METHODS IN BEHAVIORAL RESEARCH

Fourteenth Edition

Updated APA Style Guidelines Included!

PAUL C. **COZBY**
SCOTT C. **BATES**

Mc Graw Hill

Methods in Behavioral Research

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FOURTEENTH EDITION

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For Jeanie, Josh, Christy, Ingrid, and Pierre

–PCC

For Jay

–SCB

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Preface

Methods in Behavioral Research featuring updates from the Publication Manual of the American Psychological Association (7th ed.) guides students toward success by helping them study smarter and more efficiently. Supported by SmartBook®, McGraw-Hill Education's adaptive and personalized reading experience, Cozby and Bates provide helpful pedagogy, rich examples, and clear voice in their approach to methodological decision making.

IN THE FOURTEENTH EDITION, we strive for an accessible presentation and continue looking for opportunities to drive home foundational concepts and reinforce students' understanding of the material. We have reimagined end-of-chapter content. We chose concepts that students have traditionally found most challenging and designed exercises that ask them to reflect, recall, and organize the material. We have also aligned the fourteenth edition with the newly released the Publication Manual of the American Psychological Association (7th ed.). Focused organization combined with clear and direct writing remains a hallmark of *Methods in Behavioral Research*. Chapters follow the arc of a research investigation from planning through conducting and presenting.

ORGANIZATION

Methods in Behavioral Research moves carefully through the major concepts in behavioral research from the foundations of scientific study through practical issues in research design and implementation.

"Scientific Understanding of Behavior" grounds students in the scientific approach, emphasizing the distinction between basic and applied research. "Where to Start" discusses sources of ideas for research and the importance of library research. "Ethics in Behavioral Research" focuses on research ethics; ethical issues are covered in depth here and emphasized throughout the book. "Fundamental Research Issues" introduces validity and examines psychological variables and the distinction between experimental and nonexperimental approaches to studying relationships among variables. "Measurement Concepts" focuses on measurement issues, including reliability and validity. Nonexperimental research approaches—including naturalistic observation, cases studies, and content analysis—are described in "Observational Methods." "Asking People About Themselves: Survey Research" covers sampling as well as the design of questionnaires and interviews. "Experimental Design" and "Conducting Experiments" present the basics of designing and conducting experiments. Factorial designs are emphasized in "Complex Experimental Designs." "Single-Case, Quasi-Experimental, and Developmental Research" discusses the designs for special applications: single-case experimental designs, developmental research designs, and quasi-experimental designs. "Understanding Research Results: Description and Correlation" and "Understanding Research Results: Statistical Inference" focus on the use of statistics to help students understand research results. These chapters include material on effect size and confidence intervals. Finally, "Generalization" discusses generalization issues, meta-analyses, and the importance of replications.

FEATURES

Methods in Behavioral Research includes the following features to enhance learning:

NEW! Critical Thinking: Consumer of Research. These exercises are designed to get students out of the textbook and out of their classrooms and into the broader world in which we all move. These exercises ask students to look at examples of research—such as studies on the predictors of happiness and the causes and

effects of sitting in the front of the classroom—to compare what they've learned in class or the text with what they see. Applying the concepts they have learned will help them expand their understanding of the content.

NEW! Fully updated according to the Publication Manual of the American Psychological Association (7th ed.): This edition includes and supports new guidelines on ethical and bias-free writing, adopted the new standard for in-text citations, updated rules for manuscript formatting, and adopted APA's final resolution to the eternal question: One space or two after a period? (Answer: One!)

NEW! Updated to align with 2019 federal guidelines that govern IRBs, including new categories of exempt review.

UPDATED! Check Your Learning: Practice Exercises. In previous editions, these Check Your Learning boxes were placed within the body of the chapter. We found that students often found this placement distracting and preferred to be able to control when to complete the exercises. We now include an in-text callout to place the content; the actual exercises and answers are at the end of the chapter.

Illustrative articles. These boxes include published journal articles with questions and exercises designed to focus on chapter-related material. In addition, the articles help students become familiar with the structure and language of journal articles in psychology. We have several new articles in this edition. Most important, we have provided links to online copies of the articles whenever possible.

Solid pedagogy. Each chapter opens with a set of learning objectives that serve as reading guides and ends with a review of major concepts and key terms.

Practical examples. Thought-provoking examples help students interpret challenging concepts and complex research designs. The concept of diversity of ideas is examined through the lens of biases regarding rap music. Theory article formats are introduced though a recent study on suicide.

Decision-making emphasis. Distinguishing among a variety of research designs helps students understand when to use one type of design over another.

FLEXIBLE

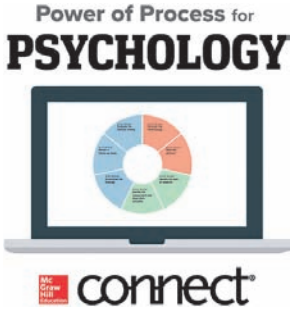
Chapters are designed to work independently, so that they can be adapted to any curriculum or syllabus. Sections are clearly defined and relevant practice exercises called out within each, making it easy to reorder or skip topics.

