PART I

OVERVIEW OF THE RESEARCH PROCESS FROM START TO FINISH

PART I INTRODUCTION

Part I of the text will introduce you to the research process that is followed by behavioral researchers. It contains chapters covering the research process from start to finish, highlighting the steps to follow in conducting research. Concepts are introduced where they are applicable, with repetition in some cases where a concept may apply in multiple contexts (e.g., validity and reliability) to help you understand the different ways in which concepts can be applied to the research process. Some steps require multiple chapters, whereas multiple steps can be covered in a single chapter as the steps are strongly related. Although the chapters in Part I are written to be read in any order your instructor may choose, you will likely follow the chapter order in Part I to follow the research process steps with some chapters in Part II mixed in for more detail on a topic.

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1 INTRODUCTION TO BEHAVIORAL RESEARCH

The Whys and Hows of the Scientific Method

CONSIDER THE FOLLOWING QUESTIONS AS YOU READ CHAPTER 1

- What is the value of research in psychology?
- Why do researchers use the scientific method?
- How do researchers use the scientific method?
- What are the canons of the scientific method?
- What is the difference between basic and applied research?
- How do basic and applied research interact to increase our knowledge about behavior?

LEARNING OBJECTIVES FOR CHAPTER 1

LO1: Describe how knowledge of research in psychology and related fields has value beyond careers in research

LO2: Explain what it means to learn about behavior through observation

LO3: List the assumptions made when using the scientific method to understand the world

LO4: Identify research in terms of the basic–applied distinction

As an instructor of an introductory psychology course for psychology majors, I have asked my first-semester freshman students the question, "What is a psychologist?" At the beginning of the semester, students typically say something like "a psychologist listens to other people's problems to help them live happier lives." By the end of the semester and their first college course in psychology, these same students will respond differently because by then they better understand how the field of psychology is advanced, and will offer responses like, "A psychologist helps people with their psychological problems but also studies behavior through research." These students have learned that psychology is a science that is used to investigate behaviors, mental processes, and their causes. That is what this book is about: how researchers use the scientific method to observe and understand behaviors and mental processes.

The goal of this text is to give you a step-by-step approach to the research process, from the purpose of research that is discussed in this chapter, and the types of questions researchers ask about behavior, to the methods used by researchers to observe and understand behavior, and to how researchers describe their findings to others in their field. As you'll see, this knowledge is useful to everyone as they attempt to understand the findings from research in all areas to make decisions in their everyday lives.

WHY SHOULD I CARE ABOUT RESEARCH IF I DON'T WANT TO DO RESEARCH IN MY CAREER?

Throughout my years of teaching research methods courses, this question is often asked by students who don't think they will want to conduct research in their careers. A few of you might be bitten by the "research bug," as I was as an undergraduate, and find research to be an exciting way to answer questions you have about behavior. Learning about the process of research can help you better understand the topics presented in other courses you may take because you will have the knowledge of how this information about behavior was gained. However, a majority of students in research methods courses are majoring in psychology or related fields and are interested in working as practitioners of psychology or a similar field, and some may be completing a psychology minor that is related to another career they want to pursue (e.g., education, social work). In fact, most people who hold a degree in psychology do not conduct research in their jobs. Instead, the majority of individuals working in jobs related to psychology are in helping or other applied professions. So, you may be asking yourself why you need to learn about research methods at all. One reason is that what we know about behavior in everyday settings comes from research findings. For example, effective treatments and counseling techniques come from research in these areas. When a new treatment technique is tested, its effectiveness is determined by the research conducted. Thus, just as medical doctors do, clinicians and counselors must evaluate the latest research to determine whether a new treatment is one they should adopt. Knowledge of how research is conducted can help them evaluate this research more effectively to aid their practice. In addition, other popular applied areas, such as industrial-organization psychology (i.e., the application of psychology to organizations and the workplace) and human factors (i.e., the application of psychology to the design of objects and situations used in everyday life) use research findings to help address issues many people will encounter in their lives. Industrial-organizational psychologists help organizations hire effective employees, prevent job dissatisfaction, and explore the best training methods for new employees using research findings on these topics (see Photo 1.1). Human factors professionals use research to help understand the best way to design products and interfaces (such as your smartphone or an airplane cockpit—see Photo 1.2) to make them easier to use and to prevent errors. Finally, it is important that we as individuals understand how to interpret the vast amounts of information we take in each day through media sources. Research findings are reported by the media that relate to various topics. We also read claims others make on social media, not always knowing if these claims are accurate. Knowing the basics of how research is conducted can help you decide which of those reports and claims you should listen to and which are best ignored or require additional data to be useful.

To give you a recent example, in debates about climate change and the seriousness of the problem, many opponents of climate change solutions point out that there is disagreement among scientists about the cause. My own father once told me that this is the reason that he doesn't believe climate change is caused by human activities—some scientists have stated that they have data to counter this conclusion. Disagreement is part of the scientific process and in

PHOTOS 1.1 AND 1.2 Knowledge of research can aid in applied areas of psychology, such as industrial-organizational psychology and human factors.

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fact, a very large majority of scientists agree that climate change is caused by human activities. No single study can fully answer a question because a study only looks at a small piece of the bigger picture. Some studies will find no evidence for a causal factor that truly exists. Others may find an effect when one doesn't exist simply due to chance factors in the data collection process. The key is to look for what the bulk of the data are showing us at any given time to help us solve problems or make decisions in our daily lives. We also need to be flexible enough to change our behavior and beliefs when they are contradicted by new data.

