Part One

Overview of the Research Process

Chapter 1

Behavioral and Social Research in the Health Sciences

All the world is a laboratory to the inquiring mind.
—Martin H. Fischer

INTRODUCTION

The best potential solutions to health-related challenges are frequently changing, as promising new techniques, therapies, and medications are continually developed and tested. This never-ending process relies on science and also carries with it the requirement that professionals within the health sciences are able to understand basic research and its potential applications within their daily health-related work. Despite the fact that so much of the widely touted and shared health sciences or medical research is focused on relatively impersonal methods of treatment or aspects of the process of treatment (e.g., medication errors or the impact of new technologies), so much of what impacts the quality of life of individual patients,

Understanding and Conducting Research in the Health Sciences, First Edition. Christopher J. L. Cunningham, Bart L. Weathington, and David J. Pittenger.

their families, and entire communities is directly linked to behavioral and social factors operating within the person and the environment in which that person functions.

Understanding complex human behaviors and cognitions associated with health is no easy task. Without an empirical, scientific approach to gaining such insight about those who work in the health sciences and those who are served by the health sciences, it is likely that either or both sides of this relationship will be operating with potentially dangerous, incomplete information. Having a solid understanding and appreciation of basic behavioral and social research methods will help you to make higher-quality and better-informed decisions. This text is designed to provide a rich introduction to the basic behavioral and social science research methods that will help you generate new health-related knowledge and translate existing health science knowledge into practice.

WHY IS UNDERSTANDING RESEARCH METHODS SO IMPORTANT?

There are three core types of information that anyone seeking to understand human behavior must know: (1) how to conduct and interpret high-quality research, (2) how to develop and evaluate measures of human thought and behavior, and (3) how to use basic statistics to make sense of available and relevant data.

Why are the three core topics just highlighted so important? Think about it—researching, analyzing, and reporting are three of the most generalizable and valuable skills learned during higher education that can help you find a job, keep a job, and more generally, make a meaningful contribution to society. You can think big thoughts and theorize all day long, but without these three research-related skills, your great ideas will never translate into credible actions. We do not want your good ideas to be restricted by the boundaries of your mind. This is why we all sincerely hope that you are not dreading learning about research methodology or fearing something nonspecific about the process of research. There is nothing scary here, just a systematic approach to learning, understanding, and questioning that will benefit you, no matter what path you take over the course of your career.

The most efficient, credible, and ultimately useful techniques for studying and understanding human behavior apply the scientific method in some way, shape, or form. Proper test development and utilization help to ensure the best possible data are collected. Appropriate statistical techniques facilitate interpretation of these data. We firmly believe that the only way to become a legitimate consumer and producer of knowledge is to first learn how to work with the tools of the trade: the scientific method, tests and assessments, and statistics.

This book will help you learn how to conduct and understand research within the health sciences that addresses questions with behavioral and social science underpinnings. Such questions could involve interpersonal phenomena or person-environment linkages, among many other possibilities. We will cover how to develop and evaluate tests, surveys, and other measures of behavior. Throughout

the chapters of this book we will also remind you of how basic statistics can help as you work to address specific research questions. If you feel you need a refresher in the most basic statistics, a review is included in Appendix A.

THE ROLE OF BEHAVIORAL AND SOCIAL SCIENCE

- *What are some examples of science in your life?*
- *Have you "researched" anything today?*
- *What are some big decisions or questions you are currently considering?*

H.G. Wells, a nineteenth-century author, predicted that "statistical thinking will one day be as necessary for effective citizenship as the ability to read and write" (as cited by Campbell, 1974). We strongly believe this prediction has come true. Although you may not plan to become a researcher yourself, working in the health sciences (and many other areas of life) will force you to confront issues that can be addressed only with the aid of scientific research. Consider the following example issues:

- What intervention technique is most likely to be effective at reducing alcohol consumption among teenagers in this community?
- What are the best ways to demonstrate empathy when interacting with patients?
- Are cultural competence training programs or interventions effective?
- Are there any side effects associated with this new medication that might negatively affect patients' quality of life?
- How can we improve patient safety and operational efficiency without reducing our level of compassionate care within this hospital?

These are just a few examples of relevant behavioral and social science-related questions that can commonly arise when working in the health sciences. Knowledge of basic behavioral and social science research methods can give you the confidence needed to ask these and other difficult questions and to actually find the important answers.

Take, for example, the classic legal case of *Daubert v. Merrell Dow Pharmaceuticals, Inc.* (1993). In this case, the Supreme Court ruled that judges, not jury members, must determine the merits and scientific validity of testimony given by expert witnesses. In response to the court's decision, the Federal Judicial Center (1994) developed the book *Reference Manual on Scientific Evidence* to help judges and lawyers understand the principles of research methods and statistics. As the authors of the book noted, "no longer can judges . . . rely on their common sense and experience in evaluating the testimony of many experts. . . . The challenge the justice system faces is to adapt its process to enable the participants to deal with this kind of evidence fairly and efficiently and to render informed decisions" (p. 1). As H.G. Wells predicted, the knowledge of the scientific method is now a vital part of our government and judicial system and, therefore, our everyday lives.

You are not alone if you fear research in general and perhaps statistics more specifically. Many otherwise very intelligent and confident people seem to freeze like a deer in the headlights when anything statistics-like appears because they do not understand the relevance or importance of these topics to their own lives. We hope that by the time you finish this text, you will understand the relevance of the scientific method, proper measurement, and appropriate statistics and have confidence in a newfound skill set that will serve you for the rest of your life.

THE SCIENTIFIC METHOD

When designing and conducting behavioral and social science research, perhaps the most important element is to ensure that you adhere to the scientific method. Knowing each of its steps and how they are interrelated will allow you to conduct the highest-quality research possible, in any domain. Perhaps the easiest way to remember the scientific method from start to finish is to learn the mnemonic *HOMER* (Lakin, Giesler, Morris, & Vosmik, 2007), which stands for

1. *H*ypothesize
2. *O*perationalize
3. *M*easure
4. *E*valuate
5. *R*eplicate, revise, report.

