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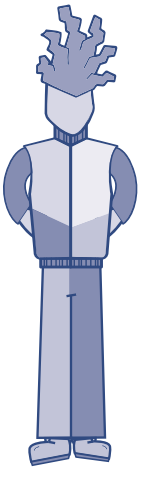
Introduction to Research in Psychology

Objectives

After studying this chapter, students should be able to

- List and describe common sources of belief and identify the likely source of example beliefs
- Explain why psychology is a science and an art
- List the steps of the critical thinking process
- Describe the objectives of science and create examples of each
- Describe the tenets of science and identify examples of each
- Apply the steps of the scientific method to a problem
- Describe the difference between a theory, a concept, and a hypothesis
- Discuss the various reasons why scientists do research
- Describe various approaches to research and classify research examples
- List the steps in planning and doing research and generate a research topic from available sources



> Vancouver yoga teacher Shakti Mhi has been drinking her own urine every day for the past two decades. Ms. Mhi claims that it not only is rich in nutrients but also offers numerous health benefits, including a boosted immune system. "I drink it first thing in the morning. . . . If I feel my energy level is dropping, I'll drink three cups a day. . . . I always heal myself. I haven't seen a doctor in 20 years."
>
> —*Globe and Mail*, Saturday, September 25, 2004

Are you wondering what the basis is for Ms. Mhi's claims about drinking urine? So are we.

Acquiring Knowledge About the World

Some expectant mothers play classical music to their growing bellies because they believe this will make their babies more musically talented. Some people believe that dreams predict future events or that a broken mirror can cause 7 years of bad luck. Many people believe all sorts of things that really have no factual foundation.

Why are many people hard-pressed to give up beliefs such as these even in the face of solid evidence to the contrary? Where do these beliefs come from?

Surprisingly, and often unfortunately, we acquire many of our beliefs from flawed sources or in flawed ways.

Tradition or Tenacity: I Believe It Is True Because It Has Always Been True

Good fences make good neighbors. Our parents believed this so-called truism. So did their parents. The willingness to accept an idea as valid or as truth because it has been accepted as such for so long or because it has been heard so often is an example of a belief acquired through **tradition**. Psychologists have demonstrated that simply repeating an idea increases the likelihood that people will believe it (e.g., Schwartz, 1982). No proof is necessary—there is no need to check the accuracy of the idea. Indeed, little intellectual effort is required to acquire knowledge through tradition. Advertisers are well aware of this.

Accepting something as true because it has been traditionally accepted as such is a flawed way of acquiring knowledge. And many traditionally accepted truisms are in fact contradictory. Compare the adage *Out of sight, out of mind* with *Absence makes the heart grow fonder.* These truisms cannot both be correct. What about *Birds of a feather flock together* and *Opposites attract?* You can probably think of more examples. This is not to say that some traditional beliefs are not true; it is to say that we cannot know that something is true simply because it has always been thought to be true. A willingness to do so indicates intellectual laziness.

Consider the following dialogue:

"Grandpa is never going to figure out e-mail."

"What makes you say that?"

"Everybody knows you can't teach an old dog new tricks."

The belief expressed in this example is supported by nothing more than tradition.

Intuition: I Believe It Is True Because I Feel It Is True

Intuitive knowledge or beliefs come to us without any direct involvement of our senses, apparently. Years ago, there was quite a flurry of interest in something called subliminal suggestion. It was thought that we could be influenced by messages sent to our unconscious mind, messages that could not be detected by our normal sensory processes. The fact that there was and still is no evidence that such a process can occur has not deterred some people from continuing to believe that it can. The idea that we can perceive things that are purported to exist outside our senses (i.e., extrasensory perception) continues to thrive today, to such an extent that some police forces have been known to consult with psychics.

Consider the following dialogue:

"Same-sex couples do not make good parents."

"How do you know that?"

"I don't care what anybody says; I just know it."

The belief expressed in this example is founded on a feeling or an **intuition**—a belief that is not supported by any evidence.

Authority: I Believe It Is True Because an "Expert" Says It Is True

We professors hear our students make the following kinds of statements all the time: "I read that . . . " "I heard that . . . " "I saw somewhere that. . . . " We often reply, "Just because you read it, heard it, or saw it doesn't make it true." Accepting an idea as true because it was claimed to be so by a source we respect is the method of acquiring knowledge by **authority**. This method of acquiring knowledge is pervasive in our world. We learn from our parents, from our teachers, from our religious leaders, and from the media.

Sometimes the authority figures from whom we acquire knowledge are good authorities, and by accepting what they tell us, we avoid having to evaluate the evidence ourselves and save ourselves an enormous amount of work. Unfortunately, often we do

not discriminate between good and bad authorities. You have heard the adage *Consider the source*. We often don't consider the source—sometimes we don't even remember the source! Recall our students who heard it *somewhere*, read it *somewhere*. . . .

