PART I

Introduction to Scientific Reasoning

Your Dog Hates Hugs

NYMag.com, 2016

Mindfulness May Improve Test Scores

***Scientific American*, 2013**

1

Psychology Is a Way of Thinking

THINKING BACK TO YOUR introductory psychology course, what do you remember learning? You might remember that dogs can be trained to salivate at the sound of a bell or that people in a group fail to call for help when the room fills up with smoke. Or perhaps you recall studies in which people administered increasingly stronger electric shocks to an innocent man although he seemed to be in distress. You may have learned what your brain does while you sleep or that you can't always trust your memories. But how come you *didn't* learn that "we use only 10% of our brain" or that "hitting a punching bag can make your anger go away"?

The reason you learned some principles, and not others, is because psychological science is based on studies—on research—by psychologists. Like other scientists, psychologists are empiricists. Being an empiricist means basing one's conclusions on systematic observations. Psychologists do not simply think intuitively about behavior, cognition, and emotion; they know what they know because they have conducted studies on people and animals acting in their natural environments or in specially designed situations. Research is what tells us that most people will administer electric shock to an innocent man in certain situations, and it also tells us that people's brains are usually fully engaged—not just 10%. If you are to think like a psychologist, then you must think like a researcher, and taking a course in research methods is crucial to your understanding of psychology.

This book explains the types of studies psychologists conduct, as well as the potential strengths and limitations of each type of study. You will learn not only how to plan your own studies but

LEARNING OBJECTIVES

A year from now, you should still be able to:

1. Explain what it means to reason empirically.
2. Appreciate how psychological research methods help you become a better producer of information as well as a better consumer of information.
3. Describe five practices that psychological scientists engage in.

also how to find research, read about it, and ask questions about it. While gaining a greater appreciation for the rigorous standards psychologists maintain in their research, you'll find out how to be a systematic and critical consumer of psychological science.

RESEARCH PRODUCERS, RESEARCH CONSUMERS

Some psychology students are fascinated by the research process and intend to become *producers* of research. Perhaps they hope to get a job studying brain anatomy, documenting the behavior of dolphins or monkeys, administering personality questionnaires, observing children in a school setting, or analyzing data. They may want to write up their results and present them at research meetings. These students may dream about working as research scientists or professors.

Other psychology students may not want to work in a lab, but they do enjoy reading about the structure of the brain, the behavior of dolphins or monkeys, the personalities of their fellow students, or the behavior of children in a school setting. They are interested in being *consumers* of research information—reading about research so they can later apply it to their work, hobbies, relationships, or personal growth. These students might pursue careers as family therapists, teachers, entrepreneurs, guidance counselors, or police officers, and they expect psychology courses to help them in these roles.

In practice, many psychologists engage in both roles. When they are planning their research and creating new knowledge, they study the work of others who have gone before them. Furthermore, psychologists in both roles require a curiosity about behavior, emotion, and cognition. Research producers and consumers also share a commitment to the practice of empiricism—to answer psychological questions with direct, formal observations, and to communicate with others about what they have learned.

Why the Producer Role Is Important

For your future coursework in psychology, it is important to know how to be a producer of research. Of course, students who decide to go to graduate school for psychology will need to know all about research methods. But even if you do not plan to do graduate work in psychology, you will probably have to write a paper following the style guidelines of the American Psychological Association (APA) before you graduate, and you may be required to do research as part of a course lab section. To succeed, you will need to know how to randomly assign people to groups, how to measure attitudes accurately, or how to interpret results from a graph. The skills you acquire by conducting research can teach you how psychological scientists ask questions and how they think about their discipline.

As part of your psychology studies, you might even work in a research lab as an undergraduate (**Figure 1.1**). Many psychology professors are active researchers, and if you are offered the opportunity to get involved in their laboratories, take it! Your faculty supervisor may ask you to code behaviors, assign participants to different groups, graph an outcome, or write a report. Doing so will give you your first taste of being a research producer. Although you will be supervised closely, you will be expected to know the basics of conducting research. This book will help you understand why you have to protect the anonymity of your participants, use a coding book, or flip a coin to decide who goes in which group. By participating as a research producer, you can expect to deepen your understanding of psychological inquiry.

FIGURE 1.1
Producers of research.
As undergraduates, some psychology majors work alongside faculty members as producers of information.

Why the Consumer Role Is Important

Although it is important to understand the psychologist's role as a producer of research, most psychology majors do not eventually become researchers. Regardless of the career you choose, however, becoming a savvy consumer of information is essential. In your psychology courses, you will read studies published by psychologists in scientific journals. You will need to develop the ability to read about research with curiosity—to understand it, learn from it, and ask appropriate questions about it.