These are the core steps to the scientific method and they should sound at least vaguely familiar from various introductory science courses you completed in middle school, high school, and college. The rest of this text focuses on ensuring you will finish with a working knowledge of all five components.

For starters, however, it is important to note that good behavioral and social science research begins with the identification of hypotheses or informed expectations about the particular phenomenon you are about to study. Once these expectations are identified, you can then work on figuring out how you would collect data, which would allow you to test your expectations. This process of operationalization is the bridge that connects relatively abstract, high-level hypotheses to the actual measuring of data. When your data are then collected you have the challenge of evaluating them and either confirming or disconfirming your hypotheses. This is not the end of the research process, however, as good science is open to modification and improvement, hence the need to replicate, revise, and report (or share) your findings with others.

BRIEF HISTORY OF SCIENTIFIC REASONING

Science is a way of thinking about and explaining the world around us. The scientific method consists of the process used for collecting, analyzing, and drawing

conclusions from data. Research methods and statistics are complementary techniques that we use to acquire information and to reach reasonable conclusions. When we speak of research methods, we refer to procedures for collecting information. When we speak of statistics, we refer to procedures for organizing, summarizing, and making inferences from the data. A little bit of history here can help you to understand how this scientific approach to understanding behavioral and social phenomena has developed.

Throughout human history, people have struggled to protect, maintain, and improve their health. It can be argued that one's health is the most valuable asset or resource one has, especially as time passes and as the end of one's life approaches. Despite this reality, as a science, the fields of behavioral, social, and now health sciences are relatively young. It is important to note that efforts to understand human behavior have long been a topic of interest. Ancient Greek philosophers wrote extensively about many familiar topics, including learning, language, memory, and dreams. Although many writers and great thinkers wrote about how they thought the mind works, none conducted anything that we would call an experiment. The problem is that internal mental events are necessarily difficult to observe and measure. Consequently, many philosophers believed that we could not observe or measure mental events in the same way that we observe or measure physical objects.

This perception exists even today and has resulted in the behavioral and social sciences being labeled as "soft" sciences, a term that suggests that other sciences such as chemistry and physics (the so-called hard sciences) are more accurate or empirically valid. Interestingly, essentially identical research methods are used across all of these scientific fields (Hedges, 1987). It is the subject matter that sets the sciences apart. Properly designed and implemented research in the social sciences can be as valid and replicable as any other research. Historically, though, before this research could be conducted, a profound shift in studying human social interaction and behavior had to occur.

Although Greek philosophers had a profound effect on the generations of scholars who followed them, it was not until the questioning of these ancient authorities that the scientific revolution occurred. During this revolution, seventeenth-century scientists decided that there was more to learn about nature than the ancient philosophers had described in their writings. One of the more articulate spokespersons for the new scientific revolution was Sir Francis Bacon. Much of the scientific method as we know it today evolved to overcome and protect us from several basic human biases or "idols" that Bacon (1620/1994) outlined in his seminal book on this topic.

Interestingly, Sir Francis Bacon (1561–1626) was not a scientist; he was a British politician who was interested in empirical science and became one of its strongest proponents. In 1620, he published a book on the scientific method titled *Novum Organum* ("the new instrument"). Bacon saw the scientific method as a better way of finding accurate answers to difficult questions. Like many of his contemporaries, Bacon distrusted the wholesale belief in everything that the ancient philosophers had to say. He (Bacon, 1620/1994) wrote, "For the ancients . . . out

of a few examples and particulars, with the addition of common notions and perhaps some portion of the most popular received opinions, they flew to the most general conclusions or principles of the sciences . . . through intermediate propositions, they extracted and proved inferior conclusions" (p. 127). In essence, Bacon accused the earlier philosophers of making hasty generalizations that had little or no merit. He also argued that to comprehend the physical world, we must use the scientific method to ask and answer questions.

Bacon's most important and lasting contribution to the history of science may be his discussion of common human biases that can cause us to make irrational decisions or to ignore important information. According to Bacon, there are four main human biases that hinder our ability to think clearly. He referred to each of these biases as the **idols of the tribe**, **idols of the cave**, **idols of the marketplace**, and **idols of the theater**. Bacon's observations were as insightful then (early 1600s) as they are now. Indeed, we continue to rely on the scientific method, statistics, critical thinking, and analysis skills to overcome the obstacles to credible behavioral and social science research that each of these idols creates.

Idols of the Tribe

The first source of bias described by Bacon involves our human tendency to rely on intuition and common sense when trying to understand a complex phenomenon. Bacon (1620/1994) suggested that

> *The Idols of the Tribe lie deep in human nature itself and . . . it is wrongly asserted that the human sense is the measure of all things. It is rather the case that all our perceptions . . . are reflections of man [sic] not of the universe, and the human understanding is like an uneven mirror that cannot reflect truly the rays from objects, but distorts and corrupts the nature of things by mingling its own nature with it. (p. 56)*

Bacon recognized that many people have a tendency to believe that what they see and how they interpret events is accurate, and that their common sense is well informed and infallible. This tendency leads us to selectively perceive events around us, trust our first impressions, and then uncritically use those impressions to form "answers" or to make decisions.

A common example of the idols of the tribe is illustrated by self-fulfilling prophecies. A **self-fulfilling prophecy** occurs when we believe something is true and these preconceived beliefs then influence the way we perceive and react to specific events, ultimately confirming our initial beliefs (Baron, Graziano, & Stangor, 1991). In most cases, we are unaware of how our attitudes affect our behaviors and cognitions. Moreover, when we believe something to be true, we tend to remember events that align with our beliefs and forget or ignore events that conflict with our beliefs. This human tendency functions as a bias because preconceived ideas have considerable influence on how we interpret and react to cues in different situations.

Another example of the idols of the tribe is known as the **gambler's fallacy**. If a person bets on black three times in a row and red wins, most people believe that

the next round *must* come up black instead of red. Some people will argue, "It makes *good common sense* that red cannot win four times in a row!" However, the probability of winning with black or red is 50% each time (unless the particular game is somehow rigged or weighted), making it entirely possible that the next round could come up red. Many people make this error because they trust their intuition and preconceived beliefs about probability; that is a sure way to lose a lot of money at the gambling tables.