Consider the following dialogue:

"Women are more emotional and less rational than men."

"How do you know that?"

"My philosophy professor said so."

The belief expressed in this example is a belief acquired through authority. The truth of the belief depends on the credibility of the authority.

Uncritical acceptance of an idea acquired through tradition, intuition, or authority is a flawed method of acquiring knowledge. An intuitive belief that eating pizza late at night will make you dream about dying is probably not going to adversely affect your life. Likewise, not eating pork because your pastor says it is a sin or never wearing white shoes after Labor Day will have few negative consequences in the larger scheme of things. But feeding your infant nothing but eggs for the first year of her life on the advice of your meditation guru (as a relative of one of the authors of this book did) is a decision better made after a more rigorous evaluation of information. Accepting such advice on the basis of this particular authority is doubly flawed: a flawed source and a flawed process.

Personal Experience: I Believe It Is True Because I Experienced It

Personal experience is a very powerful way of knowing the world. You know something because it happened to you, and now it's part of your personal history. This way of knowing may be convincing to you, but often it is not convincing to others.

According to the Old Testament, Noah was told by God that the world was going to end in a flood and that he should build an ark. The conversation motivated him to do as he was told but had little effect on anyone else.

Often, this way of knowing puts an end to discussion with friends and family. Usually, it goes something like this: "You don't understand _____ like I do. I know _____ is true because it happened to me."

Consider the following:

"I know what it's like to be poor and homeless because I've lived on the street."

"I know that divorce has a negative influence on children because I was only 10 when my parents divorced."

"I know that talking on a phone doesn't interfere with driving because I do it all the time, and I've never had an accident."

Personal experience is very difficult to argue against and equally difficult to convey to others. It often is the basis of religious or mystic experiences. The problem with this

way of knowing is that personal experience is personal and subjective. There is no way for others to make it objective. It is also a problem because there is no way of knowing if your experience is typical or usual. It could be that your experience is very rare.

Reasoning: I Believe It Is True Because It Is Logically Derived

Rational thought is thinking with reason. Rules of logic are applied so that reasonable conclusions are made. Logical **reasoning** is a more rigorous way of arriving at knowledge. However, logical reasoning requires confirmation from other evidence. A conclusion reached from logical deduction is only as good as the assumptions of the reasoning process. If the assumptions are flawed, the conclusion, although logical, is still flawed.

Consider the following:

All poodles are dogs. (Major premise)

Fido is a poodle. (Minor premise)

Therefore, Fido is a dog. (Conclusion)

The conclusion is logical and follows from the premises.

However, consider the following:

All poodles are afraid of hot air balloons.

Fido is a poodle.

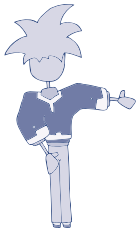
Therefore, Fido is afraid of hot air balloons.

The conclusion is logically valid, but Fido, the dog of one of your authors, is afraid of just about everything *except* hot air balloons. The premise that all poodles are afraid of hot air balloons must be wrong, or the premise that Fido is a poodle must be wrong. Each premise must be demonstrated to be true in some way other than logical reasoning before the process of logical reasoning will work.

Empiricism: I Believe It Is True Because I Measured It

Empiricism is acquiring knowledge through our senses or with instruments that extend our senses. In research, we often think of instruments such as microscopes or telescopes, but in psychology, we refer to intelligence tests and surveys as instruments. The important point is that other people can verify such observations and measurements using their senses or their instruments. Directly observing an event and using a machine to measure something are both means of obtaining empirical evidence.

Of course, it would be foolish to always require direct sensory experience before we believe something. For example, just because we have never skied at Park City, Utah, does not mean that the ski resort does not exist. Empiricism must be combined with rational thought to make meaning of our world, and this is what science does.



FYI

Interestingly, as its first entry, the Merriam-Webster dictionary defines *empiricism* as "**a:** a former school of medical practice founded on experience without the aid of science or theory **b:** QUACKERY, CHARLATANRY." This is not what we are referring to in our use of the word. Our use reflects the second entry: "the practice of relying on observation and experiment especially in the natural sciences." Curious how the word refers to both quackery and the natural sciences!

Science

Science is a way of acquiring knowledge through the continual interaction of empiricism and reasoning. Observation of real events provides the basis for hypotheses that can be tested in methodical and systematic ways. Hypotheses that are not supported by further empirical evidence are abandoned, and new hypotheses are constructed. In this way, general principles are identified, and predictions can be made. This is the basis of **theory building**. Hypotheses that have been tested and found to be supported by the available evidence are then encompassed in the body of knowledge of the discipline.