Another example comes from my life as a parent. A number of years ago, my son was diagnosed with Attention-Deficit/Hyperactivity Disorder (ADHD). As this is a fairly common disorder, I knew a few things about ADHD, but not a lot. A couple years after his diagnosis, my son started to have very severe tics that affected his whole body. To try to learn more about Tourette disorder, which is the cause of his tics, I started looking at the research studies published on both ADHD and Tourette disorder and found that many people with one of these disorders also have the other disorder. This knowledge has helped me communicate with his doctors and to make informed decisions about treatment options for him. His doctors were not always aware of some of the most recent research on these disorders and their treatments, and, with my knowledge from evaluating this research, I was able to advocate for treatments that have been the best ones for my son. It required more than just Googling these topics, which can produce unreliable information. I used my knowledge of research and how to evaluate it to make informed decisions for him based on the data that have been collected on these topics.

As voters and consumers, it is also important that we understand which evidence from research is the most accurate and that there will almost always be disagreement among researchers in an area because no single study can fully answer a research question or prove something is factual, or true. In order to understand the answers research provides on a question, we must consider both the consistency of data across several research studies (and this is what I told my father when he stated his reasoning to me about his beliefs) and the quality of the research that's been conducted. We must also understand that new knowledge is always being discovered, and we must be flexible in our conclusions about an issue when new data suggest a different answer. Remember, there was a time when most humans believed the sun revolved around the Earth. Scientific study revealed this idea to be false, and, over time, humans adapted their beliefs to the new knowledge. And consider how quickly information about COVID-19 changed during the pandemic, with studies today continuing to explore the virus and how it affects us. We must continuously evaluate new findings that inform us about the best everyday behaviors, such as how to prevent Alzheimer's disease or how to keep our hearts healthy so we can live longer, and we must always be prepared to consider the quality and type of research that new advice is based on. It's this critical evaluation of data and the conclusions from these data that are the cornerstones of good science.

In almost all cases, media sources present concise and simplified reports of a research study and its results, leaving many questions about the quality of the study still to be answered. When you encounter reports of research in the media, some important questions should come to mind. Who were the research subjects/participants? Was an appropriate sample tested? Was an appropriate method used to investigate the question? Were the results published in a high-quality

source where other researchers were able to evaluate and critique the study? How do the results compare with those from past studies on this topic? The topics covered in this text and in your methods course will help you ask and answer these questions as you evaluate reports in the media to help you make informed decisions about your life.

Finally, the new knowledge you gain from your study of research methods can help you decide how to evaluate claims made by others in general. When you see an ad on television for a new miracle diet pill that the ad claims has helped people lose weight in studies, should you buy the pill because it has been tested in research studies? When your friends tell you that drinking energy drinks would help you study better and achieve higher scores on exams, should you follow their advice? Should you believe claims that vaccines cause autism? (You shouldn't: There's no good research evidence that vaccinations cause autism.) Hopefully, one of the things you will consider as you learn about research is to be skeptical about claims that seem too good to be true. An informed person uses the available data to decide what the best thing to do is rather than using unsubstantiated advice from others who just sound knowledgeable about a topic but who cannot provide evidence beyond an anecdote or two. Examples of how to evaluate claims and research reported in the media are given in the *Using Research* sections found at the end of the chapters in this text.

WHY PSYCHOLOGISTS CONDUCT RESEARCH

Think about how you know the things you know. How do you know the Earth is round? How do you know it is September? How do you know that gun violence is increasing in the United States? There are probably many ways that you know these things. In some cases, you may know things because you used your **intuition** or previous knowledge to deduce these facts (i.e., to learn them by **deduction**). For example, you may know from past experience that where you live, in the month of September, days tend to be warm but start to get cooler, especially at night. Therefore, remembering the characteristics of the weather you are experiencing and knowing you are still living in the same location as past years, you can deduce that the month is September from your knowledge base. You may have first learned that the Earth is round from an **authority** figure like your parents, teachers, or text authors. You may have also observed that the Earth is round by viewing photographs of the Earth taken from space. You may know that gun violence is increasing in the United States from authority figures as well (e.g., magazine and newspaper reporters, your country's leaders' statements). These are the primary ways that we learn new facts: intuition, deduction, authority, and **observation**.

Suppose something occurred that caused you to suspect that the authority figures you have learned these facts from are not reliable sources of information. Perhaps they have been caught lying about other facts. You might also consider a situation where you do not have enough previous experience with a topic to use your intuition to determine the information for yourself. In these situations, what is the best way for you to find the facts? The answer is observation. If you had reason to believe, for example, that an increase in gun violence is not being represented accurately (say from overcoverage of shootings in the news), you could examine the incidence of gun violence in the United States (e.g., from public records) over a

period of time to find out if this statement represents the true conditions. Observing the world directly is going to give you the most accurate information because you are directly gaining the knowledge yourself—you are not relying on possibly faulty reasoning on your part or information someone may be giving you that is false or misleading. See Table 1.1 for some examples of the different ways of knowing information.

This is why psychologists conduct behavioral research: it is the best way to make certain that the information they have about behavior is accurate. By conducting careful and systematic observations, they can be certain that they are getting the most accurate knowledge they can about behavior. This does not mean that every study conducted will yield accurate results. There are many cases where the observations collected by different researchers conflict, but this is an important part of the process. Different ways of observing a behavior may yield different results, and these different results help us to better understand how behaviors occur. Over time, with enough observations, a clearer answer to the question can be found. But no single research study can "prove" that something is true. Researchers are not able to "prove" facts with a study; the best they can do is support an idea about behavior with their data. Despite the limits of observation as a way of knowing, it is superior to the other methods because it allows for a more objective way of gaining knowledge. Relying on the other ways of gaining knowledge can be misleading because they can be more easily influenced by biases that people have. This is why science can be trusted to learn the truth about the world—it involves careful observations, critical evaluation of those observations, and then revision of our ideas when those evaluations conflict with our beliefs.