Many researchers (e.g., Nisbett & Ross, 1980; Rosnow & Rosenthal, 1997) have examined the shortcomings of human decision making. The consensus among researchers is that humans tend to rely too much on intuition and common sense to make decisions. In summary, the idols of the tribe highlight our human tendency to depend too much on common sense and to the tendency to make consistent errors in logical reasoning.

How could this affect your ability to conduct credible research?

How can this risk be addressed by proper use of the scientific method?

Idols of the Cave

This second source of information processing bias develops from our exposure to culture, common practice, and education. According to Bacon (1620/1994), our life experiences shape how we look at things. Although our experiences are valuable, there are important sources of limitations. As Bacon (1620/1994) described them, "The *Idols of the Cave* arise from the individual's particular nature, both of mind and body, and come also from education, habits and by chance. Though there are many different kinds, we cite those which call for the greatest caution, and which do most to pollute clear understanding" (p. 61).

The problem with personal experience is that it is personal, unique to you. Chances are that your background and our backgrounds are very different. Who is to say which of us has a more *valid* or accurate worldview? Each of us has experienced different important or critical life events. These events shape our beliefs and perceptions and affect how we perceive things. Although these beliefs and perceptions help to make us unique, we also need to recognize their potential influence on our decision making and reasoning. Karl Popper (1902–1994), a famous philosopher, provided an interesting example of what can happen if we depend too much on personal experience. Early in his career, Popper worked with the psychotherapist Alfred Adler, who had developed a comprehensive theory of personality development from observations made within his clinical practice. Popper (1963) described the following episode:

> *Once . . . I reported to him [Adler] a case which to me did not seem particularly Adlerian, but he found no difficulty in analyzing in terms of his theory of inferiority feelings, although he had not even seen the child. Slightly shocked, I asked him how he could be so sure. "Because of my thousand fold experience," he replied; whereupon I could not help saying: "And with this new case, I suppose, your experience has become thousand-and-one fold." (p. 35)*

The problem relevant to our discussion is Adler's use of personal experience. Adler's status as a professional psychoanalyst in no way guarantees that his observations or conclusions are automatically valid. A moment's thought will reveal the limitation of personal experience in this situation. Adler was a therapist who treated people suffering from a wide variety of psychological ailments. His patients were hardly representative of the general population and, therefore, not the foundation for a comprehensive theory of personality development that describes all people. The idols of the cave, therefore, refers to our human tendency to depend on our personal experiences to explain and determine why things happen as they do. As we will soon see, we must do more than merely rely on personal experience to develop scientific explanations.

How could this affect your ability to conduct credible research?

How can this risk be addressed by proper use of the scientific method?

Idols of the Marketplace

The third bias that Bacon examined involves our use of language. Turning to Bacon (1620/1994), we read, "The *Idols of the Market-place* [*sic*] are the most troublesome of all; these are idols that have crept into the understanding through the alliance of words and names" (p. 64). Bacon recognized that our use of words shapes how we think about things. Consider an example regarding day care. Scarr, Phillips, and McCartney (1990) noted that during the 1950s and 1960s, developmental psychologists who studied the effect of child care examined the effects of *maternal absence* or *maternal deprivation*. Clearly, these emotionally charged phrases create a negative bias against women who choose to pursue a career while their children are infants and toddlers. Why use these phrases as if the mother deprived her children of food and water? What about the father's absence? If children suffer *maternal deprivation*, why don't they suffer *paternal deprivation* as well? Could it be that fathers are guilt-free because societal norms allow men to work outside the home? Furthermore, the words *absence* and *deprivation* evoke images of children warehoused in dangerous day-care centers. Scarr and her colleagues argued that these terms grew out of "fantasies about child development . . . mother-infant attachment . . . and the role of early experience for later development" (p. 255). These terms fell out of favor during the 1970s, when the rights of women to pursue a career became popular. Researchers then began to examine the benefits of day care. Thus, the idols of the marketplace reflect the power of language over our thought processes.

How could this affect your ability to conduct credible research?

How can this risk be addressed by proper use of the scientific method?

Idols of the Theater

The fourth and final idol in Bacon's list represents the potential biasing effects of education. Here we find Bacon (1620/1994) complaining that many of the things

we learn may mislead us. "The *Idols of the Theatre*, on the other hand, are not innate, nor are they secretly insulated into the understanding, but are imposed and received entirely from the fictitious tales in theories, and from wrong-headed laws of demonstration" (p. 66). In other words, the idols of the theater are illustrated any time we accept an explanation without critically evaluating it first. In many cases, we automatically accept certain explanations because we learned them from someone we trust or see as an authority figure. Countless "scientific" theories have enjoyed this kind of dubious honor, including the now-debunked notions that the earth is the center of the universe and the world is flat. Apart from these seemingly ancient ideas, commonly accepted notions are all around us. Perhaps the best illustration of this is in Kohn's (1990) book on popular beliefs, in which he describes various common beliefs and their fallacy, including "No pain, no gain," "Competition builds character," "Like father, like son," and "Playing hard to get makes one more attractive."

The defining characteristic of the idols of the theater is our tendency to accept the truth of a statement without criticism. The best defense against this source of bias is simply to always think critically about what someone is asking you to believe.

How could this affect your ability to conduct credible research?

How can this risk be addressed by proper use of the scientific method?

BACON'S LEGACY

Bacon's primary legacy is that he clearly identified core obstacles to critical thinking as they apply to all branches of science to this day. Although the scientific method has been around for 400 years, the effects of his idols remain. Each of us can fall prey to the idols. Being aware of this can help you to understand why researchers use specific tactics when developing and conducting research. Researchers use research methods and statistics to overcome many forms of bias. Researchers also understand that we can never become complacent with the knowledge that exists today; tomorrow's research may change everything.