Science has been very successful in helping us understand ourselves and our universe, but it is not without limitations. Scientists don't have all the answers. Science is always limited by empiricism. If we can't devise a way to measure something, we can't use science. Consider the following questions:

Is there a soul?

Is there an afterlife?

Is there a creator?

These questions may be very important, but because science relies on empiricism, we can't investigate these topics until we have the appropriate measures to do so. Until then, we have only reason, so we leave these topics for philosophers and theologians to explore.

CONCEPTUAL EXERCISE 1A

Consider each of the following beliefs. By what process do you think it is likely the believer acquired the belief?

1. Too many cooks spoil the broth.
2. Boys will be boys.
3. Politicians are corrupt.
4. Capital punishment is immoral.
5. Pedophiles can rarely be rehabilitated.

Psychology—Science and Art

Psychology is both a science and an art. The psychologist as scientist might conduct research to determine how best to ask questions of people to encourage sincere dialogue. The psychologist as artist might use that information to help troubled teens in therapy. The science provides the theory; the art of psychology might involve applying that theory in skillful ways to help others.

Critical Thinking

Critical thinking is the ability and willingness to assess claims and make objective judgments on the basis of well-supported evidence. Critical thinking skills can be applied to any topic or problem.

Critical thinkers do the following:

- Ask questions
- Objectively define problems
- Examine the available evidence
- Assess assumptions and biases
- Avoid emotional reasoning
- Separate facts from opinion
- Avoid oversimplifying
- Consider alternative explanations
- Tolerate uncertainty
- Maintain an air of skepticism but remain open-minded (i.e., not cynical)

Critical thinking is particularly relevant to psychology. Thought and thinking are important areas of study in psychology. Cognitive psychologists in particular study problem solving, concept formation, creativity, and other mental processes we would call thinking. Moreover, thinking is a topic that interests everybody. We all want to know more about thinking processes. Researchers in psychology generate many competing findings on topics that we find personally interesting or relevant. The general public's fascination with popular psychology has created a huge market for pseudoscientists and quacks. As a result, students of psychology must be particularly prudent when it comes to evaluating claims and beliefs. And critical thinking skills help us do that.

Critical thinking skills help us recognize different types of evidence and the kinds of conclusions we can draw from each. For example, limited personal experience and anecdotal evidence are not reliable sources of knowledge. A pervasive habit of many people is to form beliefs on the basis of limited experience. We sometimes call this the *n* of one fallacy. An acquaintance of ours, who should know better, believes in ghosts. Why? Because his father claimed to have seen one. One anecdote was enough

for our friend to hold a belief. Limited conclusions can be drawn from such anecdotal evidence.

The popular press is designed to be popular and often dramatizes or overgeneralizes research findings. Critical thinkers are aware that the popular press is a biased source of information. A critical thinker will view a single report linking urine drinking and improved health with skepticism. A critical thinker will not rely on a newspaper writer's assessment of research (or even the researcher's assessment) but will assess the research for himself or herself.

FYI

Do not confuse skepticism with cynicism. **Skepticism** is a healthy reluctance to accept new information without sufficient evidence, but cynicism is a scornful, negative attitude toward new ideas. A skeptic wants to see the evidence. A cynic is not interested in the evidence; he or she has already decided to not accept the new information.

The Critical Thinking Process

1. **Ask questions:** What makes people happy?
2. **Define the problem:** What does *happy* mean? How will you know whether someone is or is not happy?
3. **Examine the available evidence:** Accepting a conclusion without evidence is not critical thinking.
4. **Analyze assumptions and biases:** Consider an advertiser who claims that medical doctors prefer her pain reliever. The conclusion she wants you to draw is that doctors prefer her pain reliever because it is a better product. But neither does she say that, nor is it likely to be true. Perhaps doctors prefer it because it is cheaper than other pain relievers. What if the advertiser says that no other pain reliever relieves pain better than hers? What does this really mean? It may mean that her pain reliever is as effective as every other pain reliever on the market. Again, remember the adage *Consider the source.* The advertiser has an interest in persuading you that her product is better, doesn't she?
5. **Avoid emotional reasoning:** Feelings alone are not reliable guides to truth. Set feelings aside as you consider the evidence. Your feeling that something is true does not make it so.
6. **Do not oversimplify:** One dishonest used-car salesperson does not mean that all used-car salespeople are dishonest—at least we do not think so!

7. **Consider other interpretations:** In general, a critical thinker accepts the interpretation that accounts for the most evidence with the least number of assumptions. Consider the claim that interpersonal attraction occurs when the planets are aligned. This interpretation requires many assumptions about the nature of the relationship between planetary alignment and human behavior. A better interpretation of attraction might be that people like people who are similar to them.
8. **Tolerate uncertainty:** Psychologists know that there may be no good answer. A critical thinker knows this and is willing to accept this uncomfortable situation.

