Four general **goals of scientific research** guide much of psychology and the behavioural sciences: (1) to describe behaviour, (2) to predict behaviour, (3) to determine the causes of behaviour, and (4) to understand or explain behaviour.

Describing Behaviour

The first goal of scientific research in psychology is to describe events, which involves careful observation and measurement. For example, University of Alberta researcher Connie Varnhagen and her colleagues explored new language use in instant messaging among teenagers (Varnhagen et al., 2010). Teens saved their instant messages for one week, and researchers analyzed the types of unconventional words used. Reflecting an emphasis on efficiency of communication, shortcuts represented the most frequent new language category, including abbreviations (e.g., *prolly*) and acronyms (e.g., *bf, ttys*). Adding emotion to bland text was also a frequent occurrence through the use of uppercase letters, emotion punctuation such as :) and emotion acronyms (e.g., *lol*). Using new language in this way was related to poor spelling among boys but not among girls.

Descriptive research like this study can provide a foundation for future work. Consider how results may inform research into these questions: Does learning new language for brief communications interfere with people's formal writing skills? Do people use new language only with others they think are "in-group" members? Do people like other people who use new language more often than those who use only formal language? Does the use of new language mean that people's spelling ability will suffer? How is interpersonal conflict affected by low levels of nonverbal communication in instant messaging situations?

Predicting Behaviour

Another goal of scientific research in psychology is to predict future behaviour. Once it has been observed with some regularity that two events are systematically related to one another (e.g., a more credible speaker is associated with greater attitude change among listeners), it becomes possible to make predictions and, therefore, to anticipate events. If we know a woman's symptoms of depression and post-traumatic stress disorder when she leaves an abusive partner, we can predict how likely she is to return to an abusive relationship within a year (Alhalal, Ford-Gilboe, Kerr, & Davies, 2012). If we know how long children can resist the temptation of eating a marshmallow, we can predict their academic success in adolescence (Shoda, Mischel, & Peake, 1990). However, we must be careful not to assume that such predictive relationships imply causation. We will explore appropriate conclusions from these *correlational* research designs in more detail in Chapter 4.

Determining the Causes of Behaviour

A third goal of scientific research in psychology is to determine the causes of behaviour. Although we might accurately predict the occurrence of a behaviour, we might not have correctly identified its cause. For example, high school grades do not cause university grades, although they are related. There are likely various causes of grades achieved at both education levels (e.g., motivation, study skills); research may be undertaken to study these factors. Similarly, research shows that a child's aggressive behaviour may be predicted by knowing how much violence the child views on television. Unless we know that exposure to television violence is a *cause* of behaviour, we cannot assert that aggressive behaviour can be reduced by limiting scenes of violence on television. Thus, to know how to *change* behaviour, we need to know the *causes* of behaviour. Experiments help us to identify cause-and-effect relationships (see Chapter 4).

Criteria for Causal Claims To make a causal claim, it is not enough to know that two events occur together. Cook and Campbell (1979) describe three criteria (drawn from the work of philosopher John Stuart Mill) that must be satisfied to identify a cause. For example, consider research showing that multitasking on a laptop during a lesson predicts worse test scores than strictly taking notes on a laptop during a lesson (Sana, Weston, & Cepeda, 2013). These researchers made a claim that multitasking *causes* worse test scores by meeting the three criteria:

1. When the cause (i.e., multitasking) is present, the effect (i.e., low test score) occurs; when the cause is not present, the effect does not occur. This is called **covariation of cause and effect.** Sana and colleagues showed that people who were multitasking on their laptop scored, on average, 55 percent correct on the lesson comprehension test, and people who were not multitasking scored higher (an average of 66 percent correct).
2. There is a temporal order of events in which the cause precedes the effect. This is called **temporal precedence.** In Sana and colleagues' study, listening to the lesson while multitasking (or not) occurred before the comprehension test. Test scores could not have reached back in time and affected learning during multitasking.
3. Nothing other than a causal variable could be responsible for the observed effect. This is called *elimination of alternative explanations*. There should be no other plausible **alternative explanation** for the relationship. Consider this hypothetical alternative explanation in Sana and colleagues' study: Suppose that the people who multitasked were all people who had no prior knowledge of the topic, whereas the people who did not multitask had all taken a course in the topic before. In this case, difference in test scores could have an alternative explanation: amount of prior knowledge. To avoid this and many other alternative explanations, Sana and colleagues randomly assigned research participants to either multitask or not during the experiment, thereby creating equivalent groups. Causation, including methods like *random assignment* used to achieve it, will be discussed again in later chapters.