In addition, three appendices related to communicating research findings, ethical standards, and conducting statistical analyses can be used any time throughout the course. Appendix A includes an annotated version of a published paper and provides firm instructions for organizing research. Students can easily refer to the APA Ethics Code in Appendix B, and Appendix C includes a bank of statistical tests that can be applied to a variety of research designs.

Methods in Behavioral Research is available to instructors and students in traditional print format as well as online within McGraw Hill Connect, a digital assignment and assessment platform. Connect includes assignable and assessable videos, quizzes, exercises, and interactive activities, all associated with learning objectives

for *Methods in Behavioral Research*. These online tools make managing assignments easier for instructors, and learning and studying more motivating and efficient for students.

Power of Process, available in Connect for Research Methods, guides students through the process of critical reading, analysis, and writing. Faculty can select or upload their own content, such as journal articles, and assign analysis strategies to gain insight into students' application of the scientific method. For students, Power of Process offers a guided visual approach to exercising critical thinking strategies to apply before, during, and after reading published research.



BETTER DATA, SMARTER REVISIONS, IMPROVED RESULTS

For this new edition, data were analyzed to identify the concepts students found to be the most difficult, allowing for expansion upon the discussion, practice, and assessment of challenging topics. The revision process for a new edition used to begin with gathering information from instructors about what they would change and what they would keep.

Experts in the field were asked to provide comments that pointed out new material to add and dated material to review. Using all these reviews, authors would revise the material. But today a new tool has revolutionized that model.

McGraw-Hill Education authors now have access to student performance data to analyze and inform their revisions. These data are anonymously collected from the many students who use SmartBook, the adaptive learning system that provides students with individualized assessment of their own progress. Because virtually every text paragraph is tied to several questions that students answer while using SmartBook, the specific concepts with which students are having the most difficulty are easily pinpointed through empirical data in the form of a "heat map" report.

New to this edition, SmartBook is now optimized for mobile and tablet and is accessible for students with disabilities. Content-wise, it has been enhanced with improved learning objectives that are measurable and observable to improve student outcomes.

POWERFUL REPORTING

Whether a class is face-to-face, hybrid, or entirely online, McGraw-Hill Connect provides the tools needed to reduce the amount of time and energy instructors spend administering their courses. Easy-to-use course management tools allow instructors to spend less time administering and more time teaching, while reports allow students to monitor their progress and optimize their study time.

- The **At-Risk Student Report** provides instructors with one-click access to a dashboard that identifies students who are at risk of dropping out of the course due to low engagement levels.
- The **Category Analysis Report** details student performance relative to specific learning objectives and goals, including APA learning goals and outcomes and levels of Bloom's taxonomy.
- **Connect Insight** is a one-of-a-kind visual analytics dashboard—now available for both instructors and students—that provides at-a-glance information regarding student performance.
- **The SmartBook Reports** allow instructors and students to easily monitor progress and pinpoint areas of weakness, giving each student a personalized study plan to achieve success.

ADDITIONAL RESOURCES

Achieve simplicity in assigning and engaging your students with course materials. Craft your teaching resources to match the way you teach! With McGraw-Hill Create, you can easily rearrange chapters, combine material from other content sources, and quickly upload content you have written, such as your course syllabus or teaching notes. Find the content you need in Create by searching through thousands of leading McGraw-Hill textbooks. Arrange your book to fit your teaching style. Create even allows you to personalize your book's appearance by selecting the cover and adding your name, school, and course information. Order a Create book and you'll receive a complimentary electronic review copy (eComp) via email in about an hour. Experience how McGraw-Hill Create empowers you to teach your students *your* way: http://create.mheducation.com

McGraw-Hill Campus provides faculty with true single sign-on access to all of McGraw-Hill's course content, digital tools, and other high-quality learning resources from any LMS. This innovative offering allows for secure and deep integration, enabling seamless access for faculty and students to any of McGraw-Hill's course solutions, such as McGraw-Hill Connect (all-digital teaching and learning platform) and McGraw-Hill Create (state-of-the-art custom-publishing platform McGraw-Hill Campus includes access to McGraw-Hill's entire content library, including eBooks, assessment tools, presentation slides, multimedia content, and other resources. McGraw-Hill Campus provides instructors with open, unlimited access to prepare for class, create tests/quizzes, develop lecture material, integrate interactive content, and more: http://www.mhcampus.com

CHANGES TO THE FOURTEENTH EDITION

The fourteenth edition of *Methods in Behavioral Research* includes numerous updates and new references. Here is a list of major changes as they appear by chapter.

Chapter 1

- Added discussion on the importance of becoming a savvy consumer of research.
- Added discussion of risky outcomes that result from researcher overreach.
- Critical Thinking: Read editorials from large national newspapers and evaluate for intuition, appeals to authority, and supporting evidence. Consider both sides of two arguments about major assertions about behavioral research studies as a discipline. Sift through data presented in an online article about eating disorders to identify cause and effect and explanation.