Think about how often you encounter news stories or look up information on the Internet. Much of the time, the stories you read and the websites you visit will present information based on research. For example, during an election year, Americans may come across polling information in the media almost every day. Many online newspapers have science sections that include stories on the latest research. Entire websites are dedicated to psychology-related topics, such as treatments for autism, subliminal learning tapes, or advice for married couples. Magazines such as *Scientific American*, *Men's Health*, and *Parents* summarize research for their readers. While some of the research—whether online or printed—is accurate and useful, some of it is dubious, and some is just plain wrong. How can you tell the good research information from the bad? Understanding research methods enables you to ask the appropriate questions so you can evaluate information correctly. Research methods skills apply not only to research studies but also to much of the other types of information you are likely to encounter in daily life.

Finally, being a smart consumer of research could be crucial to your future career. Even if you do not plan to be a researcher—if your goal is to be a social worker, a teacher, a sales representative, a human resources professional, an entrepreneur, or a parent—you will need to know how to interpret published research with a critical eye. Clinical psychologists, social workers, and family therapists must read research to know which therapies are the most effective. In fact, licensure in these helping professions requires knowing the research behind **evidence-based treatments**—that is, therapies that are supported by research. Teachers also use research to find out which teaching methods work best. And the business world runs on quantitative information: Research is used to predict what sales will be like in the future, what consumers will buy, and whether investors will take risks or lie low. Once you learn how to be a consumer of information—psychological or otherwise—you will use these skills constantly, no matter what job you have.

In this book, you will often see the phrase "interrogating information." A consumer of research needs to know how to ask the right questions, determine the answers, and evaluate a study on the basis of those answers. This book will teach you systematic rules for interrogating research information.

The Benefits of Being a Good Consumer

What do you gain by being a critical consumer of information? Imagine, for example, that you are a correctional officer at a juvenile detention center, and you watch a TV documentary about a crime-prevention program called Scared Straight. The program arranges for teenagers involved in the criminal justice system to visit prisons, where selected prisoners describe the stark, violent realities of prison life (**Figure 1.2**). The idea is that when teens hear about how tough it is in prison, they will be scared into the "straight," law-abiding life. The program makes a lot

FIGURE 1.2
Scared straight.
Although it makes intuitive sense that young people would be scared into good behavior by hearing from current prisoners, such intervention programs have actually been shown to cause an increase in criminal offenses.

of sense to you. You are considering starting a partnership between the residents of your detention center and the state prison system.

However, before starting the partnership, you decide to investigate the efficacy of the program by reviewing some research that has been conducted about it. You learn that despite the intuitive appeal of the Scared Straight approach, the program doesn't work—in fact, it might even cause criminal activity to get worse! Several published articles have reported the results of randomized, controlled studies in which young adults were assigned to either a Scared Straight program or a control program. The researchers then collected criminal records for 6–12 months. None of the studies showed that Scared Straight attendees committed fewer crimes, and most studies found an *increase* in crime among participants in the Scared Straight programs, compared to the controls (Petrosino, Turpin-Petrosino, & Finckenauer, 2000). In one case, Scared Straight attendees had committed 20% *more* crimes than the control group.

At first, people considering such a program might think: If this program helps even one person, it's worth it. However, we always need empirical evidence to test the efficacy of our interventions. A well-intentioned program that seems to make sense might actually be doing harm. In fact, if you investigate further, you'll find that the U.S. Department of Justice officially warns that such programs are ineffective and can harm youth, and the Juvenile Justice and Delinquency Prevention Act of 1974 was amended to prohibit youth in the criminal justice system from interactions with adult inmates in jails and prisons.

Being a skilled consumer of information can inform you about other programs that might work. For example, in your quest to become a better student, suppose you see this headline: "Mindfulness may improve test scores." The practice of mindfulness involves attending to the present moment, on purpose, with a nonjudgmental frame of mind (Kabat-Zinn, 2013). In a mindful state, people simply observe and let go of thoughts rather than elaborating on them. Could the practice of mindfulness really improve test scores? A study conducted by Michael Mrazek and his colleagues assigned people to take either a 2-week mindfulness training course or a 2-week nutrition course (Mrazek, Franklin, Philips, Baird, & Schooner, 2013). At the end of the training, only the people who had practiced mindfulness showed improved GRE scores (compared to their scores beforehand). Mrazek's group hypothesized that mindfulness training helps people attend to an academic task without being distracted. They were better, it seemed, at controlling their minds from wandering. The research evidence you read about here appears to support the use of mindfulness for improving test scores.

By understanding the research methods and results of this study, you might be convinced to take a mindfulness-training course similar to the one used by Mrazek and his colleagues. And if you were a teacher or tutor, you might consider advising your students to practice some of the focusing techniques. (Chapter 10 returns to this example and explains why the Mrazek study stands up to interrogation.) Your skills in research methods will help you become a better consumer of studies like this one, so you can decide when the research supports some programs (such as mindfulness for study skills) but not others (such as Scared Straight for criminal behavior).

CHECK YOUR UNDERSTANDING

1. Explain what the consumer of research and producer of research roles have in common, and describe how they differ.
2. What kinds of jobs would use consumer-of-research skills? What kinds of jobs would use producer-of-research skills?