Using Science to Understand and Explain Behavior

Observation is really what sets scientific fields apart from other fields of study. Someone who wants to know about the political situation during a Civil War may read historical documents and use their intuition to describe the situation based on these documents. One might also read books by experts (authority figures) on that Civil War period or books on important figures who lived during that time. However, historians typically cannot observe the historical event they are studying. Psychologists have

TABLE 1.1 Examples of Ways of Knowing Information

Way of Knowing	Example
Intuition	I'm trying to go someplace I've never been, but I do not know the precise directions. I decide to turn left because it just "feels like" that's the right way to go.
Deduction	I want to know which direction I am facing. The sun is setting to my right, and I know the sun sets in the west, so I know that south is the direction I am facing.
Authority	I want to know what my pancreas does. I ask my high school biology teacher, who tells me that my pancreas produces hormones important for digestion.
Observation	I want to know how much sleep, on average, Americans get per night. I determine this by conducting a survey of Americans to learn that most Americans get an average of 6 to 8 hours of sleep per night (e.g., Moore, 2004).

an advantage in that the behavior they want to learn about is happening in humans and other animals in the world around them. The best way to learn about something is to observe it (see Photo 1.3).

Some behaviors, such as mental processes, cannot be directly observed (e.g., thoughts or memories). Thus, researchers have developed techniques for inferring information about mental processes through observation of specific behaviors that are affected by those mental processes. Researchers then attempt to understand the mental processes through observation of these behaviors and the investigation of the factors that influence those behaviors. That is what this book (and the course you are taking) is all about—understanding the methods researchers use to observe, measure, and study behavior, including mental processes.

Research is the foundation of the field of psychology. As I described earlier in this chapter, people typically think of the *helping* professions when they think about what psychologists do. This is because most people with a graduate degree in psychology work in these helping (or related) professions (American Psychological Association [APA], 2003). However, to do their jobs well, helping professionals, such as clinicians and counselors, need to understand the findings from research about behavior so that they know what types of treatments and therapies can best help their clients. The research studies conducted in the field of psychology and related fields also help clinicians and counselors understand what constitutes "normal" behavior and what behaviors might be considered "abnormal" or "dysfunctional" for an individual.

Thinking about the field of biology may help you understand how influential research is in the field of psychology. In the biological sciences, there are researchers who investigate the way our

PHOTO 1.3 If we want to know how much sleep people get, we can use scientific methods to measure this directly or ask people to report this behavior on a survey.

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bodies react physically to the world around us (e.g., after being exposed to a virus). This knowledge helps other researchers determine which drugs may be effective in helping us improve these physical reactions (e.g., reduce our symptoms as we fight the virus). Finally, the knowledge gained in biological research helps doctors correctly diagnose and treat their patients (e.g., what symptoms indicate the presence of a particular virus and which drugs are most effective in treating these symptoms). The field of psychology works a lot like the field of biology, although the term *psychologist* applies to both scientists and practitioners in psychology, which sometimes causes confusion. Some researchers investigate what causes certain types of behaviors (e.g., distraction in people with ADHD). Other researchers investigate what treatments are effective in reducing these behaviors (e.g., rewarding someone for staying on task). Finally, some psychologists work with clients to help them deal with problem behaviors. For example, school psychologists work with teachers and parents to develop a reward system for students with ADHD who have difficulty completing work in class because they become easily distracted. The research that investigated the behaviors associated with ADHD and the factors that can reduce those behaviors was necessary for the school psychologist to be able to develop an effective treatment plan for the student.

STOP AND THINK

1.1 Think about some things you know are true about the world. For each of these facts, try to determine the way you know that information (intuition, deduction, authority, or observation).

1.2 Suppose you wanted to know about the factors that cause college students to become anxious. Describe how you might learn about these factors using different kinds of observations of college students.

1.3 Explain how the fields of psychology and biology are similar in terms of what tasks people in these fields perform.

HOW RESEARCHERS USE THE SCIENTIFIC METHOD

A good starting place for understanding and conducting research studies about behavior is an understanding of the assumptions that come along with the methods of science. We need to keep some concepts in mind when we use the scientific method to understand behavior. As discussed earlier, scientific study requires observations. Observation is the primary aspect of the scientific method. However, there are actually four facets or *canons* (i.e., rules or principles that guide a field of study) that define the scientific method. They are empiricism, determinism, parsimony, and testability.

Empiricism

The first canon is **empiricism**, and this is just what we discussed above—the assumption that observations will yield the most accurate information about the world (see Photo 1.4). We have

PHOTO 1.4 The guiding principle of empiricism suggests that if we want to learn about behavior, such as social behaviors of children on the playground, we must observe those behaviors.