Chapter 2

- New discussion added to "Source of Ideas" offers clues to where one might find inspiration for a new research study.
- Added example of how practical problems in everyday life can stimulate research studies.
- New analysis of biases toward rap music within the framework of diversity of ideas.
- Refined discussion of literature reviews, where to find them and how to use them.
- New example of a recent theory article about suicide.
- New example of an article search using Web of Science.
- New Critical Thinking box: Review four different articles related to behavioral science that have recently appeared in the popular press including stress in teens and happy memories as health boosters.

Chapter 3

- Added emphasis on the exempt review of minimal risk research.
- Deeper discussion of the functions of an IRB.
- New Critical Thinking box: Consider the ethics behind three controversial research studies including Milgram. Read your college's student code of conduct and consider ways to improve upon the plagiarism section.

Chapter 4

- A fourth validity added: statistical validity.
- New Critical Thinking box: Review operational definitions and why they are important. Work through the components of research including hypothesis (both experimental and nonexperimental method) variable, cause and effect.

Chapter 5

- New study added to illustrative article on measurement concepts that aimed to reduce bias in STET ratings by adjusting language on the form.
- New Critical Thinking box: Review two personality assessments to determine their reliability and consider ways to assess construct validity.

Chapter 6

- New Critical Thinking box: Develop a research question that can best be used addressed through qualitative techniques. Locate and summarize two reviews of a recent book about Henry Molaison by his grandson.

Chapter 7

- Updated Figure 1 includes new data on annual prevalence of teenage marijuana use.
- Section of nonverbal scales has been expanded to include adult populations.
- Explanation of recently developed *Prime Panels*, a recruiting tool for unique samples.
- New Critical Thinking box: Work through a survey from evaluating the questions to analyzing the results. Briefly plan an online survey with an adult population regarding family, professional, and life satisfaction.

Chapter 8

- New Critical Thinking box: Review two different experimental designs and share ideas for how they could be improved or how specific problems could be addressed.

Chapter 9

- Refined discussion on quantifying observed behaviors.
- New illustrative article: "Conducting Experiments."
- New Critical Thinking box: Consider sample scenario in a pilot study and work through questions about the manipulations, variables, controls, and outcomes.

Chapter 10

- Revised illustrative article: "Complex Experimental Designs."
- New Critical Thinking box: Work through a 2 × 2 with independent groups and consider the effects as variables are adjusted. In a second experiment, identify the design, variables, conditions and possible interactions.

Chapter 11

- New illustrative article: "A Longitudinal Study."
- New Critical Thinking box: Look for problems and explain outcomes in five different sample research scenarios.

Chapter 12

- New Critical Thinking box: Create your own sample by asking students on campus to ask a question about the courses they are taking. Think of three variables that use a nominal scale

Chapter 13

- Added discussion on choosing a sample size.
- New Critical Thinking box: Plan parts of a research design. Analyze research on attitudes toward individuals in wheelchairs.

Chapter 14

- Added an in-depth note on the Open Science initiative and the replication crisis in psychology.
- New Critical Thinking box: Think through a sample of college students and consider what makes it a unique population.

INSTRUCTOR RESOURCES

Methods in Behavioral Research also includes the following instructor resources:

Instructor's Manual: Designed to provide a wide variety of resources for presenting the course, the instructor's manual includes learning objectives, ideas for lectures and discussions, laboratory demonstrations, and activities aligned specifically to facilitate a clearer knowledge of research methods.

Test Bank: By increasing the rigor of the test bank development process, McGraw-Hill has raised the bar for student assessment. A coordinated team of subject-matter experts methodically vetted each question and each set of possible answers for accuracy, clarity, and effectiveness. Each question is further annotated for level of page difficulty, Bloom's taxonomy, APA learning outcomes, and corresponding coverage in the text. Structured by chapter, the questions are designed to test students' conceptual, applied, and factual understanding.

Test Builder: New to this edition and available within Connect, Test Builder is a cloud-based tool that enables instructors to format tests that can be printed or administered within a Learning Management System. Test Builder offers a modern, streamlined interface for easy content configuration that matches course needs, without requiring a download.

Test Builder enables instructors to:

- Access all test bank content from a particular title
- Easily pinpoint the most relevant content through robust filtering options
- Manipulate the order of questions or scramble questions and / or answers
- Pin questions to a specific location within a test
- Determine your preferred treatment of algorithmic questions
- Choose the layout and spacing
- Add instructions and configure default settings

Lecture Presentation: Accessibility compliant, PowerPoint slides are provided that present key points of the chapter, along with supporting visuals. All of the slides can be modified to meet individual needs.

Image Gallery: The complete set of figures and tables from the text are available for download and can be easily embedded into PowerPoint slides.