1. See pp. 6–7. 2. See pp. 7–8.

HOW SCIENTISTS APPROACH THEIR WORK

Psychological scientists are identified not by advanced degrees or white lab coats; they are defined by what they do and how they think. The rest of this chapter will explain the fundamental ways psychologists approach their work. First, they act as empiricists in their investigations, meaning that they systematically observe the world. Second, they test theories through research and, in turn, revise their theories based on the resulting data. Third, they take an empirical approach to both applied research, which directly targets real-world problems, and basic research, which is intended to contribute to the general body of knowledge. Fourth, they go further: Once they have discovered an effect, scientists plan further research to test why, when, or for whom an effect works. Fifth, psychologists make their work public: They submit their results to journals for review and respond to the opinions of other scientists. Another aspect of making work public involves sharing findings of psychological research with the popular media, who may or may not get the story right.

Scientists Are Empiricists

» For more on the contrast between empiricism and intuition, experience, and authority, see Chapter 2, pp. 26–31.

Empiricists do not base conclusions on intuition, on casual observations of their own experience, or on what other people say. **Empiricism**, also referred to as the *empirical method* or *empirical research*, involves using evidence from the senses (sight, hearing, touch) or from instruments that assist the senses (such as thermometers, timers, photographs, weight scales, and questionnaires) as the basis for conclusions. Empiricists aim to be systematic, rigorous, and to make their work independently verifiable by other observers or scientists. In Chapter 2, you will learn more about why empiricism is considered the most reliable basis for conclusions when compared with other forms of reasoning, such as experience or intuition. For now, we'll focus on some of the practices in which empiricists engage.

Scientists Test Theories: The Theory-Data Cycle

In the theory-data cycle, scientists collect data to test, change, or update their theories. Even if you have never been in a formal research situation, you have probably tested ideas and hunches of your own by asking specific questions that are grounded in theory, making predictions, and reflecting on data.

For example, let's say you need to take your bike to work later, so you check the weather forecast on your tablet (**Figure 1.3**). The application opens, but you see a blank screen. What could be wrong? Maybe your entire device is on the blink: Do the other apps work? When you test them, you find your calculator is working, but not your e-mail. In fact, it looks as if only the apps that need wireless are not working. Your wireless indicator looks low, so you ask your roommate, sitting nearby, "Are you having wifi problems?" If she says no, you might try resetting your device's wireless connection.

FIGURE 1.3
Troubleshooting a tablet.
Troubleshooting an electronic device is a form of engaging in the theory-data cycle.

Notice the series of steps in this process. First, you asked a particular set of questions, all of which were guided by your theory about how such devices work. The questions (Is it the tablet as a whole? Is it only the wifi?) reflected your theory that the weather app requires a working electronic device as well as a wireless connection. Because you were operating under this theory, you chose not to ask other kinds of questions (Has a warlock cursed my tablet? Does my device have a bacterial infection?). Your theory set you up to ask certain questions and not others. Next, your questions led you to specific predictions, which you tested by collecting data. You tested your first idea about the problem (My device can't run any apps) by making a specific prediction (If I test any application, it won't work). Then you set up a situation to test your prediction (Does the calculator work?). The data (The calculator does work) told you your initial prediction was wrong. You used that outcome to change your idea about the problem (It's only the wireless-based apps that aren't working). And so on. When you take systematic steps to solve a problem, you are participating in something similar to what scientists do in the theory-data cycle.

THE CUPBOARD THEORY VS. THE CONTACT COMFORT THEORY

A classic example from the psychological study of attachment can illustrate the way researchers similarly use data to test their theories. You've probably observed that animals form strong attachments to their caregivers. If you have a dog, you know he's extremely happy to see you when you come home, wagging his tail and jumping all over you. Human babies, once they are able to crawl, may follow their parents or caregivers around, keeping close to them. Baby monkeys exhibit similar behavior, spending hours clinging tightly to the mother's fur. Why do animals form such strong attachments to their caregivers?

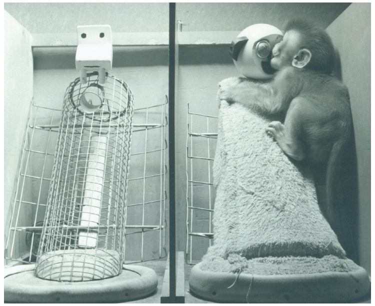

FIGURE 1.4
The contact comfort theory.
As the theory hypothesized, Harlow's baby monkeys spent most of their time on the warm, cozy cloth mother, even though she did not provide any food.

One theory, referred to as the cupboard theory of mother-infant attachment, is that a mother is valuable to a baby mammal because she is a source of food. The baby animal gets hungry, gets food from the mother by nursing, and experiences a pleasant feeling (reduced hunger). Over time, the sight of the mother is associated with pleasure. In other words, the mother acquires positive value for the baby because she is the "cupboard" from which food comes. If you've ever assumed your dog loves you only because you feed it, your beliefs are consistent with the cupboard theory.