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several important people to thank for the empirical nature of science. Galileo, for example, was an influential scientist who used observations to understand the world (Sharratt, 1996). Much of the learning up to Galileo's time (1564–1642) had relied on authority figures, such as Aristotle, Plato, or church authority figures, and their ideas about the world, to understand how the world worked. However, Galileo and his near contemporaries (e.g., Copernicus, Newton) claimed that, to learn how the world works, one should observe it. When Galileo wanted to understand how our solar system worked, he *watched* the movement of the planets around the sun through a telescope, instead of simply accepting the authoritative position held by Aristotle that the Earth was the center of the solar system and everything revolved around it. He made careful, systematic observations of the phenomena of interest to better understand those phenomena. What we do in behavioral research is not very different from what Galileo did. If developmental psychologists want to know about the effects of being bullied on elementary school children, they go out and carefully observe children on the playground where they might be bullied, or systematically record or observe the behaviors of children who have been identified as victims of bullying.

Why do researchers observe behavior? Observing behavior gives researchers a more accurate understanding of the causes of behaviors than other methods of gaining knowledge. Relying on an authority to learn about behavior, for example, greatly limits our understanding of behaviors across large groups of individuals because not all authority figures are equally reliable and some may have faulty information. Or their knowledge may be limited to a small set of individuals.

How do we use empiricism to learn about behavior? There are many different ways to do this. We can simply observe people in their normal environment (e.g., children on a playground at recess). We can ask them to complete a survey (e.g., have the participants respond to items that help us measure their mood). We can ask them to come in to a lab and complete a task on a computer (e.g., test their memory for different types of information) or in a situational game we have set up. Each of these methods allows us to gather empirical measurements of behavior. (Observation techniques are discussed further in Chapter 4.)

One thing to keep in mind is that one observation (either from one individual or from one study) is never enough for us to be sure that the knowledge we are gaining is real. Chance factors can affect the results from a study, which will not be clear if we consider only that one study. Therefore, it is important to replicate our observations, both across multiple individuals within a study and/or across multiple studies using different sets of subjects/participants and, oftentimes, different procedures. This replication of results assures researchers that the behaviors they observe are not just due to chance factors and that the results they find can be used to make more confident conclusions about how behavior works. We will discuss the importance of replication across individuals further in our discussion of sampling in Chapter 6.

Determinism

Another important aspect of the scientific method is the adherence to **determinism**. This is the assumption that phenomena in the world (including human behaviors) occur naturally and have identifiable causes. In other words, by conducting studies to observe behavior, we can understand the factors that *cause* those behaviors to occur through observation of that behavior in different situations. One goal of behavioral research is to be able to explain the behavior of interest by understanding its causes. For example, why do people get depressed? What causes false memories? Does sleeplessness cause anxiety? Does anxiety cause sleeplessness? The assumption of determinism in psychological research is that each of these behaviors (depression, false memories, anxiety, and insomnia) has a specific cause or set of causes, and we can understand these causes using scientific methods. For many behaviors studied by researchers, multiple causes may affect the behaviors, or the cause may depend on the situation in which the behavior is observed. However, not all research is conducted to directly test causes of behavior. In some cases, the behavior first must be described and related factors identified. In other cases, it would be unethical to create situations in which to observe the behavior (e.g., Does being the victim of violence cause one to become more violent?). Although these types of studies do not directly test a cause of behavior, they do contribute to our knowledge of the behavior, which can contribute to our understanding of its causes. We will discuss the different ways psychological studies are conducted and the different goals researchers may have in their studies in Chapter 4.

How is determinism used in behavioral research? Because the overall goal of research is typically to gain a better understanding of behavior and its causes, researchers design their studies to contribute to this goal through the description of behaviors (e.g., How common is anxiety among college freshmen?), through the identification of factors related to the behaviors (e.g., Are students who are younger more anxious than students who are older during their freshman year in college?), and through the testing of specific causes of changes in the behaviors (e.g., Does having a strong peer group reduce anxiety in college freshmen?).

Parsimony

Some of you may have heard of the concept of "Occam's Razor," which was named after the Franciscan friar who suggested it as an important part of the scientific method. **Parsimony** is another term that describes the scientific concept that simple explanations of a phenomenon are more likely to be correct. In psychological research, we develop explanations of behavior starting with the simplest descriptions and expanding those descriptions only when it becomes clear that the behavior is more complex than its original description. In other words, simple explanations are preferred—it is assumed that a simple explanation is more likely to be correct than a complex explanation. More complex explanations should be developed only after simpler explanations have failed to be supported by research studies. This is an aspect of the revision of our conclusions after critical evaluation of the available data.

How is parsimony useful in behavioral research? Parsimony helps scientists test their research questions because it is easier to develop a study that might falsify a simple explanation than to develop a study that might falsify a more complex explanation. Falsification is an important part of the research process, as you will see in the next section.

Testability

The fourth canon of science is **testability**. The scientific method can only be used to test ideas that can be falsified through observation. *Why* is falsifiability important? It is important because a test of an explanation of a behavior that allows that explanation to be falsified provides a stronger test of that explanation. If we look only for evidence to support our explanations of behavior, we are likely to find supporting evidence, to ignore contradictory evidence, and to hold on to those explanations longer even if they are wrong. Seeking only confirmatory evidence and ignoring contradictory evidence is known as **confirmation bias**. To avoid confirmation bias, researchers design studies that can result in behaviors that are inconsistent with their explanations. They are then more likely to find evidence against these explanations in their studies, if such evidence exists. It takes only a few studies with results inconsistent with an explanation of behavior to falsify it. However, it takes many studies conducted in many different contexts to produce results consistent with an explanation of behavior to support it.