ACKNOWLEDGMENTS

Many individuals helped to produce this and previous editions of this book. The portfolio manager at McGraw-Hill was Nancy Welcher; we are also indebted to the editors of previous editions, Franklin Graham, Ken King, Mike Sugarman, and Krista Bettino, for their guidance. We are extremely grateful for the input from numerous students and instructors, including the following individuals, who provided detailed reviews for this edition:

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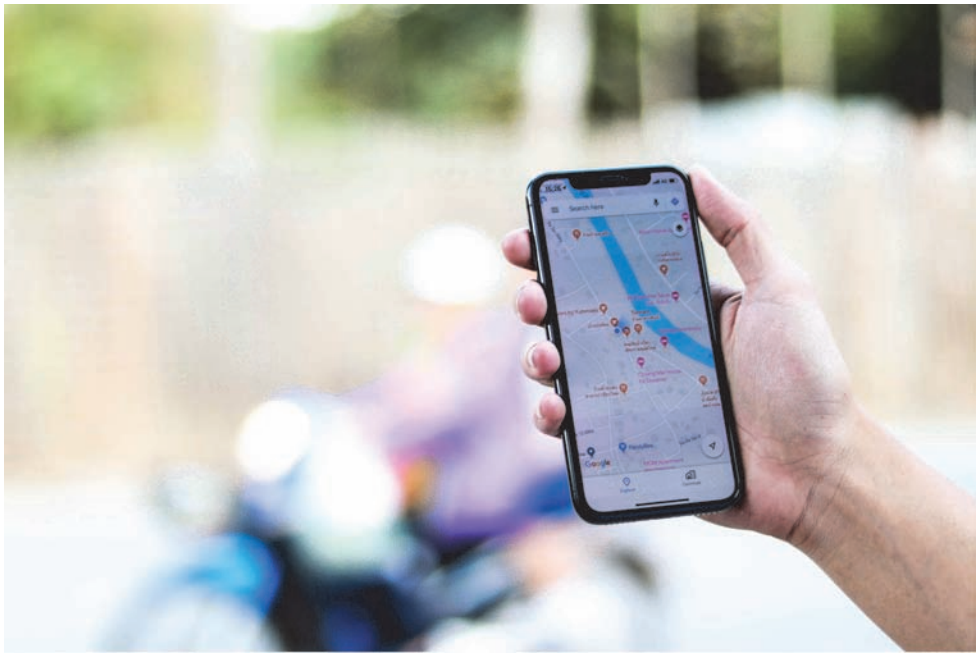
We are always interested in receiving comments and suggestions from students and instructors. Please email us at scott.bates@usu.edu or cozby@fullerton.edu.

1 Scientific Understanding of Behavior



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LEARNING OBJECTIVES

- Describe why it is important to understand research methods.
- Describe the scientific approach to understanding behavior, and contrast it with a pseudoscientific approach.
- Define and give examples of the four goals of scientific research: description, prediction, determination of cause, and explanation of behavior.
- Discuss the three elements for inferring causation: temporal order, covariation of cause and effect, and elimination of alternative explanations.
- Define, describe, compare, and contrast basic and applied research.

Do social media sites like Facebook and Instagram impact our relationships? What causes alcoholism? How do our early childhood experiences affect our later lives? How do we remember things, what causes us to forget, and how can memory be improved? Why do we procrastinate? Why do some people experience anxiety so extreme that it disrupts their lives, while others—facing the same situation—seem to be unaffected? How can we help people who suffer from depression? Why do we like certain people and dislike others? How can employers nurture employee well-being in a high-stress workplace?

Curiosity about questions like these is probably the most important reason many students decide to take courses in the behavioral sciences. Science is the best way to explore and answer these sorts of questions. In this book, we will examine the methods of scientific research in the behavioral sciences. In this introductory chapter, we will focus on ways in which knowledge of research methods can be useful in understanding the world around us. Further, we will review the characteristics of a scientific approach to the study of behavior and the general types of research questions that concern behavioral scientists.

CONSUMING RESEARCH

We are continuously bombarded with research results: The *New York Times* runs many articles with titles like "Parents Should Avoid Comments on a Child's Weight," "Abortion Is Found to Have Little Effect on Women's Mental Health," and "Insomniacs Are Helped by Online Therapy." The *Washington Post* declared, "Large study supports 'weekend warrior' approach to lifetime fitness." Meanwhile, over on cable news, CNN reports that "Facebook can actually make us more narrow-minded," while Fox News notes that "Alcohol ads should be banned from sporting events, says study." MSNBC told us to buy a pet—"Kids with pets have less anxiety"—but *People Magazine* tells us, hold on, "Your Beloved Cat Could Be Making Your PMS Worse!" Even Buzzfeed gets into the act, letting the bookstore owners among us know that a "New Study Finds That Filling Bookstores with the Scent of Chocolate Makes You Shop Longer," and Buzzfeed also wondered, "Is America Having a 'Friendship Slump'?"

Articles, books, websites, and social media posts make claims about the beneficial or harmful effects of particular diets or vitamins on one's sex life, personality, or health. There are frequent reports of survey results that draw conclusions about our views on a variety of topics—who we will vote for, what we think about a product, where we stand on political hot topics of the day.