An alternative theory, proposed by psychologist Harry Harlow (1958), is that hunger has little to do with why a baby monkey likes to cling to the warm, fuzzy fur of its mother. Instead, babies are attached to their mothers because of the comfort of cozy touch. This is the contact comfort theory. (In addition, it provides a less cynical view of why your dog is so happy to see you!)

In the natural world, a mother provides both food and contact comfort at once, so when the baby clings to her, it is impossible to tell why. To test the alternative theories, Harlow had to separate the two influences—food and contact comfort. The only way he could do so was to create "mothers" of his own. He built two monkey foster "mothers"—the only mothers his lab-reared baby monkeys ever had. One of the mothers was made of bare wire mesh with a bottle of milk built in. This wire mother offered food, but not comfort. The other mother was covered with fuzzy terrycloth and was warmed by a lightbulb suspended inside, but she had no milk. This cloth mother offered comfort, but not food.

Note that this experiment sets up three possible outcomes. The contact comfort theory would be supported if the babies spent most of their time clinging to the cloth mother. The cupboard theory would be supported if the babies spent most of their time clinging to the wire mother. Neither theory would be supported if monkeys divided their time equally between the two mothers.

When Harlow put the baby monkeys in the cages with the two mothers, the evidence in favor of the contact comfort theory was overwhelming. Harlow's data showed that the little monkeys would cling to the cloth mother for 12–18 hours a day (**Figure 1.4**). When they were hungry, they would climb down, nurse from the wire mother, and then at once go back to the warm, cozy cloth mother. In short, Harlow used the two theories to make two specific predictions about how the monkeys would interact with each mother. Then he used the data he recorded (how much time the monkeys spent on each mother) to support only one of the theories. The theory-data cycle in action!

THEORY, HYPOTHESIS, AND DATA

A **theory** is a set of statements that describes general principles about how variables relate to one another. For example, Harlow's theory, which he developed in light of extensive observations of primate babies and mothers, was about the overwhelming importance of bodily contact (as opposed to simple nourishment) in forming attachments. Contact comfort, not food, was the primary basis for a baby's attachment to its mother. This theory led Harlow to investigate particular kinds of questions—he chose to pit contact comfort against food in his research. The theory meant that Harlow also chose *not* to study unrelated questions, such as the babies' food preferences or sleeping habits.

The theory not only led to the questions; it also led to specific hypotheses about the answers. A **hypothesis**, or *prediction*, is the specific outcome the researcher expects to observe in a study if the theory is accurate. Harlow's hypothesis related to the way the baby monkeys would interact with two kinds of mothers he created for the study. He predicted that the babies would spend more time on the cozy mother than the wire mother. Notably, a single theory can lead to a large number of hypotheses because a single study is not sufficient to test the entire theory—it is intended to test only part of it. Most researchers test their theories with a series of empirical studies, each designed to test an individual hypothesis.

Data are a set of observations. (Harlow's data were the amount of time the baby monkeys stayed on each mother.) Depending on whether the data are consistent with hypotheses based on a theory, the data may either support or challenge the theory. Data that match the theory's hypotheses strengthen the researcher's confidence in the theory. When the data do not match the theory's hypotheses, however, those results indicate that the theory needs to be revised or the research design needs to be improved. **Figure 1.5** shows how these steps work as a cycle.

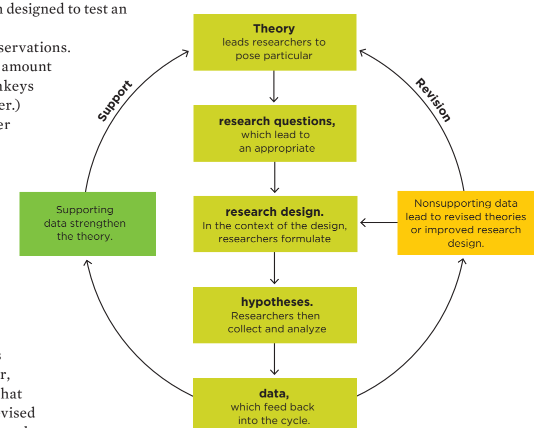

FIGURE 1.5
The theory-data cycle.

FIGURE 1.6
An example of a theory that is not falsifiable.
Certain people might wear a tinfoil hat, operating under the idea that the hat wards off government mental surveillance. But like most conspiracy theories, this notion of remote government mindreading is not falsifiable. If the government has been shown to read people's minds, the theory is supported. But if there is no physical evidence, that also supports the theory because if the government does engage in such surveillance, it wouldn't leave a detectable trace of its secret operations.

FEATURES OF GOOD SCIENTIFIC THEORIES

In scientific practice, some theories are better than others. The best theories are supported by data from studies, are falsifiable, and are parsimonious.

Good Theories Are Supported by Data. The most important feature of a scientific theory is that it is supported by data from research studies. In this respect, the contact comfort theory of infant attachment turned out to be better than the cupboard theory because it was supported by the data. Clearly, primate babies need food, but food is not the source of their emotional attachments to their mothers. In this way, good theories, like Harlow's, are consistent with our observations of the world. More importantly, scientists need to conduct multiple studies, using a variety of methods, to address different aspects of their theories. A theory that is supported by a large quantity and variety of evidence is a good theory.