Testability is one of the reasons why many of Sigmund Freud's ideas have not had more influence on current clinical and personality psychology theories—they are difficult to test using the scientific method. For example, Freud proposed that many of our personality traits are a product of a struggle between constructs of our minds (id, ego, and superego) that we do not have full conscious access to (Nairne, 2009). It is difficult to test this theory because the constructs Freud proposed are difficult to connect to observable behaviors. Thus, it is difficult to systematically observe behaviors in a research study that would contradict the theory. We can, however, answer questions about other types of mental processes that are indicated by observable behaviors. For example, we can test the idea that anxiety causes sleeplessness. We can observe behaviors of sleeplessness in situations where people are placed in anxiety-provoking situations with anxiety verified by self-report. If anxious people are sleeping well, this contradicts our explanation of sleeplessness (i.e., anxiety) and provides us with a good test of our explanation, although this particular result is unlikely to be

found. For researchers using the scientific method, it is important to ask questions and test explanations about behavior that can be falsified by observations of those behaviors.

How is falsifiability used in behavioral science? As described already, falsification of explanations of behavior advances psychological science much more than supporting explanations (Platt, 1964). Whenever researchers can show that an accepted explanation is not supported, it changes the direction of investigation in an area of research and moves psychological science forward in gaining new knowledge about behavior. Making predictions about the results they will find in their studies helps researchers contribute to the testability of their observations. With clear predictions made before a study is conducted, researchers can design good tests of their ideas about behavior, which helps them avoid falling prey to the confirmation bias—believing the results are consistent with their ideas regardless of how they turn out.

The canons of science provide a general "how to" guide for psychologists designing research studies because they help us conduct good tests of our explanations of the causes of behaviors and further our understanding of why certain behaviors occur. The rest of this text describes more of the details of how psychologists apply these canons in designing and conducting research and walks you through the process of developing research studies of your own.

STOP AND THINK

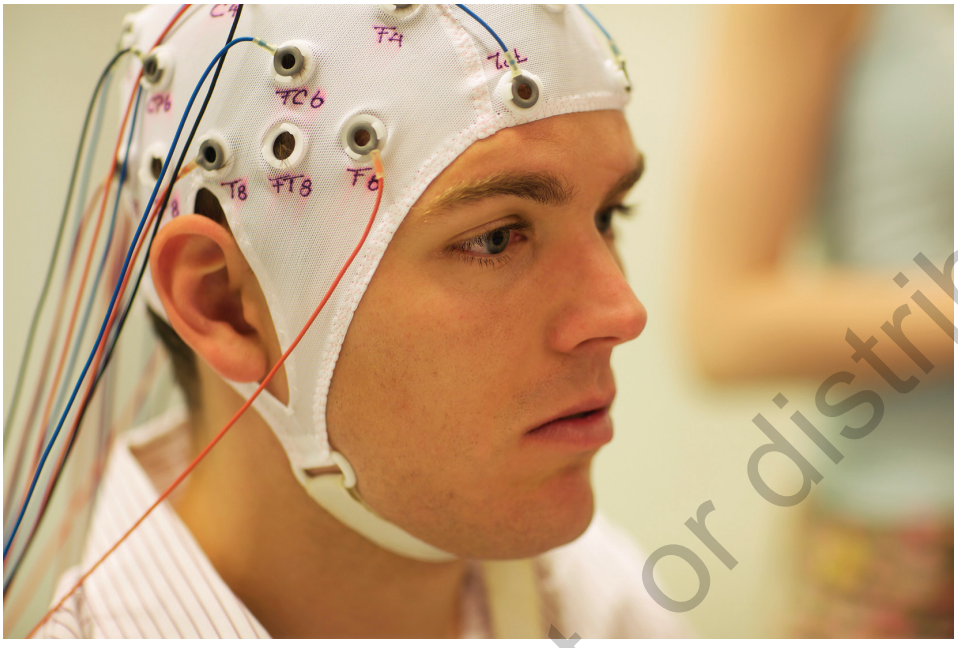
1.4 Which assumption of the scientific method suggests that simple explanations are most likely to be correct? Which assumption of the scientific method suggests that observation is the best means of learning about the world?
1.5 Explain how confirmation bias could affect decision-making in your everyday life.
1.6 Explain why replication of results is an important part of the scientific process.

BASIC RESEARCH AND APPLIED RESEARCH

As you begin to consider the types of questions that can be answered in behavioral research studies (a topic that will be discussed more in Chapter 2), it is important to keep in mind the goals of two major categories of research: **basic research** and **applied research**.

The goal of basic research is to understand the most fundamental processes of behavior and how they operate. Research questions in basic research are typically about how a behavior works. How much information can we store in short-term memory? Who exhibits more symptoms of depression: men or women? Do people have implicit stereotypes that affect their social behavior?

Applied research is generally focused on answering questions related to solving real-world problems. How should a web site be designed to make it easy to navigate? Does meditation reduce symptoms in people who are anxious? What type of work environment increases productivity of employees? What sorts of treatment programs best prevent relapse in drug addiction? See Photos 1.5 and 1.6 for examples of each type of research.



PHOTOS 1.5 AND 1.6 Both basic research studies (e.g., measuring brain activity [top image]) and applied research studies (e.g., observing workplace behaviors [bottom image]) contribute important knowledge about behavior.

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Typically, basic research provides fundamental knowledge of how behaviors operate that is useful to researchers conducting applied studies. For example, suppose that a researcher finds that people who report having insomnia also report symptoms of anxiety; a similar result was reported by Morphy et al. (2007). A conclusion from this study might be that anxiety and sleeplessness are related in some way. (Note that this does not mean that anxiety *causes* sleeplessness, only that they are related.) This conclusion represents basic knowledge about the connection between emotional state and sleeplessness or insomnia. Researchers interested in the more applied question of how we help people with sleep problems may use this basic knowledge to test treatments for sleeplessness that focus on reducing anxiety to determine whether the relationship found in the above study is causal or not. The basic research in this case is vital for the development of applied studies that address a real-world problem (e.g., insomnia). Table 1.2 provides some additional examples of basic and applied research studies.

