PART I

OVERVIEW OF THE RESEARCH PROCESS

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RESEARCH AND BUSINESS

CHAPTER OVERVIEW

> The whole of science is nothing more than a refinement of everyday thinking.
>
> — Albert Einstein

Understanding Business Research, First Edition. Bart L. Weathington, Christopher J.L. Cunningham, and David J. Pittenger.
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INTRODUCTION

Good business depends on good research and on those who know how to interpret empirical evidence. Understanding something as complex as social interaction or human behavior, especially in an organizational context, is not easy. Without an empirical, scientific approach to the development of a body of knowledge, our understanding of people in the workplace will be incomplete and rife with error. Having a solid understanding and appreciation of research methods will help you to make quality, informed decisions. The goal of this chapter is to prepare you to be both a producer and consumer of scientific knowledge about human behavior in the workplace.

WHY IS UNDERSTANDING RESEARCH METHODS SO IMPORTANT?

Although there are differences across specialty fields, there are three core types of information that anyone seeking to understand human behavior must know. First is the knowledge of basic statistics. Second is knowing how to develop and evaluate measures of human thought and behavior. Third is knowing how to conduct and interpret high quality research, the purpose of this book.

This book helps you learn how to conduct and understand business research that is focused on social and behavioral questions. Throughout the chapters of this book we will also remind you of how statistics can help you answer specific questions. We will cover how to develop and evaluate tests, surveys, and other measures of behavior. If you feel you need a refresher in basic statistics, a review is included in Appendix A.

Why are these three core topics so important? Think about it—researching, analyzing, and reporting are the skills from your education that will help you find a job, keep a job, and make a contribution to both society and, more specifically, your workplace. You can think big thoughts and theorize all day long, but without these three skills, these great ideas will never translate to credible and applicable action. 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 science or research. There is nothing scary here; just a systematic approach to learning, understanding, and questioning that will benefit you, no matter what you decide to do across the course of your career.

There are many ways to study human behaviors and thought, but all of these methods, if done right, use the scientific method in some way, shape, or form. Statistical description and analysis techniques provide structure to these methods, and good test development and utilization provide the conduit through which good research is conducted. In other words, to become a proficient consumer or producer of knowledge you must learn to work with the tools of the trade: the scientific method, statistics, and tests and assessments.

THE ROLE OF SCIENCE IN BUSINESS AND EVERYDAY LIFE

Thought Starters

- 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, the 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 that this prediction has come true. Although you may not plan to become a researcher, working in any field of business (and in many areas of life in general) will force you to confront issues that can be addressed only with the aid of scientific research. Consider the following example issues:

- What effect does offering on-site child care have on employee attendance and attitudes toward their employer?
- What are the best ways to prevent employee theft?
- Are employer-sponsored treatment programs for drug and alcohol abuse effective?
- Will a specific test accurately predict how well a person will do on a job?
- What is the best way to present new information to a large group of people?

These are clear and direct questions that anyone could ask. Will you recommend that your company invest in an employee on-site day care? If you do, how will you evaluate its value? Will this promote trust in the employer and feelings of safety? As an employer, what should you do to discourage your employees from using illegal drugs? If you have a management position, should you use personality tests to predict who will be a good employee? These are the types of questions you will face when you start to apply your methodological training to the real world. Knowledge of the scientific method can be invaluable where the rubber meets the road.

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 statistics and research methods. Many people seem to detest anything related to mathematics and statistics 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 chapter, you will know that the relevance has been there all the time—understanding how to do good research and work with statistics will be skills you can use for the rest of your life.

THE SCIENTIFIC METHOD

The scientific method is really the most critical concept in this course for you to remember and understand. Knowing each of the steps in this process and how they are managed will allow you to conduct the highest quality research possible. Sometimes the most difficult challenge for students in courses such as these is figuring out how to remember the core elements of a topic so that they can then (hopefully) attach some meaning to

these elements and retain this knowledge in their long-term memory. Perhaps, the easiest way to remember the scientific method from start to finish is to learn the mnemonic *HOMER* (Lakin et al., 2007)

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 vaguely familiar from middle school and high school science and various introductory science courses you may have taken. The rest of this chapter focuses on ensuring that you finish with a working knowledge of all five components.