Good Theories Are Falsifiable. A second important feature of a good scientific theory is **falsifiability**. A theory must lead to hypotheses that, when tested, could actually fail to support the theory. Harlow's theory was falsifiable: If the monkeys had spent more time on the *wire* mother than the cloth mother, the contact-comfort theory would have been shown to be incorrect. Similarly, Mrazek's mindfulness study could have falsified the researchers' theory: If students in the mindfulness training group had shown *lower* GRE scores than those in the nutrition group, their theory of mindfulness and attention would not have been supported.

In contrast, some dubious therapeutic techniques have been based on theories that are not falsifiable. Here's an example. Some therapists practice facilitated communication (FC), believing they can help people with developmental disorders communicate by gently guiding their clients' hands over a special keyboard. In simple but rigorous empirical tests, the facilitated messages have been shown to come from the therapist, not the client (Twachtman-Cullen, 1997). Such studies demonstrated FC to be ineffective. However, FC's supporters don't accept these results. The empirical method introduces skepticism, which, the supporters say, breaks down trust between the therapist and client and shows a lack of faith in people with disabilities. Therefore, these supporters hold a belief about FC that is not falsifiable. To be truly scientific, researchers must take risks, including being prepared to accept data indicating their theory is not supported. Even practitioners must be open to such risk, so they can use techniques that actually work. For another example of an unfalsifiable claim, see **Figure 1.6**.

Good Theories Have Parsimony. A third important feature of a good scientific theory is that it exhibits **parsimony**. Theories are supposed to be simple. If two theories explain the data equally well, most scientists will opt for the simpler, more parsimonious theory.

Parsimony sets a standard for the theory-data cycle. As long as a simple theory predicts the data well, there should be no need to make the theory more complex. Harlow's theory was parsimonious because it posed a simple explanation for infant attachment: Contact comfort drives attachment more than food does. As long as the data continue to support the simple theory, the simple theory stands. However, when the data contradict the theory, the theory has to change in order to accommodate the data. For example, over the years, psychologists have collected data showing that baby monkeys do not always form an attachment to a soft, cozy mother. If monkeys are reared in complete social isolation during their first, critical months, they seem to have problems forming attachments to anyone or anything. Thus, the contact comfort theory had to change a bit to emphasize the importance of contact comfort for attachment *especially in the early months of life*. The theory is slightly less parsimonious now, but it does a better job of accommodating the data.

THEORIES DON'T PROVE ANYTHING

The word *prove* is not used in science. Researchers never say they have proved their theories. At most, they will say that some data *support* or *are consistent with* a theory, or they might say that some data *are inconsistent with* or *complicate* a theory. But no single confirming finding can prove a theory (**Figure 1.7**). New information might require researchers, tomorrow or the next day, to change and improve current ideas. Similarly, a single, disconfirming finding does not lead researchers to scrap a theory entirely. The disconfirming study may itself have been designed poorly. Or perhaps the theory needs to be modified, not discarded. Rather than thinking of a theory as proved or disproved by a single study, scientists evaluate their theories based on the **weight of the evidence**, for and against. Harlow's theory of attachment could not be "proved" by the single study involving wire and cloth mothers. His laboratory conducted dozens of individual studies to rule out alternative explanations and test the theory's limits.

« For more on weight of the evidence, see Chapter 14, p. 436.


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Science / Science Now

Science proves what you suspected: hiking's good for your mental health

FIGURE 1.7
Scientists don't say "prove."
When you see the word *prove* in a headline, be skeptical. No single study can prove a theory once and for all. A more scientifically accurate headline would be: "Study Supports the Hypothesis that Hiking Improves Mental Health." (Source: Netburn, LAtimes.com, 2015.)

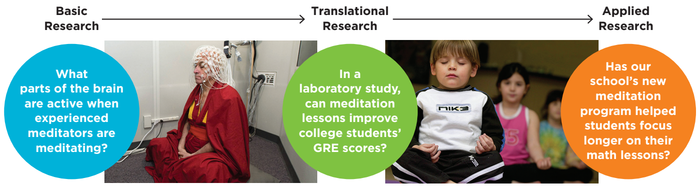

FIGURE 1.8
Basic, applied, and translational research.
Basic researchers may not have an applied context in mind, and applied researchers may be less familiar with basic theories and principles. Translational researchers attempt to translate the findings of basic research into applied areas.

Scientists Tackle Applied and Basic Problems

The empirical method can be used for both applied and basic research questions. **Applied research** is done with a practical problem in mind; the researchers conduct their work in a particular real-world context. An applied research study might ask, for example, if a school district's new method of teaching language arts is working better than the former one. It might test the efficacy of a treatment for depression in a sample of trauma survivors. Applied researchers might be looking for better ways to identify those who are likely to do well at a particular job, and so on.