An important example of how basic research can inform on a real-world issue is in eyewitness testimony in the legal system. According to The Innocence Project, 70% of cases where defendants were later exonerated from DNA evidence in the United States were for cases that included a false eyewitness identification (http://www.innocenceproject.org). In the 1970s, Elizabeth Loftus (see Photo 1.7) began conducting research to look at how accurate eyewitness memory is in different situations. Along with her colleagues, she conducted studies looking at how the wording of questions asked about an event can affect the way someone remembers the event (e.g., Loftus, 1975; Loftus & Palmer, 1974). Over time, applied work in this area followed these early, basic studies that developed and tested new techniques of questioning witnesses that have been adopted by many police departments across the world (e.g., the cognitive interview, Fisher & Geiselman, 1992; Geiselman et al.,

TABLE 1.2 ■ Examples of Basic and Applied Research Studies

Basic Research
● Researchers investigated the process through which visual memories are stored and strengthened in memory (Ricker & Hardman, 2017).
● Making choices leads people to think more analytically (Savani et al., 2017).
● Participants were randomly assigned to mixed-race groups while their brain activity was recorded to investigate brain areas involved in in-group biases (Van Bavel et al., 2008).
Applied Research
● Researchers showed that writing to-do lists for the future helps people fall asleep faster than making a list of completed tasks (Scullin et al., 2018).
● Experienced border officers detected fraudulent passports based on face-matching more often than novices but still missed a high ratio of the inaccurate or false passports (Wirth & Carbon, 2017).
● Stereotypes presented about boys' greater interest in engineering and computer activities than girls' interest influence activity choices in girls as young as 8 years old (Master et al., 2021).

PHOTO 1.7 Elizabeth Loftus conducted basic research on eyewitness memory that has influenced applied research on this topic and changed the way eyewitnesses are questioned.

Dan Tormey/Contributor/via Getty Images

1986). Research (both basic and applied) continues to help us better understand how accurate eyewitnesses' memories really are (e.g., Wixted & Mickes, 2022; Wixted & Wells, 2017).

It is also important to remember that the applications of basic research may not be obvious when the research is initially conducted. The utility of such research to real-world problems may not be revealed until much later, when enough is known about an issue to apply the knowledge gained in the basic research studies. For example, early neuroscientists (e.g., Santiago Ramón y Cajal, as cited in Meyers, 2007) conducted basic research studies to understand how neurons function. The applications of this knowledge were not clear until much later when neuroscientists better understood how this neural functioning affected behavior. For example, we now know that some types of disorders (e.g., depression) are linked to neural functioning that is abnormal (e.g., higher levels of serotonin than are typical; Barlow & Durand, 2008), and drugs have been developed to alter neuron functioning to help individuals with such disorders. The basic knowledge of neural functioning became useful in helping individuals with disorders long after this research had been completed. Thus, it is important to conduct basic research, even if an application is not immediately clear.

Because applied research investigates realistic problems, applied researchers are often concerned with the **external validity** of their studies. This means that they attempt to observe behaviors that can easily be applied to real-life situations. This finding is important because these researchers want to be able to apply their results both to the individuals who were observed in the study, and to the individuals who were not participants in their study. External validity is also a consideration in basic research but, in some cases, can be less important than it is in applied research.

In turn, knowledge gained in applied studies can also help basic researchers refine their theories about how behavior works. Suppose, in the above example regarding anxiety and insomnia, the applied studies showed that treatments reducing anxiety did not reduce the symptoms of insomnia; similar results were reported by Morin et al. (2006). In this case, the basic researchers may use this knowledge to hypothesize that the link between anxiety and insomnia may not be a simple causal relationship and so may conduct further studies to better understand the causes of insomnia and how it is related to anxiety. In this way, the two types of research, basic and applied, interact with each other, showing that both types of research are critical to the field of psychology.

As you encounter descriptions of psychological research, you may find that not all research fits neatly into basic or applied categories. Some research can both answer fundamental questions about behavior and help solve a real-world problem. It may be better to think about research as primarily basic or applied. In other words, basic and applied descriptors may be end points in a continuum of types of research studies, with each research study falling somewhere between these end points.

STOP AND THINK

1.7 Explain how external validity differs for basic and applied research studies.
1.8 In what way(s) can knowledge of the scientific process help you in your daily life?

THINKING ABOUT RESEARCH

A summary of a research study in psychology is given below. After you read the summary, answer the following questions:

1. What behaviors did the researchers observe?
2. How were the observations recorded by the researchers?
3. Were the researchers able to identify a cause of behavior from this study?
4. Were the researchers able to answer their research questions with the observations they collected? If so, how?
5. What results would have falsified the explanation of behavior the authors tested?
6. Do you think this study qualifies as primarily basic or applied research? Explain your answer.
7. What are some examples of real-world behaviors that the results of this study might apply to?

Research Study. Strayer, D. L., & Johnston, W. A. (2001). Driven to distraction: Dual-task studies of simulated driving and conversing on a cellular phone. *Psychological Science, 12*, 462–466.