For these reasons, the primary lesson to take away from Bacon is that the idols of the tribe, cave, marketplace, and theater are always present, and we must work to guard against these biases whenever we utilize the scientific method to study and explain the behavior of people. Take some time to review Table 1.1 and think

Table 1.1 Summary of Bacon's Idols

Idols of the tribe	Biases due to overreliance on common sense and the tendency to make errors in logical reasoning
Idols of the cave	Biases due to dependence or reliance on personal experience to explain why things occur the way they do
Idols of the marketplace	Biases due to how we use specific words to describe phenomena in the world around us
Idols of the theater	Biases due to uncritical acceptance of explanations that people in authority tell us are true

of examples of Bacon's idols that are relevant in your own areas of interest or line of work.

OTHER IMPORTANT HISTORICAL FIGURES

The goal of this text is not to provide you with a history of science or a comprehensive listing of individuals who have influenced scientific thought. However, a brief review of two additional individuals (Gustav T. Fechner and John B. Watson), among many others, who had a significant impact on the current state of behavioral and social research methods follows.

On October 22, 1850, *Gustav T. Fechner* (1801–1887) discovered a way to measure mental events. All science relies on measurement, which is nothing more than assigning numbers to observations. All sciences have specific methods for measuring the phenomena they study. However, before Fechner's work, researchers had no objective method for measuring mental events. Fechner studied physics and human perception. In his research, he observed that there was not a one-to-one relation between the intensity of a stimulus and our perception of the stimulus. For example, imagine a friend asks you to hold out your hand and close your eyes. If your friend puts a pencil on your hand, you will notice its weight. Now imagine your friend putting this textbook on your hand. You will feel the weight of the book. What if your friend then places the same pencil on top of the book? You will probably not be able to detect the additional weight. Why are you able to feel the weight of the pencil in one situation but not the other?

Fechner reasoned that better understanding the relationship between changes in the intensity of a stimulus (a physical event) and changes in a person's perception (a mental event) of a stimulus could help us better understand how the mind generally functions. He then proceeded to conduct a series of famous experiments that we now recognize as the start of *psychophysics*. Even if Fechner's experiments are not the most exciting thing you have heard about today, his work is very important because it caused people to recognize that it is possible to study mental events using empirical techniques.

John B. Watson (1878–1958) is another important person in the history of behavioral and social science research methodology. In 1913, Watson wrote an influential paper titled "Psychology as the Behaviorist Views It." The paper began with the proclamation, "Psychology as the behaviorist views it is a purely objective experimental branch of natural science. Its theoretical goal is the prediction and control of behavior" (p. 158). This statement seems obvious now, but was written at a critical moment in the history of science (Murray, 1983).

The implications of developing a science of behavior extend well beyond psychology. At the start of the twentieth century, the scientific study of human behavior and cognition was a new phenomenon and scientists were searching for the best methods to conduct scientific research. At the time, many researchers used a procedure known as **introspection**. *Introspection* means to examine or look within. Whenever you think about your own thinking and mental events, you are

using a form of introspection. Try this experiment in introspection: What reactions do you have when you read the word *health*? Although introspection can be revealing, it has several shortcomings. Take a moment to think of a few.

Perhaps the most troubling question is, *how do we know that the self-report is accurate?* When you are asked to introspect about something, will you report everything that occurs to you? Is it possible that thinking of work evokes a painful memory that you do not want to share? How complete is your report? Although you may report things of which you are aware, could there be reactions that you did not recognize as important and worthy to share with others? Is it possible that there are unconscious mental processes that you do not directly experience? The use of introspection troubled Watson because there is no way to verify the accuracy of an introspective report. The problem with introspection is that only one person can *experience or observe* your mental events—you. In science, researchers want to examine phenomena that others can see when they use the same procedures.

There are other problems with introspection. To what extent does your introspection influence the mental events you wish to study? Does thinking about your thinking affect your thinking? Are you confused? Try another thought experiment. Can you read and introspect about the process of reading at the same time? If you are like us, reading for content while introspecting is essentially impossible. As soon as we start examining the process of reading, we are no longer reading. When we read for content, we cannot introspect. Watson (1913) rejected introspection as a research tool and recommended that psychologists study behavior exclusively. He believed that by focusing on behavior, psychologists could engage in the objective study of all living creatures. For Watson, if you can observe the behavior, then you can conduct scientific research.

Watson's legacy to the study of people from a health sciences perspective is that he focused our attention on behavior. Watson has had a lasting impact on all research involving the study of behavior and social interaction. Many researchers today subscribe to the perspective of **methodological behaviorism**, a philosophical stance evolving from Watson's beliefs. Methodological behaviorism suggests that researchers should study overt and observable behaviors as the primary focus of their research. Researchers use observable behaviors to make inferences about the emotional, cognitive, and other mental processes that occur within a person. Behavior is the focal point of research dealing with human beings. As one general example, a great deal of emphasis in the health sciences now is placed on translating research-based knowledge into practice. What this really means, in most cases, is figuring out how to change human behaviors. Fechner's and Watson's work can help us to understand that the behaviors we can observe, and may seek to change, are intimately linked to underlying complex mental and cognitive events.

ASSUMPTIONS OF SCIENCE

Supporting everything we have discussed so far are two core assumptions, which operate behind the scenes of any good research study. All sciences make the same basic assumptions about their subject matter.

Behavior Is Determined

Our first assumption is quite possibly the most important. We believe that behaviors are caused or triggered by specific factors. This perspective is known as **determinism**. Someone who believes this (that all behaviors have a knowable set of causes) can be referred to as a *determinist*. You will learn that almost all researchers are determinists of one form or another. Sigmund Freud (1856–1939), for example, was a *psychical* determinist because he believed that human behavior reflected a series of unconscious drives and motivations. He believed that there are no accidents of behavior—everything we do reveals something about our character and unconscious drives.

In contrast, B.F. Skinner (1904–1990) was an *environmental* determinist because he believed that an individual's interaction with the environment produces changes in behavior. Other researchers are *biological* determinists because they believe that biological processes control many behaviors. Finally, some researchers are *sociocultural* determinists because they believe that cultural traditions, customs, and regulations control people's lives. When you examine different fields of study, such as human development, social behavior, marketing, or behavioral finance, you will find that researchers in each area conduct research to find the things that determine behavior. Regardless of their perspective, each type of determinist believes that by observing behavior and the surrounding conditions, we can infer the causes of the behavior.