The key question is: How do you evaluate such reports? Do you simply accept the findings because they are supposed to be scientific? A background in research methods will help you read these reports critically, evaluate the methods employed, and decide whether the conclusions are reasonable. Learning about research methods will help you think critically; learning about research methods will help you be a skilled consumer of research.

Why Learn About Research Methods?

Beyond learning to think critically about research findings, there are many ways that research impacts today's society, and many reasons why learning about research methods is important.

First, many occupations require the use of research findings. For example, mental health professionals must make decisions about treatment methods, assignment of clients to different types of facilities, medications, and testing procedures. Such decisions are made on the basis of research; to make good decisions, mental health professionals must be able to read the research literature in the field and apply it to their professional lives. Similarly, people working in business environments frequently rely on research to make decisions about

marketing strategies, ways of improving employee productivity and morale, and methods of selecting and training new employees. Educators must keep up with research on topics such as the effectiveness of various teaching strategies or programs to deal with special student problems. It is useful to have a knowledge of research methods and the ability to evaluate research reports in many fields.

It is also important to recognize that scientific research has become increasingly prominent in public policy decisions. Legislators and political leaders at all levels of government frequently take political positions and propose legislation based on research findings. Research may also influence judicial decisions: A classic example of this is the *Social Science Brief* that was prepared by psychologists and accepted as evidence in the landmark 1954 case *Brown v. Board of Education,* in which the U.S. Supreme Court banned school segregation in the United States. One of the studies cited in the brief was conducted by Clark and Clark (1947), who found that when allowed to choose between light-skinned and dark-skinned dolls, both Black and White children preferred to play with the light-skinned dolls (see Stephan, 1983, for a further discussion of the implications of this study).

Behavioral research on human development has influenced U.S. Supreme Court decisions related to juvenile crime. In 2005, for instance, the Supreme Court decided that juveniles could not face the death penalty (*Roper v. Simmons*), and the decision was informed by neurological and behavioral research showing that in juveniles, the level of development of their brains, social relationships, and character make juveniles less culpable than adults for the same crimes. Similarly, in 2010, in *Graham v. Florida*, the U.S. Supreme Court decided that juvenile offenders could not be sentenced to life in prison without parole for nonhomicide offenses. This decision was influenced by research in developmental psychology and neuroscience. The Court majority pointed to this research in their conclusion that assessment of blame and standards for sentencing should be different for juveniles and adults because juveniles lack adults' maturity, ability to resist pressures from peers and others, and personal sense of responsibility (Clay, 2010).

Research is also important when developing and assessing the effectiveness of programs designed to achieve certain goals—for example, to increase retention of students in school, influence people to engage in behaviors that reduce their risk of contracting HIV, or teach employees how to reduce the effects of stress. We need to be able to determine whether these programs are successfully meeting their goals.

Finally, research methods are important because they can provide us with the best answers to questions like those we posed at the outset of this chapter. Research methods can be the way to satisfy our native curiosity about ourselves, our world, and those around us.

WAYS OF KNOWING

We opened this chapter with several questions about human behavior and suggested that scientific research is a valuable means of answering them. How does the scientific approach differ from other ways of learning about behavior? People have always observed the world around them and sought explanations for what they see and experience. However, instead of using a scientific approach, many people rely on *intuition* and *authority* as primary ways of knowing.

Intuition and Anecdote

Most of us either know or have heard about a couple in a relationship who, after years of trying to conceive, adopt a child. Then very soon after adopting, the woman becomes pregnant. This observation leads to a belief that adoption increases the likelihood of pregnancy for couples who are having difficulties conceiving a child.

People usually go one step further and offer an explanation for this effect—such as, that the adoption reduces a major source of marital stress, and the stress reduction in turn increases the chances of conception (see Gilovich, 1991).

This example illustrates the use of intuition and anecdotal evidence to draw general conclusions about the world around us. When you rely on intuition, you accept unquestioningly what your own personal judgment or a single story (anecdote) about one person's experience tells you. The intuitive approach takes many forms. Often it involves finding an explanation for our own behaviors or the behaviors of others. For example, you might develop an explanation for why you keep having conflicts with your roommate, such as "He hates me" or "Having to share a bathroom creates conflict." Other times, intuition is used to explain events that you observe, as in the case of concluding that adoption increases the chances of conception among couples having difficulty conceiving a child.

A problem with intuition is that numerous cognitive and motivational biases affect our perceptions, and so we may draw erroneous conclusions about cause and effect (cf. Fiske & Taylor, 1984; Gilovich, 1991; Nisbett & Ross, 1980; Nisbett & Wilson, 1977). Gilovich points out that there is in fact no relationship between adoption and subsequent pregnancy, according to scientific research investigations. So why do we hold this belief? 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 an adoption is closely followed by a pregnancy, our attention is drawn to the situation, and we are biased to conclude that there must be a causal connection. Such illusory correlations are also likely to occur when we are highly motivated to believe in the causal relationship. Although this is a natural thing for us to do, it is not scientific. A scientific approach requires much more evidence before conclusions can be drawn.