Purpose of the Study. The researchers were interested in how use of a cell phone while driving influences driving performance (see Photo 1.8). They describe previous studies that have shown that devices that require one's hands while driving (e.g., the radio, temperature controls, etc.) can reduce driving performance. In this study, they predicted that cell phone use would reduce driving performance. They tested two ideas about how cell phone use

PHOTO 1.8 Strayer and Johnston's (2001) study examined whether talking on a cell phone while driving decreases driving performance.

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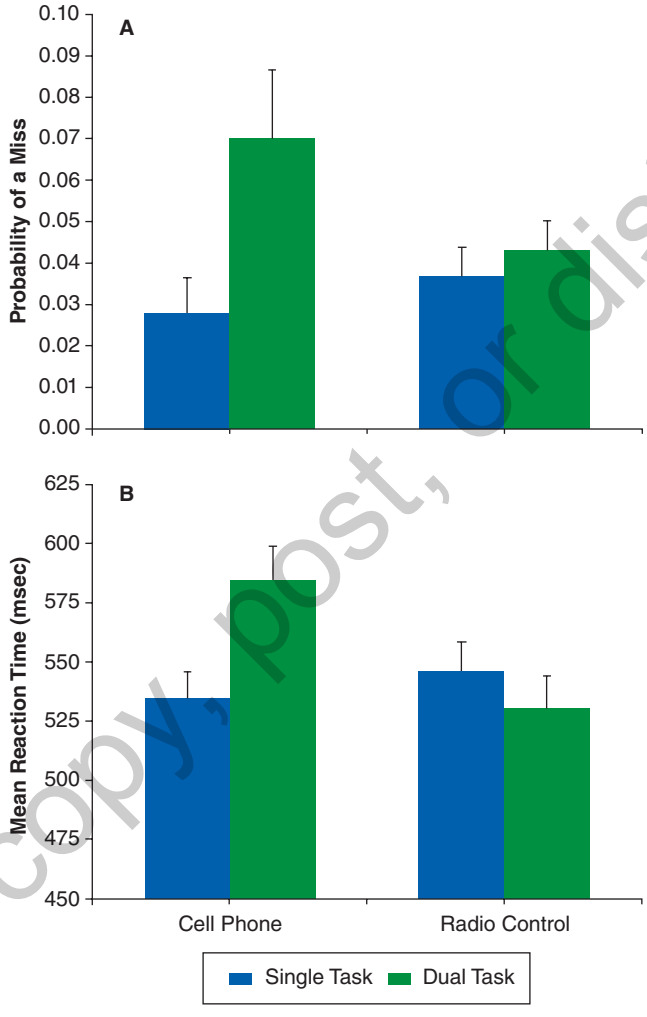
could decrease driving: (1) that the use of a hand-held phone would interfere with driving, and (2) that the attention requirements of a phone conversation would interfere with driving.

Method of the Study. Forty-eight undergraduates (half of them male, half of them female) participated in the experiment. Each of the students was randomly assigned to one of three cell phone conditions: hand-held phone, hands-free phone, and no phone (radio control only). The participants performed a computer-simulated driving task where they moved the cursor on the screen to match a moving target as closely as possible, using a joystick. Red and green lights flashed periodically during the task and participants were instructed to press the "brake" button as quickly as possible when the red light flashed. They performed this task on its own in a practice segment and two test segments, with a dual-task segment placed between the two test segments. In the dual-task segment, they were given an additional task that included one of the following to match the conditions listed above: using a hand-held phone to converse with another person (who was part of the research team) about a current news story, using a hands-free phone to converse with another person about a current news story, or controlling a radio to listen to a broadcast of their choice. The frequency of missing red lights and the reaction time to hit the "brake" button when a red light appeared were measured and compared for the three phone conditions.

Results of the Study. The two cell phone use conditions did not differ in their results, suggesting that driving performance in response to red lights is similar for hand-held and hands-free phone use. Figure 1.1 shows a graph for each of the measures according to the phone (combined for hand-held and hands-free conditions) and no-phone conditions. The data are shown in each graph separately for driving performance in the driving-only segments (single task) and for the phone/radio task while driving (dual task) segment. The graphs show that more red lights were missed and time to press the "brake" button was longer when participants were talking on the phone (compared with when only driving), but

FIGURE 1.1 ■ Driving Performance as Measured by Responses to Red Lights in the Driving Task While Performing the Driving Task on Its Own (Single Task) or While Also Performing the Phone or Radio Task (Dual Task)



Source: Figure 1 from Strayer and Johnston (2001).

there was no difference in driving performance when participants listened to the radio while driving and when they just performed the driving task on its own.

Conclusions of the Study. The authors concluded that phone use, regardless of whether it was hands-free or hand-held, interferes with driving performance more than just listening to the radio. This suggests that the attention component of phone use is the key factor in the driving performance interference.

CHAPTER SUMMARY

Reconsider the questions from the beginning of the chapter:

- What is the value of research in psychology? Research about behavior helps us better understand how common a behavior is and the possible causes of the behavior. Even practitioners need to have an understanding of research, so they can stay on top of the most recent treatments for behavioral disorders and issues.
- Why do researchers use the scientific method? Researchers use the scientific method because it provides the best way to gain new knowledge about behavior.
- How do researchers use the scientific method? Researchers use the scientific method to observe behaviors as they occur in everyday life and in situations researchers are interested in learning about.
- What are the canons of the scientific method? The canons are empiricism, determinism, parsimony, and testability.
- What is the difference between basic and applied research? Basic research is designed to answer fundamental questions about behavior. Applied research is designed to gain solutions to everyday problems.
- How do basic and applied research interact to increase our knowledge about behavior? Basic research advances our understanding of the causes of behavior. In applied research, these explanations are tested in everyday situations to inform researchers about the best solutions for everyday problems. Knowledge gained about these problems in applied research can then inform basic researchers about how explanations of behavior may need to be revised to explain behaviors that occur in everyday life.