Some people object to determinism and suggest that human behavior is only subject to **free will**. The principle of free will states that a person's soul or mind controls how he or she acts. Many religious faiths and philosophy theories suggest that humans are special because we have a spirit and self-awareness that guides us through life. These religions also teach us that we have the freedom to choose between the good and virtuous, or the evil and sinister. Thus, at first glance, it appears that there is quite a contrast between determinism and free will. Belief in determinism holds that we can explain observable behaviors by looking for and examining material causes. Belief in free will holds that each person is unique and that we cannot use the scientific method to understand human behavior.

It is not helpful to pit determinism versus free will. If you are willing to accept that people share some basic characteristics, then you will find that the scientific method does a good job of finding the causes of those common behaviors. Science does not have all the answers to important questions. Science, religion, philosophy, literature, and the arts are all different ways of knowing and experiencing our world. Each answers a unique set of questions using a different perspective. As Gould (1999) noted, science and religion are two ways of knowing. Both are equally important, yet both answer different questions. Taking a scientific perspective allows us to understand how things work, and when studying human behavior, this means trying to discover why people do what they do. Religion helps us to examine our values and to discover how we should behave. For many people, science and religion are not competing forces but rather complementary methods for addressing different issues of importance. In the same vein, determinism and free will can be viewed as complementary and not necessarily competing views.

We Can Measure the Critical Variables

A second assumption of science is that we can directly or indirectly observe (and therefore measure) the important causes of behavior. All sciences rest on a foundation of measurement. Fechner realized that we could use a person's behavior to make inferences about mental events. Physicists, chemists, and other scientists routinely use observable events to make inferences about the existence of things that they cannot directly observe. For example, no one has seen gravity, only its effects. Nevertheless, physicists can use the motion of the planets and stars to infer that there is gravity and to describe its effects. In business, we often study behavioral events and situations to make inferences about interpersonal and intrapersonal events that we do not fully understand and perhaps cannot directly observe.

REQUIREMENTS FOR SCIENTIFIC RESEARCH

Now it is time to focus on specific elements of research that, when combined, allow us to "be scientific" when doing research.

Empirical Analysis

Empirical analysis involves the gathering of data by observation and experimentation, with the goal of learning something. One important characteristic of empirical analysis is that it involves **measurement**, or the converting of observations into numbers. There are many different types of measurement, but just about all can be classified as either self- or other-observation, in which we use our own senses or someone else's senses to collect information.

Empirical methods are not the only way to gain insight into challenging questions. Within the health sciences, just about everything we "know" has come from scientists' efforts to observe and experience the phenomena of interest. Contrast this method with other ways of knowing. Mathematicians, for example, do not use empirical analysis but instead discover new ideas using deduction and formal proofs. Here is an example of the difference between the empirical method of knowing and the mathematical way of knowing. Imagine that you have 10 quarters in your hand and toss them in the air. What is the probability of obtaining 0, 1, 2, 3, . . . or 10 heads? There are two ways of finding the answer. The first method is empirical. You would toss the 10 coins, count the heads, and then repeat these steps several thousand times until you had enough samples to make a relatively accurate conclusion about the probability of each outcome. You will eventually come to the correct answer, if you are willing to spend the hours of drudgery tossing and counting coins.

The second method uses deductive logic and analytical techniques. If you know enough about probability theory and your way around mathematical proofs, you can derive an equation that gives you the correct answer. There is nothing wrong with either method, although most people find the mathematical solution more elegant and convenient. There are many times, however, when the analytical

method does not work and the empirical method is the only alternative. We can use mathematics to solve the coin problem because we know several critical things to be true, such as the fact that each coin has a 50% chance of landing heads. From these facts, we can derive additional truths. Thus, the deductive method works well when we have the necessary information before us to solve a problem. *In many cases we do not have this information*. Consequently, we must go about gathering data so that we can answer the question. In other words, empirical and deductive methods both have strengths and weaknesses.

The following is an example that illustrates the potential weakness of sole reliance on deductive logic:

1. All students are human.
2. We are all students.
3. Therefore, we must all be human.

Although extremely simple, this example illustrates a categorical syllogism that contains two premises (statements 1 and 2) and a conclusion (statement 3). In deductive logic, if we accept the premises and use the appropriate rules of logic, then the conclusion is true. Now consider the deduction:

1. All unicorns are purple.
2. Annie is a unicorn.
3. Therefore, Annie is purple.

The conclusion about Annie's color is logically consistent if we accept the premises. This example illustrates a potential problem with finding answers by deductive logic or pure reason. If we accept the premises of an argument, then we must accept the truth of logically consistent conclusions. In the example of the unicorn, the conclusion is valid, although it has no bearing in truth—unless you can find a living purple unicorn. Sir Francis Bacon and many others recognized that deductive logic can lead to erroneous conclusions based on a false or unproven premise. Consequently, scientists who utilize empirical methods are working to verify the truth of specific premises with gathered data. With respect to this admittedly bizarre example, if we can obtain observable evidence that unicorns exist and are purple, *then* we can conclude that Annie is purple.

Public Verification

Public verification is another important feature of empirical research. Using the empirical method requires us to rely on our senses when gathering data. If we design our research so that it can be publicly verified, then we are measuring things in a way that others can replicate with similar results. Therefore, public verification implies that anyone who uses the same procedure should be able to observe the same general outcome. Watson (1913) emphasized this requirement of good science when he called for all researchers to drop introspection and to adopt the

study of behavior. Studying your own mind is fine, but this pretty much ensures you will be the only researcher who can experience your thoughts and make your observations. In other words, your mental events would not be subject to public verification.