Authority

The philosopher Aristotle said: "Persuasion is achieved by the speaker's personal character when the speech is so spoken as to make us think him credible. We believe good men more fully and readily than others." Aristotle would argue that we are more likely to be persuaded by a speaker who seems prestigious, trustworthy, and respectable than by one who appears to lack such qualities.

Many of us might accept Aristotle's arguments simply because he is considered a prestigious authority—a convincing and influential source—and his writings remain important. Similarly, many people are all too ready to accept anything they learn from the internet, news media, books, government officials, celebrities, religious figures, or even a professor! They believe that the statements of such authorities must be true. The problem, of course, is that the statements 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.

Empiricism

The scientific approach to acquiring knowledge recognizes that intuition, anecdote, and authority can be sources of ideas about behavior. However, scientists do not unquestioningly accept anyone's intuitions—including their own. Scientists recognize that *their* ideas are just as likely to be wrong as anyone else's. Also, scientists do not accept on faith anyone's pronouncements, regardless of that person's prestige or authority. Thus, scientists are very skeptical about what they see and hear. Scientific skepticism means that ideas must be evaluated on the basis of careful logic and results from scientific investigations.

If scientists reject intuition and blind acceptance of authority as ways of knowing about the world, how do they go about gaining knowledge? The fundamental characteristic of the scientific method is **empiricism**—the idea that knowledge comes from observations. Data are collected that form the basis of conclusions about the nature of the world. The scientific method embodies a number of rules for collecting and evaluating data; these rules will be explored throughout this book.

The Scientific Approach

The power of the scientific approach can be seen all around us. Whether you look at biology, chemistry, medicine, physics, anthropology, or psychology, you will see amazing advances over the past 5, 25, 50, or 100 years. We have a greater understanding of the world around us, and the applications of that understanding have kept pace. Goodstein (2000) describes an "evolved theory of science" that defines the characteristics of scientific inquiry. These characteristics are summarized below.

- **Data play a central role.** For scientists, knowledge is primarily based on observations. Scientists enthusiastically search for observations that will verify or reject their ideas about the world. They develop theories, argue that existing data support their theories, and conduct research that can increase our confidence that the theories are correct. Observations can be criticized, alternatives can be suggested, and data collection methods can be called into question. But in each of these cases, the role of data is central and fundamental. Scientists have a "show me, don't tell me" attitude.
- **Scientists are not alone.** Scientists make observations that are accurately reported to other scientists and the public. You can be sure that many other scientists will follow up on the findings by conducting research that replicates and extends these observations.
- **Science is adversarial.** Science is a way of thinking in which ideas do battle with other ideas in order to move ever closer to truth. Research can be conducted to test any idea; supporters of the idea and those who disagree with the idea can report their research findings, and these can be evaluated by others. Some ideas, even some very good ideas, may prove to be wrong if research fails to provide support for them. Good scientific ideas are testable. They can be supported or they can be falsified by data—the latter concept is called **falsifiability** (Popper, 2002). If an idea is falsified when it is tested, science is thereby advanced because this result will spur the development of new and better ideas.
- **Scientific evidence is peer reviewed.** Before a study is published in a top-quality scientific journal, it is reviewed by other scientists who have the expertise to carefully evaluate the research. This process is called **peer review.** The role of these reviewers is to recommend whether the research should be published. This review process ensures that research with major flaws will not become part of the scientific literature. In essence, 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.

Integrating Intuition, Anecdote, and Authority With Skepticism

The 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 information. It is an open system that allows ideas to be refuted or supported by others. This does not mean that intuition, anecdote, and authority are unimportant, however. As noted previously, scientists often rely on intuition and assertions of authorities for ideas for research. Moreover, there is nothing wrong with accepting the assertions of an authority as long as we do not accept them as scientific evidence. In many cases scientific evidence is not obtainable—for example, when a religious figure or text asks us to accept certain beliefs on faith. Some beliefs cannot be tested and

thus are beyond the realm of science. In science, however, ideas must be evaluated on the basis of available evidence that can be used to support or refute the ideas.

There is also nothing wrong with having opinions or beliefs as long as they are presented simply as opinions or beliefs. However, we should always ask whether the opinion can be tested scientifically or whether scientific evidence exists that relates to the opinion. For example, opinions on whether exposure to violent movies, TV, and video games increases aggression are only opinions until scientific evidence on the issue is gathered.

As you learn more about scientific methods, you will become increasingly skeptical of the research results reported in the media and the assertions of scientists as well. You should be aware that scientists often become authorities when they express their ideas. When someone claims to be a scientist, should we be more willing to accept what he or she has to say? First, ask about the individual's credentials. It is usually wise to pay more attention to someone with an established reputation in the field and attend to the reputation of the institution represented by the person. It is also worthwhile to examine the researcher's funding source; you might be a bit suspicious when research funded by a drug company supports the effectiveness of a drug manufactured by that company, for example. Similarly, when an organization with a particular social-political agenda funds the research that supports that agenda, you should be skeptical of the findings and closely examine the methods of the study.