Explaining Behaviour

A final goal of scientific research in psychology is to explain *why* the events and behaviours occur. Consider the relationship between television violence and aggression; even if we know that television violence is a cause of aggression, we need to explain this relationship. Why does it occur? Is it due to imitation of the violence seen on television? Does viewing television violence desensitize people to violence, which then leads to more aggressive behaviour when given the chance to aggress? Or does watching television violence lead to a belief that aggression is a normal response to frustration and conflict, and that belief is what ultimately triggers aggressive acts? Do all three of these possibilities (modelling, desensitization, and believing aggression is normal) combine to jointly explain why aggression increases after viewing television violence? Additional research is often needed to explore possible explanations of the causal relationship. Such research often involves testing theories that are developed to explain particular relationships. Experiments and mediation analyses can help us explain behaviour (see Chapter 4).

Description, prediction, determination of cause, and explanation are all closely connected. Determining cause and explaining behaviour are particularly closely related because it is difficult to ever know the true cause or all the causes of any behaviour. An explanation that appears satisfactory may turn out to be inadequate when other causes are identified in subsequent research. For example, when early research showed that speaker credibility is related to attitude change, researchers explained the finding by stating that people are more willing to believe what is said by a person with high credibility than by a person with low credibility. This explanation was inadequate, but it formed the basis of a more complex theory of attitude change that includes many other factors related to persuasion (Petty & Cacioppo, 1986). There is a certain amount of ambiguity in scientific inquiry. New research findings almost always invite new questions to be addressed by further research; explanations of behaviour often must be discarded or revised as new evidence is gathered. Such ambiguity is part of the excitement and fun of science.

LO4

BASIC AND APPLIED RESEARCH

There are differences in the extent to which research is readily applicable to everyday contexts. The terms *basic* and *applied* research are often used to denote the ends of this continuum. To illustrate the distinctions between these approaches, we will consider different examples drawn from research using virtual reality.

Basic Research

The four goals of scientific research in psychology capture much of the focus of **basic research,** which attempts to answer fundamental questions about the nature of behaviour. Studies are often designed to develop and test aspects of *theories* (see Chapter 2) about phenomena such as cognition, emotion, motivation, learning, psychobiology, personality development, and social behaviour. In the following example of basic research, notice that the purpose is theory testing rather than a specific application. Results might be used to inform research on a variety of different phenomena (e.g., gaming, GPS navigation tools, post-brain injury rehabilitation), but these applications are not its primary purpose.

Han, X., & Becker, S. (2014). One spatial map or many? Spatial coding of connected environments. *Journal of Experimental Psychology: Learning, Memory, & Cognition, 40,* 511–531.

Researchers sought to clarify which of two competing theories best explained how people develop mental maps in complex environments. Using a virtual driving simulator, participants explored two virtual neighbourhoods under different conditions (e.g., sequentially or being free to navigate back and forth). Based on participants' memories of the neighbourhoods (which were tested later), researchers concluded support for hierarchical theory: People tended to form separate mental maps of regions, and later developed overarching connections across regions as a second step. The alternative theory, which proposed that maps of regions develop along with their interconnections, was not supported.

Test yourself! Which goal(s) does this research address?

Applied Research

Applied research is conducted to address practical problems and potential solutions. There is a range of how immediately "applied research" is expected to be applied; some offers insight into problems or solutions, and some offers specific tools to address those problems in specific settings (Klatzky, 2009). Consider how both of the following studies are examining applications of virtual reality to inform the practical issue of treating anxiety disorders: the first explores many different effects of this potential new treatment, and the second pits it head-to-head against the standard.

Côté, S., & Bouchard, S. (2005). Documenting the efficacy of virtual reality exposure with psychophysiological and information processing measures. *Applied Psychophysiology and Biofeedback, 30,* 217–232.

One well-established way for clinical psychologists to treat spider phobia is *exposure therapy,* which includes gradually exposing people to live spiders over weeks of treatment until they can hold one and not feel afraid. Researchers tested whether five weeks of exposure therapy using virtual spiders could decrease cognitive, physiological, and emotional symptoms of spider phobia. Participants had all been officially diagnosed with spider phobia. After virtual exposure therapy, people no longer fixated on images of spiders, their heart rate did not jump when presented with a live spider, and they reported having less spider-related anxiety.

Michaliszyn, D., Marchand, A., Bouchard, S., Martel, M.-O., & Poirier-Bisson, J. (2010). A randomized, controlled clinical trial of *in virtuo* and *in vivo* exposure for spider phobia. *Cyberpsychology, Behavior, and Social Networking, 13,* 689–695.