COMMON PITFALLS AND HOW TO AVOID THEM

Problem: Assuming that psychology equals practice in a *helping* profession, ignoring or dismissing the scientific aspect of psychology.

Solution: Understand that science and practice are both important aspects of the field of psychology. In addition, it is important that practitioners of psychology stay up to date with current research findings to ensure that they are using the most effective treatments.

Problem: Falling prey to confirmation bias, such as designing studies that provide supportive evidence of an explanation of behavior without including the possibility for contradictory evidence.

Solution: Design studies carefully to allow collection of data that can support or contradict explanations of behavior.

Problem: Misinterpretation of causation, such as concluding that something causes a behavior simply because it occurs with the behavior. In other words, correlation does not equal causation, but many people assume a link between two things means one caused the other.

Solution: Do not assume a reported relationship between factors is evidence that one factor causes another unless the study has been designed in such a way that other noncausal relationships can be ruled out. This issue will be further discussed in later chapters.

Problem: Dismissing basic research. Some people dismiss basic research as unimportant because the results are not always applicable to a real-world problem.

Solution: View the "big picture" of knowledge about behavior to see how basic research informs applied research by providing fundamental knowledge of behavior that guides research questions and interpretation of results in applied studies. In addition, for a basic research study, do not assume that, because an application is not immediately evident, the study is not valuable. Applications of basic research findings are often unclear until long after the basic research has been conducted.

APPLYING YOUR KNOWLEDGE

On Facebook one day, you see a post from one of your friends that they have found the most amazing vitamin supplement. They claim that they have taken the vitamin once a day for the past few weeks and they have more energy and feel great. They are passing on the information to their friends (including you) and urging you to try the vitamin for yourself.

- Why should you be skeptical of the claim you read from your friend?
- What other information would you want to have before deciding if you should try the new vitamin your friend is so excited about?
- Suppose you came across a news item reporting that thousands of people have been trying the new vitamin (i.e., they include interviews with some of these people) and that overall, these people have reported positive results. Would this convince you to try the new vitamin? Why or why not?

TEST YOURSELF

Match each canon of science below with its correct definition.

1.	Determinism	(a) The scientific method can be used to test descriptions and explanations of the world that can be contradicted by observations.
2.	Empiricism	(b) The scientific method is used to examine phenomena that have an identifiable cause.
3.	Testability	(c) An assumption of science is that simpler explanations are more likely than complex explanations to be correct.

4. Parsimony (d) Knowledge is gained in science by systematically observing the phenomenon being studied.
5. Freud hypothesized that many of our personality traits are controlled by an unconscious conflict between aspects of ourselves—the id, ego, and superego—that we are not consciously aware of. Using what you know about the scientific method, explain why this hypothesis is difficult to support with observations of behavior.
6. Explain how parsimony is helpful in behavioral research studies.
7. For each reference listed below, decide whether the study is primarily basic or applied.
   a. Drews, F., Pasupathu, M., & Strayer, D. (2008). Passenger and cell phone conversations in simulated driving. *Journal of Experimental Psychology: Applied, 14*, 392–400.
   b. Roediger, H. L., III, & Geraci, L. (2007). Aging and the misinformation effect: A neuropsychological analysis. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 33*, 321–334.
   c. Wagman, J. B., Langley, M. D., & Farmer-Dougan, V. (2017). Doggone affordances: Canine perception of affordances for reaching. *Psychonomic Bulletin & Review, 24*, 1097–1103.
   d. Smith, A. M., & Thomas, A. K. (2018). Reducing the consequences of acute stress on memory retrieval. *Journal of Applied Research in Memory and Cognition 7*, 219–229.
   e. West, R. (2007). The influence of strategic monitoring on the neural correlates of prospective memory. *Memory & Cognition, 35*, 1034–1046.
   f. McClernon, C. K., McCauley, M. E., O'Connor, P. E., & Warm, J. S. (2011). Stress training improves performance during a stressful flight. *Human Factors, 53*, 207–218.
   g. Weaver, J. R., & Bosson, J. K. (2011). I feel like I know you: Sharing negative attitudes of others promotes feelings of familiarity. *Personality and Social Psychology Bulletin, 37*, 481–491.
   h. Blanchette, I., & Leese, J. (2011). The effect of negative emotion on deductive reasoning: Examining the contribution of physiological arousal. *Experimental Psychology, 58*, 235–246.
8. I believe that the best way to study for exams is to reread my notes three times from start to finish because last semester I did that and I got an A on my psychology exam. I believe this despite the fact that I have tried this method before and did not receive an A on an exam. I am falling prey to the _____.
9. The scientific method relies on which way of knowing information about the world?
10. If I am concerned about whether the behavior exhibited in my research study is similar to the everyday behaviors of individuals, I am considering the _____ of my study.

11. Explain why scientists make observations to learn about behavior.

12. A researcher designs a study to examine the effect of time pressure on anxiety. The study involves having undergraduate students complete a puzzle either with instructions to complete it within 5 minutes or with no time limit. After working on the puzzle, the students complete an anxiety survey. How could the researcher increase the external validity of this study?

Answers can be found in Appendix B.

KEY TERMS

applied research
authority
basic research
confirmation bias
deduction
determinism
empiricism
external validity
intuition
observation
parsimony
testability