Basic research, in contrast, is not intended to address a specific, practical problem; the goal is to enhance the general body of knowledge. Basic researchers might want to understand the structure of the visual system, the capacity of human memory, the motivations of a depressed person, or the limitations of the infant attachment system. Basic researchers do not just gather facts at random; in fact, the knowledge they generate may be applied to real-world issues later on.

Translational research is the use of lessons from basic research to develop and test applications to health care, psychotherapy, or other forms of treatment and intervention. Translational research represents a dynamic bridge from basic to applied research. For example, basic research on the biochemistry of cell membranes might be translated into a new drug for schizophrenia. Or basic research on how mindfulness changes people's patterns of attention might be translated into a study skills intervention. **Figure 1.8** shows the interrelationship of the three types of research.

Scientists Dig Deeper

Psychological scientists rarely conduct a single investigation and then stop. Instead, each study leads them to ask a new question. Scientists might start with a simple effect, such as the effect of comfort on attachment, and then ask, "Why does this occur?" "When does this happen the most?" "For whom does this apply?" "What are the limits?"

Mrazek and his team did not stop after only one study of mindfulness training and GRE performance. They dug deeper. They also asked whether mindfulness training was especially helpful for people whose minds wander the most. In other studies, they investigated if mindfulness training influenced skills such as people's insight about their own memory (Baird, Mrazek, Phillips, & Schooler, 2014). And they have contrasted mindfulness with mind-wandering, attempting to find both the benefits and the costs of mind-wandering (Baird et al., 2012). This research team has conducted many related studies of how people can and cannot control their own attention.

Scientists Make It Public: The Publication Process

When scientists want to tell the scientific world about the results of their research, they write a paper and submit it to a scientific **journal**. Like magazines, journals usually come out every month and contain articles written by various qualified contributors. But unlike popular newsstand magazines, the articles in a scientific journal are *peer-reviewed*. The journal editor sends the submission to three or four experts on the subject. The experts tell the editor about the work's virtues and flaws, and the editor, considering these reviews, decides whether the paper deserves to be published in the journal.

The peer-review process in the field of psychology is rigorous. Peer reviewers are kept anonymous, so even if they know the author of the article professionally or personally, they can feel free to give an honest assessment of the research. They comment on how interesting the work is, how novel it is, how well the research was done, and how clear the results are. Ultimately, peer reviewers are supposed to ensure that the articles published in scientific journals contain innovative, well-done studies. When the peer-review process works, research with major flaws does not get published. However, the process continues even after a study is published. Other scientists can cite an article and do further work on the same subject. Moreover, scientists who find flaws in the research (perhaps overlooked by the peer reviewers) can publish letters, commentaries, or competing studies. Through publishing their work, scientists make the process of their research transparent, and the scientific community evaluates it.

Scientists Talk to the World: From Journal to Journalism

One goal of this textbook is to teach you how to interrogate information about psychological science that you find not only in scientific journals, but also in more mainstream sources that you encounter in daily life. Psychology's scientific journals are read primarily by other scientists and by psychology students; the general public almost never reads them. **Journalism**, in contrast, includes the kinds of news and commentary that most of us read or hear on television, in magazines and newspapers, and on Internet sites—articles in *Psychology Today* and *Men's Health*, topical blogs, relationship advice columns, and so on. These sources are usually written by journalists or laypeople, not scientists, and they are meant to reach the general public; they are easy to access, and understanding their content does not require specialized education.

How does the news media find out about the latest scientific findings? A journalist might become interested in a particular study by reading the current issue of a scientific journal or by hearing scientists talk about their work at a conference. The journalist turns the research into a news story by summarizing it for a popular audience, giving it an interesting headline, and writing about it using nontechnical terms. For example, the journal article by Mrazek and his colleagues on the effect of mindfulness on GRE scores was summarized by a journalist in the magazine *Scientific American* (Nicholson, 2013).

BENEFITS AND RISKS OF JOURNALISM COVERAGE

Psychologists can benefit when journalists publicize their research. By reading about psychological research in the newspaper, the general public can learn what psychologists really do. Those who read or hear the story might also pick up important tips for living: They might understand their children or themselves better; they might set different goals or change their habits. These important benefits of science writing depend on two things, however. First, journalists need to report on the most important scientific stories, and second, they must describe the research accurately.

Is the Story Important? When journalists report on a study, have they chosen research that has been conducted rigorously, that tests an important question, and that has been peer-reviewed? Or have they chosen a study simply because it is cute or eye-catching? Sometimes journalists do follow important stories, especially when covering research that has already been published in a selective, peer-reviewed journal. But sometimes journalists choose the sensational story over the important one.

For example, one spring, headlines such as "Your dog hates hugs" and "You need to stop hugging your dog, study finds" began popping up in newsfeeds. Of course, this topic is clickbait, and dozens of news outlets shocked readers and listeners with these claims. However, the original claim had been made by a psychology professor who had merely reported some data in a blog post. The study he conducted had not been peer-reviewed or published in an empirical journal. The author had simply coded some Internet photographs of people hugging their dogs; according to the author, 82% of the dogs in the sample were showing signs of stress (Coren, 2016). Journalists should not have run with this story before it had been peer-reviewed. Scientific peer reviewers might have criticized the study because it didn't include a comparison group of photos of dogs that weren't being hugged.