BRIEF HISTORY OF THE SCIENCE OF BEHAVIOR IN THE WORKPLACE

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 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.

Before we get into the real meat of this course, a little history lesson is necessary. It will be relatively painless, we promise. To understand where you are and where you are going, we think it would be helpful to first tell you where the study of human behavior, in business and other aspects of life, has been and how it has developed. This discussion will entail a consideration of both the history of business and of the social sciences.

Even though businesses, as we think of them at present, have only been around for a few hundred years, people throughout history have had to develop methods and procedures for producing needed goods and transferring them to others. This has necessitated the development of writing, mathematics, and money (as a way of measuring stored wealth). In addition, fields such as those we now call management and marketing arose to deal with the necessities of commerce and the employer–employee relationship.

As formalized fields of study, both management and the social sciences are technically young. However, they both have a long history. We know that workplace testing was utilized in ancient China (around 2200 BC) when the Chinese emperor ordered that government officials be evaluated every 3 years to examine their fitness for holding office (Teng, 1942–1943). In addition, governments and empires throughout history (e.g., the Roman Empire, Mayans, etc.) have developed well-defined societal and organizational structures. The serious and formal study of people in the workplace did not begin until relatively recently when individuals such as English mathematician Charles Babbage (1792–1871) began to study ways to improve efficiency and productivity (Babbage, 1832/2010).

Of course, the attempt to understand human beings and their behavior has 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 the mental events are difficult to observe and measure. Consequently, many philosophers believed that we could not observe or measure mental events in the same way in which we observe or measure physical objects.

This perception exists even today and has resulted in the social sciences, including management and marketing along with more traditional social science topics such as psychology and sociology, being labeled as the "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 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, but rather a British politician. He was interested, however, in the developments of 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 path to good answers. Similar to 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 have 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 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, Cave, Marketplace**, and **Theatre**. Bacon's observations were as insightful in their own time (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 learning that each of these idols creates.

Idols of the Tribe

The first source of bias described by Bacon was our human tendency to rely on intuition and common sense to reach conclusions. 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 make decisions.

A common example of the Idols of the Tribe is a **self-fulfilling prophecy**. A self-fulfilling prophecy occurs when we believe something is true and our beliefs then influence the way in which we perceive and react to specific events to confirm our beliefs (Baron et al., 1991). In most cases, we are unaware of how our attitudes affect our behavior. Moreover, when we believe something to be true, we tend to remember events that agree with our beliefs and forget or ignore events that disagree with our beliefs. At the heart of the problem is that our preconceived ideas have considerable influence on how we interpret and react to different situations.

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. Another example of the Idols of the Tribe is the **gambler's fallacy**. If a person tosses a coin three times in a row and gets heads each time, most people believe that the fourth toss of the coin *must* be tails. Some people will argue, "It makes *good common sense* that you cannot have four heads tossed in a row!" However, the probability that the coin will land heads on the next toss is fixed at 50% each time (unless the coin is weighted). 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. In summary, the Idols of the Tribe refers to the human tendency to depend too much on common sense and to the tendency to make consistent errors in logical reasoning. *Why do you think this is a problem for science to avoid*?

Idols of the Cave

This second source of bias is formed from the effect of our exposure to culture, common practice, and education on our processing of information. 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 events in our lives. These events shape our beliefs and perceptions and affect how we perceive things. Although these beliefs and perceptions make us unique, we need to recognize their effect on our decision making and reasoning. Karl Popper (1902–1994), a famous philosopher, provided an interesting example of depending 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 based on his clinical experiences. 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. That Adler was a professional psychoanalyst does not mean that his experiences are automatically valid. A moment's thought will reveal the limitation of personal experience. Adler was a therapist and treated people suffering from various psychological problems. 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 refers to the fact that we too often depend on our personal experiences to 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. *Why might this be a problem for scientific research?*

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 Marketplace* [*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 directly related to our earlier on-site day-care question. Scarr et al. (1990) have 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 do they not 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 reflects the power of language over our thought processes. *How could this be a limitation to good science*?