You should also be skeptical of pseudoscientific research. **Pseudoscience** is the use of seemingly scientific terms and demonstrations to substantiate claims that have no basis in scientific research. The claim may be that a product or procedure will enhance your memory, relieve depression, or treat autism or post-traumatic stress disorder. The fact that these are all worthy outcomes makes us very susceptible to believing pseudoscientific claims and forgetting to ask whether there is a valid scientific basis for the claims.

A good example comes from a procedure called *facilitated communication* that has been used by therapists working with children with autism. These children lack verbal skills for communication; to help them communicate, a facilitator holds the child's hand while the child presses keys to type messages on a keyboard. This technique produces impressive results, indicating that the children are now able to express themselves. Of course, well-designed studies revealed that the facilitators, not the children, controlled the typing. The problem with all pseudoscience is that hopes are raised and promises will not be realized. Often the techniques can be dangerous as well. In the case of facilitated communication, a number of facilitators typed messages accusing a parent of physically or sexually abusing the child. Some parents were actually convicted of child abuse. In these legal cases, the scientific research on facilitated communication was used to help the defendant parent. Cases such as this have led to a movement to promote the exclusive use of evidence-based therapies—therapeutic interventions grounded in scientific research findings that demonstrate their effectiveness (Brown, 2016; cf. Lilienfeld et al., 2004).

So how can you tell if a claim is pseudoscientific? It is not easy. In fact, a philosopher of science noted that "the boundaries separating science, nonscience, and pseudoscience are much fuzzier and more permeable than ... most scientists ... would have us believe" (Pigliucci, 2010). Here are a few things to look for when evaluating claims:

- Claims that are untestable and therefore cannot be refuted
- Claims that rely on imprecise, biased, or vague language
- Evidence that is based on anecdotes and testimonials rather than scientific data
- Evidence that is from "experts" who have only vague qualifications and do not support their claims with sound scientific evidence
- Claims based only on confirmatory evidence, ignoring conflicting evidence
- Reliance on "scientific" evidence that cannot be independently verified because the methods used to establish that evidence have not been described

Finally, we are all increasingly susceptible to false reports of scientific findings circulated via the internet. Many of these reports claim to be associated with a reputable scientist or scientific organization, and then they take on a life of their own. A recent widely covered report, supposedly from the World Health Organization, claimed that the gene for blond hair was being selected out of the human gene pool. Blond hair would be a disappearing trait! General rules to follow when reading internet sites: (1) Be highly skeptical of scientific assertions that are supported by only vague or improbable evidence, and (2) Take the time to do an internet search for supportive evidence. At internet sites like **snopes.com**, **truthorfiction.com**, and **factcheck.org/askscicheck/** you can check many of the claims that are on the internet.

Being a Skilled Consumer of Research

How much trust we should place in a study depends upon the methods that were used to conduct the study. Sometimes study authors overreach, coming to conclusions that are not justified. Four questions can be asked of any research study that will reveal a lot about how much the study should be trusted. The better the answers to these questions, the more confident you can be of the study:

1. **"What was measured?"** All studies in the behavioral sciences start with measurement: identifying the important concepts to be studied, and figuring out how to measure them. This is related to the concept of construct validity, which will be covered in depth in later chapters.
2. **"How do they know that one thing caused another?"** Often—particularly in popular media—there will be the claim that one thing causes another. A good question to ask here is: How do they know? This is related to the concept of internal validity, which will be covered in later chapters.
3. **"To what or whom can we generalize the results?"** This is related to the concept of external validity, which will be covered in later chapters.
4. **"Have other researchers found similar results?"** A single study can be interesting, but scientific progress involves the accumulation of studies. We can be more confident in a study if other studies have found the same thing.

GOALS OF BEHAVIORAL SCIENCE

Scientific research on behavior has four general goals: (1) to describe behavior, (2) to predict behavior, (3) to determine the causes of behavior, and (4) to understand or explain behavior.

Description of Behavior

The scientist begins with careful observation, because the first goal of science is to describe behavior—which can be something directly observable (such as running speed, eye gaze, or loudness of laughter) or something less observable (such as self-reports of perceptions of attractiveness). Using a written questionnaire, researchers at the Kaiser Family Foundation (Rideout et al., 2010) collected data on the use of media (e.g., television, cell phones, movies) by more than 2,000 8- to 18-year-olds. One section of the questionnaire asked about computer use. **Figure 1** shows the percentage of time spent on various recreational computer activities in a typical day. As you can see, social networking and game playing are the most common activities. This is the sort of study that benefits from replication every few years to reveal changes that occur with new technologies and attitudes.