Your behavior and actions, however, are things that can be observed by anyone. Using a video camera, we can record your interactions with coworkers and team members, and any researcher can share those observations. We can also attach sensors to your body and monitor your heart rate, the sweat on your palms, and the electrical activity of your brain. We can give you a personality test as a way to measure how you perceive yourself. In each case, we have collected public information that others can verify. Public verification also means that anyone with the appropriate equipment can repeat an experiment. This facet of public verification is extremely important. Our ability to repeat or replicate experiments gives us greater confidence in the general applicability of our results. The more times we can repeat an experiment and obtain similar results, the more likely we are to agree that an effect we observed is real and not just a fluke, due to chance.

Systematic Observation

Systematic observation refers to the way we go about collecting information. Whenever we collect data, we want to make our observations under specific and controlled conditions. Doing so can help us to rule out alternative explanations for the outcomes we might be observing. Imagine that a pharmaceutical company claims to have a new medicine that can prevent obesity and lead to dramatic weight loss in those who are already overweight. Although this claim sounds great, we need to determine its truth. We can do this using systematic observation. For example, we should determine whether the medication, which has particularly noxious side effects, yields better results than more natural intervention options (e.g., diet and exercise). We could evaluate this within a controlled experimental framework by assigning patients to one of several conditions, for example, no treatment, **placebo** treatment, exercise and diet treatment, or new medication treatment.

In this example, the systematic observation comes into play as we measure differences in weight loss and side effects for the participants in each of the treatment conditions Yet another way to use systematic observation in this type of scenario might be to determine whether this medication works better for some people than others (e.g., perhaps only those over a certain BMI are likely to benefit to a degree that the noxious side effects are worth enduring).

The overarching goal of systematic observation is to examine a particular phenomenon under as many relevant situations as possible. We continue to repeat our observations and experiments to determine which conditions consistently produce the effect and what other possible factors aside from the training might influence the phenomenon. Unfortunately, many people do not recognize the necessity of systematic observation, tending instead to accept testimonials and/or

personal opinions without question. **Testimonials** are not a form of systematic observation, although they are often treated as such. Testimonials are nothing more than an example of Bacon's idols of the theater. When people make a claim like this, we are supposed to believe what they say. Testimonials are also an example of the idols of the cave because they reflect personal experience. Watch any infomercial on television and you will hear many happy customers share their personal experiences with the product: "My life was really going nowhere fast until I learned about Bacon's Idols. Now look at me!" Good researchers shy away from putting too much emphasis or weight on testimonial claims that are neither systematic nor objective. *How do you think this can improve the quality of research?*

Control of the Environment

In all forms of research, we attempt to exercise **control of the environment** in some way. We do this to ensure that the conditions in which we make our observations are consistent and can be replicated by other researchers who might wish to verify our findings. Researchers have the greatest level of control when they conduct research in a laboratory setting because they can control many or all external environmental conditions. This control helps to reduce the number of possible factors that might influence a participant's behavior, thoughts, or feelings. There are many cases, however, in which direct control of the research environment is not possible. This is especially true when a **field study** is being conducted, but even here, a true researcher will try to ensure as much as possible that the environment is the same each time he or she collects data from that sample.

Rational Explanation

A **rational explanation** refers to the two basic assumptions of science: (1) Behavior is determined and (2) behavior follows a pattern that can be studied.

Rational explanations of behavior, therefore, include two essential components. The first is that the explanation refers only to causes that one can observe or confirm through public verification. The second is that the explanation makes a clear and logical link between the cause and effect. Explanations that are not rational are not scientific. Instead, these are typically called **pseudoexplanations** because although they may sound like sophisticated explanations of some phenomenon, they do not improve our understanding of the phenomenon in any way. A pseudoexplanation is also commonly referred to as a **nominal fallacy** or a **tautological (circular) explanation** in that this type of explanation uses the phenomenon to define itself. Thus, a pseudoexplanation is an example of the idols of the tribe, as it appeals to our desire for commonsense explanations.

For example, a typical early definition of a *reinforcer* was *a stimulus, produced by a behavior, that increases the probability that the individual will repeat the behavior*. This explanation is circular because there is no independent definition

of the reinforcer. The definition uses the effect of reinforcement to define the property of reinforcement. Why is this technique a problem? Consider the following exchange.

QUESTION: *"What is a reinforcer?"*
ANSWER: *"A reinforcer is anything that increases the probability of a behavior."*
QUESTION: *"How do we know that something is a reinforcer?"*
ANSWER: *"Because it increased the probability of a behavior."*
QUESTION: *"Why did the probability of the behavior increase?"*
ANSWER: *"Because we used a reinforcer."*
QUESTION: *"But what is a reinforcer?"*

The problem with this cycle is that we have no way of defining the reinforcer without referring to the behavior it affects. In other words, this type of definition tells us nothing about why a reinforcer works. Using the definition of reinforcement does not allow us to predict what things will serve as effective reinforcers. This definition also does not explain why a reinforcer will increase the probability of reinforcement.

Fortunately, David Premack (1959, 1965) discovered that high-frequency behaviors can reinforce low-frequency behaviors (the Premack principle). The advantage of this definition is that it breaks the circular definition, defining the cause as independent from the effect. More specifically, Premack's theory states that any high-frequency voluntary behavior will reinforce a low-frequency voluntary behavior. According to this definition of reinforcement, we can take several behaviors and categorically predict which will and will not be reinforcers. Consider this example: "For Alex, playing video games is a high-frequency behavior and studying math is a low-frequency behavior. Therefore, playing video games will serve as a reinforcer for studying math." We predict that video game playing is a reinforcer because it is a high-frequency behavior. We can then verify this hypothesis with an empirical test by allowing Alex to play video games only if he spends more time studying math. If there is an increase in the amount of time spent studying math (the effect), we can then say that the reinforcement (playing video games) caused the change.

Another feature of a rational explanation is that a researcher can empirically test and determine whether an explanation is correct. What if your professor told you that there is a special energy force that affects the brains of some people and causes them to be schizophrenic? The first question you should ask is, "Where's the empirical evidence?" What if the professor told you that no known apparatus can detect the radiation from this special energy force? At this point, you should realize that your professor is either losing his mind or offering you a classic pseudoexplanation. A better explanation is one that is objectively defined in a way that can be supported with observational data by you and other researchers who may wish to replicate your work. Indeed, many researchers have tested the accuracy of the Premack principle. Some have verified Premack's predictions, whereas others have not (Mazur, 1998). Using the results of these experiments, Timberlake

and Allison (1974) were able to refine Premack's definition and offer a more comprehensive definition of reinforcement.