The author also left out important details, such as how the photographs were selected and whether the dogs' behavior actually meant they were stressed. In this case, journalists were quick to publish a headline that was sensational, but not necessarily important.

Is the Story Accurate? Even when journalists report on reliable, important research, they don't always get the story right. Some science writers do an excellent, accurate job of summarizing the research, but not all of them do (**Figure 1.9**). Perhaps the journalist does not have the scientific training, the motivation, or the time before deadline to understand the original science very well. Maybe the journalist dumbs down the details of a study to make it more accessible to a general audience. And sometimes a journalist wraps up the details of a study with a more dramatic headline than the research can support.

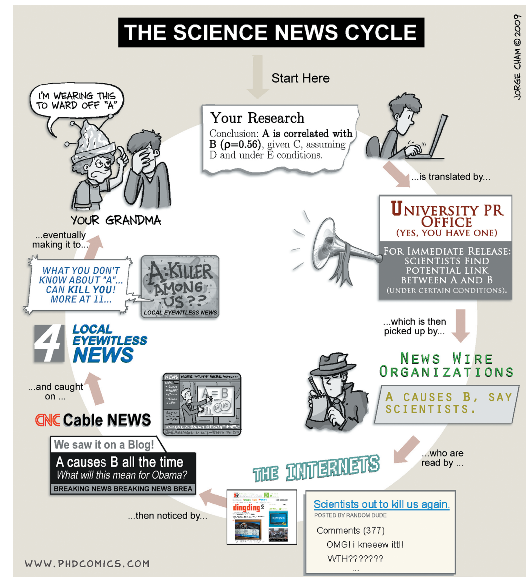

FIGURE 1.9
Getting it right.
Cartoonist Jorge Cham parodies what can happen when journalists report on scientific research. Here, an original study reported a relationship between two variables. Although the University Public Relations Office relates the story accurately, the strength of the relationship and its implications become distorted with subsequent retellings, much like a game of "telephone."

FIGURE 1.10
The Mozart effect.
Journalists sometimes misrepresent research findings. Exaggerated reports of the Mozart effect even inspired a line of consumer products for children.

Media coverage of a phenomenon called the "Mozart effect" provides an example of how journalists might misrepresent science when they write for a popular audience (Spiegel, 2010). In 1993, researcher Frances Rauscher found that when students heard Mozart music played for 10 minutes, they performed better on a subsequent spatial intelligence test when compared with students who had listened to silence or to a monotone speaking voice (Rauscher, Shaw, & Ky, 1993). Rauscher said in a radio interview, "What we found was that the students who had listened to the Mozart sonata scored significantly higher on the spatial temporal task." However, Rauscher added, "It's very important to note that we did not find effects for general intelligence . . . just for this one aspect of intelligence. It's a small gain and it doesn't last very long" (Spiegel, 2010). But despite the careful way the scientists described their results, the media that reported on the story exaggerated its importance:

> The headlines in the papers were less subtle than her findings: "Mozart makes you smart" was the general idea. . . . But worse, says Rauscher, was that her very modest finding started to be wildly distorted. "Generalizing these results to children is one of the first things that went wrong. Somehow or another the myth started exploding that children that listen to classical music from a young age will do better on the SAT, they'll score better on intelligence tests in general, and so forth." (Spiegel, 2010)

Perhaps because the media distorted the effects of that first study, a small industry sprang up, recording child-friendly sonatas for parents and teachers (**Figure 1.10**). However, according to research conducted since the first study was published, the effect of listening to Mozart on people's intelligence test scores is not very strong, and it applies to most music, not just Mozart (Pietschnig, Voracek, & Formann, 2010).

The journalist Ben Goldacre (2011) catalogs examples of how journalists and the general public misinterpret scientific data when they write about it for a popular audience. Some journalists create dramatic stories about employment statistics that show, for example, a 0.9% increase in unemployment claims. Journalists may conclude that these small increases show an upward trend—when in fact, they may simply reflect sampling error. Another example comes from a happiness survey of 5,000 people in the United Kingdom. Local journalists picked up on tiny city-to-city differences, creating headlines about, for instance, how the city of Edinburgh is the "most miserable place in the country." But the differences

the survey found between the various places were not statistically significant (Goldacre, 2008). Even though there were slight differences in happiness from Edinburgh to London, the differences were small enough to be caused by random variation. The researcher who conducted the study said, "I tried to explain issues of [statistical] significance to the journalists who interviewed me. Most did not want to know" (Goldacre, 2008).

« To learn about sampling error, see Chapter 7, pp. 196–197.

How can you prevent being misled by a journalist's coverage of science? One idea is to find the original source, which you'll learn to do in Chapter 2. Reading the original scientific journal article is the best way to get the full story. Another approach is to maintain a skeptical mindset when it comes to popular sources. Chapter 3 explains how to ask the right questions before you allow yourself to accept the journalist's claim.