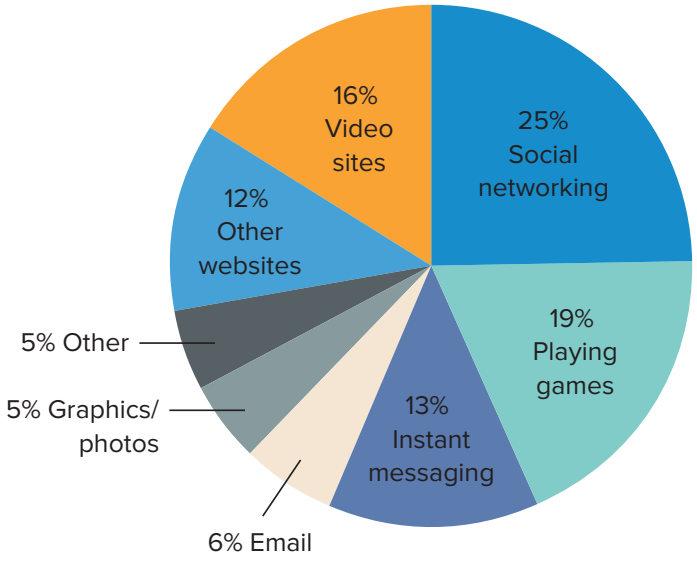

FIGURE 1 Time spent on recreational computer activities by 8-18 year olds

Researchers are often interested in describing the ways in which events are systematically related to one another. If parents place limits on their children's recreational computer use, do their children perform better in school? Do jurors judge attractive defendants more leniently than unattractive defendants? Are people more likely to be persuaded by a speaker who has high credibility? In what ways do cognitive abilities change as people grow older? Do students who study with a television set on score lower on exams than students who study in a quiet environment? Do taller people make more money than shorter people?

Prediction of Behavior

A second goal of behavioral science is to predict behavior. Once it has been observed with some regularity that two events are related to one another (e.g., that greater attractiveness is associated with more lenient sentencing), it becomes possible to make predictions. We can anticipate events. If you read about an upcoming trial of a very attractive defendant, you can predict that the person will likely receive a lenient sentence. Further, the ability to make accurate predictions can help us make better decisions. For example, if you study the behavioral science research literature on attraction and relationships, you will learn about factors that predict long-term relationship satisfaction. You may be able to then use that information when predicting the likely success of your own relationships. You can even complete a questionnaire designed to measure a number of predictors of relationship success. Measures such as RELATE, FOCCUS Pre-Marriage Inventory, and PREPARE can be completed by yourself, with a partner, or with the help of a professional counselor (Larson et al., 2002).

Determining the Causes of Behavior

A third goal of science is to determine the *causes* of behavior. Although we might accurately predict the occurrence of a behavior, we might not correctly identify its cause. Research shows that a child's aggressive behavior can be predicted by knowing how much violence the child views on television. Unfortunately, unless

we know that exposure to television violence is a *cause* of behavior, we cannot assert that aggressive behavior can be reduced by limiting scenes of violence on television. A child who is highly aggressive may prefer to watch violence when choosing television programs. We are now confronting questions of cause and effect: To know how to *change* behavior, we need to know the *causes* of behavior.

Cook and Campbell (1979) describe three types of evidence (drawn from the work of philosopher John Stuart Mill) used to identify the cause of a behavior. It is not enough to know that two events occur together, as in the case of knowing that watching television violence is a predictor of actual aggression. To conclude causation, three things must hold true (see **Figure 2**):

1. There is a temporal order of events in which the cause *precedes* the effect. This is called **temporal precedence.** Thus, we need to know that television viewing occurred first and aggression followed.

2. When the cause is present, the effect occurs; when the cause is not present, the effect does not occur. This is called **covariation of cause and effect.** We need to know that children who watch television violence behave aggressively and that children who do not watch television violence do not behave aggressively.

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. This third point about alternative explanations is very important: Suppose that the children who watch a lot of television violence are left alone more than are children who do not view television violence. In this case, the increased aggression could have an alternative explanation: lack of parental supervision. Causation will be discussed again in the chapter **"Fundamental Research Issues."**

Explanation of Behavior

A final goal of science is to explain the events that have been described. The scientist seeks to understand *why* the behavior occurs. Consider the relationship between playing violent video games and aggression (APA Task Force on Violent Media, 2015). Even if we know that playing violent video games is a cause of aggressiveness, we still need to explain this relationship. Is it due to imitation or "modeling" of the game violence? Is it the result of psychological desensitization to violence and its effects? Does playing violent video games lead to a belief that aggression is a normal response to frustration and conflict? Further research is necessary to shed light on possible explanations of what has been observed. Usually additional research like this is carried out by testing theories that are developed to explain particular behaviors.

Description, prediction, determination of cause, and explanation are all closely intertwined. Determining cause and explaining behavior are particularly closely related because it is difficult ever to know the true cause or all the causes of any behavior. 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, the researchers explained the finding by stating that people are more willing to believe what is said by a person with high credibility than by one with low credibility. However, this explanation has given way to a more complex theory of attitude change that takes into account many other factors that are related to persuasion (Cooper et al., 2016; Petty et al., 2003). In short, there is a certain amount of ambiguity in the enterprise of scientific inquiry. New research findings almost always pose new questions that must be addressed by further research; explanations of behavior often must be discarded or revised as new evidence is gathered. Such ambiguity is part of the excitement and fun of science.