Parsimonious Explanation

In addition to being rational, scientists strive to make explanations *parsimonious*. Parsimony means simplicity. If you have difficulty remembering this concept, try to link it in your mind visually to a big fat kiss and remember that K.I.S.S. represents the "Keep it simple, stupid!" principle. In the present context, a scientific conclusion or explanation is parsimonious if it makes relatively few assumptions, does not refer to unobservable causes, and refers to specific causes. This requirement is also known as **Occam's razor**.

Please realize that we are *not* saying that simplicity automatically makes a theory correct. Instead, a parsimonious theory allows for specific predictions that researchers can directly test. Its value to science is its ability to generate many ideas for specific research projects. When possible and appropriate, simpler explanations often have more utility than more complex explanations.

Tentative Explanations

Whenever a researcher presents the results of a study, the explanation of the results is **tentative**. No single study can account for all the potential explanations of the results. You can think of any single study as a small step in a long journey. Although each step may take us closer to our goal, it may also take us in the wrong direction. Although the theory is useful, it is never fully complete.

As you read more about science, you will learn that researchers are continually revising their explanations for why things work the way they do. The change occurs because each study adds new information. Some new information may confirm what we already know and so we continue to use the theory to explain the phenomenon we study. Other new information, however, may indicate that the theory cannot account for specific events and must be revised or replaced. Therefore, it is the case that explanations of behavior are only as good as the data they have collected. Researchers recognize that as new data are collected, they may have to revise their explanations or develop new explanations.

CHAPTER SUMMARY

This chapter introduced you to research methods by briefly examining the history of science as it relates to research methods and by offering an overview of the meaning of scientific research. The goal of this chapter was to illustrate that understanding research methods and the basics of science is important whenever you are trying to understand how and why people behave in the ways they do. Researchers use the scientific method to

conduct basic research to understand various behavioral phenomena. Research methods also have many practical applications. Regardless of your current or future career objectives, it is important to understand the foundations of science and research methods.

Sir Francis Bacon was an early advocate of empirical science. He believed that the scientific method would overcome several human tendencies that are obstacles to a better understanding of our world. He called these tendencies *idols* and identified four specific ones: *idols of the tribe* (common modes of thought that lead to irrational conclusions), *idols of the cave* (overreliance on personal experiences), *idols of the marketplace* (biases in beliefs based on the meaning and use of words), and *idols of the theater* (biased thought based on tradition, habit, or deference to authority).

Gustav T. Fechner recognized that researchers could indirectly observe or make inferences about mental events by observing reactions to physical stimuli. John Watson's contribution to research was his insistence that behavior is the proper target of research and that introspection is not a useful procedure for science. The objective study of behavior allows researchers to understand behavioral and cognitive phenomena. Therefore, many researchers in the behavioral and social sciences are methodological behaviorists.

Researchers believe that they can use the scientific method to study behavioral and cognitive phenomena. They base this belief on the assumptions that the behavior they study is determined by specific causes that can be measured. Scientific research, regardless of the discipline, incorporates the following seven general characteristics:

1. Empirical analysis is the process of learning through observation and experimentation and through quantifying observations.
2. Public verification requires that we conduct research that can be repeated by others and specifically that the variables we examine can be observed by everyone.
3. The systematic observation criterion requires us to make our observations under various conditions or settings.
4. Control of environment refers to our ability to conduct our research under consistent conditions. When researchers explain various phenomena, they also attempt to make their explanations rational, parsimonious, and tentative.
5. The rational explanation means the terms are clearly defined and can be independently assessed and defined.
6. Parsimonious explanations are specific, make few assumptions, and generate many testable ideas. Pseudoexplanations, by contrast, are circular in definition and cannot be directly or objectively assessed.
7. Explanations are tentative. Researchers recognize that their explanations must be revised in the face of additional research.

KNOWLEDGE CHECK

1. Think about a health-related issue that affects a large number of people in your community. How could the scientific method help researchers better understand this issue?
2. Many disciplines examine human behavior. The authors of many great novels write about the human condition and use their stories to describe

why people behave as they do. Describe the difference in perspective between a health sciences researcher and the author of a novel.

3. Many people believe that professional athletes have moments when they are "in the zone," during which their performance is greatly enhanced. There are also times when the athlete will be "in a slump." By contrast, statisticians argue that these phases do not exist and are nothing more than random events. Which of Bacon's four idols best describes the belief that athletes are in the zone or in a slump?
4. You want to buy a new car. A friend of yours, an auto mechanic, says, "Stay away from that car, my shop is always filled with them. I plan to send my kids through college on the work that model makes for me." How does this example relate to Bacon's idols of the cave?
5. Describe the meaning of introspection and why Watson objected to its use.

Use the following scenario to answer questions 5 and 6: Imagine that your friend believes that he has psychic powers. He claims that he can often guess what another person is thinking. Two of your other friends agree and claim that there have been several times when your friend has shown his psychic abilities. Given this information, respond to the following questions:

6. Why would you want to use empirical methods to confirm your friend's psychic abilities? Why not rely on the testimonials of your friends who are being honest when they say that your friend is psychic?
7. Your friend agrees to a test. You create a list of randomly selected common words. As you concentrate on the word, your friend tries to read your mind. He fails the test and is unable to guess any of the words. To explain the failure, he says, "Well you see, it only works when there is no doubt of my ability. You doubt my ability and that creates negative energy that blocks my ability to read minds." Based on what you read in this chapter, comment on your friend's reaction.
8. According to the text, what are the essential elements of scientific research? Describe how these are incorporated into business research.
9. Contentment is a mental phenomenon that we cannot directly observe; yet it is a common experience. Describe how a researcher might measure contentment and make it an observable phenomenon.
10. Why is public verification especially important for studying behavior?
11. Would science exist if there were no measurement? Defend your answer.