Idols of the Theatre

The last of Bacon's idols represents the effects of our 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 Theatre are illustrated any time we accept an explanation without critically evaluating it first. In many cases, we automatically accept certain explanations because we learn 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 Theatre 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. *Why can this be a problem?*

BACON'S LEGACY

Bacon's primary legacy is that he clearly identified the obstacles to critical thinking as they apply to science even today. 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. Studying Bacon will help you understand why researchers use specific tactics when conducting their research. Researchers use research methods and statistics to overcome many forms of bias. By studying Bacon, you will learn that you can never become complacent with your knowledge. The lesson we can learn from Bacon is that the Idols of the Tribe, Cave, Marketplace, and Theatre are always present, and we 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 of examples of Bacon's idols.

OTHER IMPORTANT HISTORICAL FIGURES

The goal of this chapter 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) will help illustrate the development of current views of research methods. Many other individuals are listed and discussed here.

TABLE 1.1. Review 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 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 things
Idols of the Theatre	Biases due to uncritical acceptance of explanations that people in authority tell us are true

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 October 22, 1850, 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 that 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 in the other?

Fechner reasoned that, by studying the relation between changes in the intensity of a stimulus (a physical event) and changes in a person's perception (a mental event), he could study how the mind works. He then proceeded to conduct a series of famous experiments that we now recognize as the start of *psychophysics*. Fechner's experiments may not sound like the most exciting thing that you have learned today. Nevertheless, 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 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 *work*? 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 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 at work 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. As you will learn in this and other courses, behavior is the focal point of research that deals with human beings. An economist may look at the behavior of rational or irrational investors. Following Fechner's and Watson's lead, we use the observable behavior of individuals to make inferences about various mental or cognitive events.

ASSUMPTIONS OF SCIENCE

Underlying everything we have discussed so far are two core assumptions that can be found built into 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**, and 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.

By 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 he or she can infer the causes of the behavior.

Some people object to determinism and suggest that human behavior is 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 they have a spirit and self-awareness that guides them through life. These

religions also teach them that they 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. By contrast, 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 examine our values and 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 always competing views.

We Can Measure the Critical Variables

A second assumption of science is that we can directly or indirectly observe 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 grouped as either self- or other-observation, in which we use our own senses or someone else uses his or her own senses to collect information on how we interact with our environments.

Empirical methods are not the only way to gain insight into challenging questions. Within business, 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 the 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 following 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 attempt to verify the truth of premises with gathered data. In other words, 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 adopt the study of behavior. Studying your own mind is fine, but this ensures that 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 conditions, as we attempt to rule out alternative explanations for the outcomes we might be observing. Imagine that an outside vendor claims that a new method of training employees will result in an increase in productivity and a corresponding decrease in unsafe work behavior (as measured by on the job accidents). 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 training technique produces better results than could be achieved without the training or with a placebo treatment. To do this study, we could assign employees to one of three training conditions: no treatment, a **placebo** treatment, and the new training.

In this example, the systematic observation comes into play as we measure differences in our participants' levels of productivity and unsafe behaviors under each of the three different treatment conditions. Another way in which we can use systematic observation is to compare the new technique to other current training programs offered by vendors. For this type of research, we want to determine whether the training is in some way better than other techniques. Yet another way to use systematic observation is to determine whether the training works better with some people than others. Thus, we would conduct studies comparing the differences among men and women; males and females; or people who are prone to risky behavior.

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 Theatre. 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 enrolled in Research Methods. Now I'm 'the king of the world!'" Good researchers shy away from putting too much emphasis or weight on testimonial claims that are neither systematic nor objective. *How does this help them conduct better 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 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: (i) behavior is determined and (ii) behavior follows a lawful 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 in any way. A pseudoexplanation is also commonly referred to as a **nominal fallacy** or a **tautological** or **circular explanation**, referring to the tendency to use 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 playing a video game 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? At this point, you should realize that your professor is either losing his own 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 in remembering this concept, try to link it in your mind visually to a big fat kiss and remember that that kiss 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.

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 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 has 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 studying research methods is an important component of any student's education, especially when people are involved. 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 Theatre* (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, has several 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 an issue that impacts people in the workplace that you find interesting. How does 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 business 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 6 and 7: 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." On the basis of what you have 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. In an interview, a reporter asked a government official to explain why an accused computer hacker had broken into the government's high security computers. The official replied, "The accused has an antisocial personality." Comment on the value of this response.
12. Would science exist if there were no measurement? Defend your answer.

CHAPTER GLOSSARY FOR REVIEW

Control of 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 theatre: 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.

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