CHECK YOUR UNDERSTANDING

1. What happens to a theory when the data do not support the theory's hypotheses? What happens to a theory when the data do support the theory's hypotheses?
2. Explain the difference between basic research and applied research, and describe how the two interact.
3. Why can't theories be proved in science?
4. When scientists publish their data, what are the benefits?
5. Describe two ways journalists might distort the science they attempt to publicize.

1. See the discussion of Harlow's monkey experiment on p. 13. 2. See p. 16. 3. See p. 15. 4. See p. 17. 5. See pp. 18–21.

CHAPTER REVIEW

Summary

Thinking like a psychologist means thinking like a scientist, and thinking like a scientist involves thinking about the empirical basis for what we believe.

Research Producers, Research Consumers

- Some students need skills as producers of research; they develop the ability to work in research laboratories and make new discoveries.
- Some students need skills as consumers of research; they need to be able to find, read, and evaluate the research behind important policies, therapies, and workplace decisions.
- Having good consumer-of-research skills means being able to evaluate the evidence behind the claims of a salesperson, journalist, or researcher, and making better, more informed decisions by asking the right questions.

How Scientists Approach Their Work

- As scientists, psychologists are empiricists; they base their conclusions on systematic, unbiased observations of the world.
- Using the theory-data cycle, researchers propose theories, make hypotheses (predictions), and collect data. A good scientific theory is supported by data, is falsifiable, and is parsimonious. A researcher might say that a theory is well supported or well established, rather than proved, meaning that most of the data have confirmed the theory and very little data have disconfirmed it.
- Applied researchers address real-world problems, and basic researchers work for general understanding. Translational researchers attempt to translate the findings of basic research into applied areas.
- Scientists usually follow up an initial study with more questions about why, when, and for whom a phenomenon occurs.
- The publication process is part of worldwide scientific communication. Scientists publish their research in journals, following a peer-review process that leads to sharper thinking and improved communication. Even after publication, published work can be approved or criticized by the scientific community.
- Journalists are writers for the popular media who are skilled at transforming scientific studies for the general public, but they don't always get it right. Think critically about what you read online, and when in doubt, go directly to the original source—peer-reviewed research.

Key Terms

evidence-based treatment, p. 8
empiricism, p. 10
theory, p. 13
hypothesis, p. 13
data, p. 13
falsifiability, p. 14
parsimony, p. 15
weight of the evidence, p. 15
applied research, p. 16
basic research, p. 16
translational research, p. 16
journal, p. 17
journalism, p. 18

To see samples of chapter concepts in the popular media, visit www.everydayresearchmethods.com and click the box for Chapter 1.

Review Questions

1. Which of the following jobs most likely involves producer-of-research skills rather than consumer-of-research skills?
   a. Police officer
   b. University professor
   c. Physician
   d. Journalist

2. To be an empiricist, one should:
   a. Base one's conclusions on direct observations.
   b. Strive for parsimony.
   c. Be sure that one's research can be applied in a real-world setting.
   d. Discuss one's ideas in a public setting, such as on social media.

3. A statement, or set of statements, that describes general principles about how variables relate to one another is a(n) ______________.
   a. prediction
   b. hypothesis
   c. empirical observation
   d. theory

4. Why is publication an important part of the empirical method?
   a. Because publication enables practitioners to read the research and use it in applied settings.
   b. Because publication contributes to making empirical observations independently verifiable.
   c. Because journalists can make the knowledge available to the general public.
   d. Because publication is the first step of the theory-data cycle.

5. Which of the following research questions best illustrates an example of basic research?
   a. Has our company's new marketing campaign led to an increase in sales?
   b. How satisfied are our patients with the sensitivity of the nursing staff?
   c. Does wearing kinesio-tape reduce joint pain?
   d. Can 2-month-old human infants tell the difference between four objects and six objects?

Learning Actively

1. To learn more about the theory-data cycle, look in the textbooks from your other psychology courses for examples of theories. In your introductory psychology book, you might look up the James Lange theory or the Cannon-Bard theory of emotion. You could look up Piaget's theory of cognitive development, the Young-Helmholz theory of color vision, or the stage theory of memory. How do the data presented in your textbook show support for the theory? Does the textbook present any data that do not support the theory?

2. Go to an online news website and find a headline that is reporting the results of a recently published study. Read the story, and ask: Has the research in the story been published yet? Does the journalist mention the name of a journal in which the results appeared? Or has the study only been presented at a research conference? Then, use the Internet to find examples of how other journalists have covered the same story. What variation do you notice in their stories?

3. See what you can find online that has been written about the Mozart effect, about whether people should hug their dogs, or whether people should begin a mindfulness practice in their lives. Does the source you found discuss research evidence? Does the source provide the names of scientists and the journals in which data have been published? On the downside, does the coverage suggest that you purchase a product or that science has "proved" the effectiveness of a certain behavior or technique?