CHAPTER GLOSSARY FOR REVIEW

Control of the Environment A feature of empirical research. The researcher attempts to observe the phenomenon under identical conditions. Also implies that the researcher reduces the effects of distracting or nuisance conditions that will add confusion to the data.

Determinism A philosophical stance that natural events and human behavior are the result of an orderly sequence of preceding events that can be predicted using fundamental scientific laws.

Empirical Analysis Using observation and research methods involving the gathering of data to help with identifying answers to research questions.

Field Study Research conducted beyond the boundaries of a laboratory, in an environment in which the phenomenon under study tends to occur or exist.

Free Will A philosophical stance that human behavior is independent of external causes and that humans are free to choose how they will act.

Gambler's Fallacy An example of the idols of the tribe. The fallacy is a belief that random events follow a predetermined pattern. For example, many people believe that for six tosses of a fair coin, the pattern THHTHT is more likely than TTTHHH; both are equally likely based on laws of probability.

Idols of the Cave Bacon's phrase to describe the tendency to use one's personal experience as the foundation for truth or the measure of all things.

Idols of the Marketplace Bacon's phrase to describe how our use of words shapes our perception of and reaction to things.

Idols of the Theater Bacon's phrase to describe the tendency to accept a theory or statement as fact and fail to question its accuracy or generality.

Idols of the Tribe Bacon's concept to describe common errors in humans' thinking. These errors of thought are present, to varying extents, in all people and include overreliance on common sense and logical errors of reasoning.

Introspection A process by which one attempts to analyze his or her own conscious experiences.

Measurement The process of converting observations to numbers using a set of rules.

Methodological Behaviorism The belief that when studying human beings researchers should study observable behaviors. By observing the conditions under which behavior occurs, one can then infer the causes of the behavior or the presence of mental processes that cannot be directly observed.

Nominal Fallacy An example of a pseudoexplanation that makes the erroneous assumption that naming a phenomenon is the same as explaining the phenomenon.

Occam's Razor A version of parsimony that requires that we do not create more distinctions among things than is necessary.

Parsimonious Explanation A requirement in science that we offer explanations that make the fewest assumptions and require reference to few or no unobservable phenomena.

Placebo A false treatment condition in which participants are not exposed to any real stimulus but rather an imaginary placeholder such as a sugar pill or glass of water. Useful as a means of creating a control group without the participant knowing he or she is not getting the real treatment.

Pseudoexplanation An explanation of a phenomenon that does not really explain the phenomenon.

Public Verification The requirement that the subject matter of any empirical research must be observable to any person who uses the same procedures and equipment to examine the phenomenon.

Rational Explanation Offering a description or interpretation of a phenomenon that follows the rules of logic.

Self-Fulfilling Prophecy An example of the idols of the tribe. People will act in ways that bring about the result(s) they expected in the first place.

Systematic Observation A process in which the researcher varies the conditions under which he or she studies a particular phenomenon.

Tautological (Circular) Explanation A form of pseudoexplanation that involves circular

definitions, which use the phenomenon to be described when trying to define its cause.

Tentative Explanation The recognition that all descriptions and explanations that arise from empirical research may be incomplete or inaccurate. Additional research may force us to revise our beliefs.

Testimonial A statement that a person makes about the truth of a fact or a claim based on personal experience.

REFERENCES

Bacon, F. (1994). *Novum organum* (P. Urbach & J. Gibson, Trans.). Chicago: Open Court (original work published in 1620).

Baron, R.M., Graziano, W., & Stangor, C. (1991). Social perception and social cognition. In R.M. Baron & W. Graziano (Eds.), *Social psychology* (pp. 108–159). Fort Worth, TX: Holt, Rinehart and Winston.

Campbell, S. (1974). *Flaws and fallacies in statistical thinking*. Englewood Cliffs, NJ: Prentice-Hall.

Daubert v. Merrell Dow Pharmaceuticals, Inc., 113 S. Ct. 2786 (1993).

Federal Judicial Center (1994). *Reference manual on scientific evidence*. Washington, DC: Author.

Gould, S.J. (1999). *Rock of ages: Science and religion in the fullness of life*. New York: Ballantine.

Hedges, L.V. (1987). How hard is hard science, how soft is soft science? The empirical cumulativeness of research. *American Psychologist*, *42*(5), 443–455.

Kohn, A. (1990). *You know what they say . . . : The truth about popular beliefs*. New York: HarperCollins.

Lakin, J.L., Giesler, R.B., Morris, K.A., & Vosmik, J.R. (2007). HOMER as an acronym for the scientific method. *Teaching of Psychology*, *34*(2), 94–96.

Mazur, J.E. (1998). *Learning and behavior*. Upper Saddle River, NJ: Prentice-Hall.

Murray, D.J. (1983). *A history of Western psychology*. Englewood Cliffs, NJ: Prentice-Hall.

Nisbett, R.E. & Ross, L. (1980). *Human inference: Strategies and shortcomings of social judgment*. Englewood Cliffs, NJ: Prentice-Hall.

Popper, K. (1963). *Science: Conjectures and refutations*. New York: Harper and Row.

Premack, D. (1959). Toward empirical behavioral laws: I. Positive reinforcement. *Psychological Review*, *66*, 219–233.

Premack, D. (1965). Reinforcement theory. In D. Levine (Ed.), *Nebraska symposia on motivation* (pp. 123–180). Lincoln: University of Nebraska Press.

Rosnow, R.L. & Rosenthal, R. (1997). *People studying people: Artifacts and ethics in behavioral research*. New York: Freeman.

Scarr, S., Phillips, D., & McCartney, K. (1990). Facts, fantasies, and the future of child care in the United States. *Psychological Science*, *1*, 255–264.

Timberlake, W. & Allison, J. (1974). Response deprivation: An empirical approach to instrumental performance. *Psychological Review*, *81*, 146–164.

Watson, J.B. (1913). Psychology as the behaviorist views it. *Psychological Review*, *20*, 158–177.