Consider a claim that we have heard many times:

- "Eating raw oysters increases libido."

First, let's consider the possible sources of this popular belief. Perhaps someone in authority claimed that oysters increase libido. Perhaps this belief has been accepted for so long that it has become part of a general belief system (tradition). Perhaps we have had personal experience with eating oysters and the consequences thereof. Perhaps. But we think it is highly unlikely that this belief has come about as a result of scientific inquiry.

So let's analyze this claim as a critical thinker might.

1. **Ask the question:** Does eating raw oysters improve libido?
2. **Define the problem:** How many raw oysters must we eat? How do we measure improved libido?
3. **Examine the available evidence:** Is there any scientific empirical evidence about oysters and libido?
4. **Analyze assumptions and biases:** Did the claim originate from oyster farmers?
5. **Avoid emotional reasoning:** Set aside our feelings about oysters.
6. **Don't oversimplify:** Did we have one experience with increased libido after eating some oysters?
7. **Consider other interpretations:** If we have found that there is evidence that libido increases after eating oysters, could there be another explanation for this? Perhaps we only have the opportunity to eat raw oysters at fancy restaurants with candlelight and romantic settings.

All good scientists practice critical thinking and base their scientific beliefs primarily on empirical evidence. Let's now turn to the goals or objectives of science.

Objectives of Science

The **goals of science** are to describe, explain, predict, and control some event(s). A young science first must describe its subject matter. This is the first step, and empiricism is the primary method of doing this. A mature science may be busier with prediction and control. Early astronomers, for example, spent their time describing what they observed in the skies. Only later, when a body of empirical evidence had been gathered, could they begin to explain how planets, stars, and other cosmic entities were formed, interacted, and died.

To Describe

Description of its subject matter is the first objective of a science. The subject matter of psychology is human behavior and mental processes. Describing general laws of human behavior is the work of many researchers in psychology today. Sometimes animal models are used to study human behavior. For example, Frank Epling (deceased) and David Pierce of the University of Alberta have spent several years studying anorexia nervosa in laboratory rats. They have described the phenomenon quite clearly. Rats will develop anorexia if they are given access to a running wheel and if they are given an adequate amount of food for a specific period of time each day. The rats will, over time, spend excessive amounts of time running and will eat less and less, even when adequate food is available, but only when that food is offered for a limited time each day. Are rats the same as humans? Of course not, but this kind of research may offer some insights into similar processes in humans.

To Explain

Once we have described the general laws of our subject matter, we then proceed to try to explain those trends. Epling and Pierce postulated that excessive exercise prompts the body to produce a lot of beta endorphins, which suppress appetite and cause feelings of well-being, sometimes called the *runner's high*. This, then, was their *explanation* for why rats become anorectic under their laboratory conditions. This may not help us explain the problem with humans; humans suffering from anorexia and bulimia have lower levels of beta endorphins.

To Predict

Once a behavior has been well described and an explanation has been offered, the next step is often to make *predictions* from the explanation. If the predictions are not confirmed, the explanation is considered faulty and must be revised. A prediction that might be made from Epling and Pierce's explanation for the development of anorexia in rats would be that people with anorexia engage in excessive exercise. Epling and Pierce found that excessive physical exercise in anorectic patients was reported quite often and was thought by professionals to be a side effect of the disorder (Epling & Pierce, 1992). Another interesting prediction Epling and Pierce made was that people in some professions would be more likely than others to become anorectic. For example, according to their model, ballet dancers (who are required to be very active)

should be more likely to develop anorexia than models. Both groups must control their weight to be successful, but only ballet dancers must also be active. Epling and Pierce (1992) report that the available data support this prediction.

To Control

Once a science has described, explained, and made predictions about its subject matter, *control* of the phenomena can be attempted. Applied psychology has a mandate to take the principles of behavior demonstrated by researchers and use them to help with problems people have. For example, a useful control application based on Epling and Pierce's work might be to treat people with anorexia by reducing the amount of exercise they are getting, rather than trying to change their eating habits.

We have seen that scientists are critical thinkers, their beliefs are founded on empirical evidence, and their goals in doing their science are to describe, explain, predict, and control the subject matter of the discipline. Science, therefore, is a way of thinking and a way of doing things. Scientists view the world differently than many nonscientists do. The process of scientific inquiry involves certain assumed principles or tenets about how the world works.

The Tenets of Science

The scientific approach to discovering truth assumes several fundamental principles about how the world works and demands that certain criteria be met. Some people misunderstand some of these tenets of science. Perhaps the most misunderstood is the doctrine of determinism.

Determinism

Determinism is a doctrine of belief that events have natural causes. For psychologists, the events we are interested in are behaviors of humans. When we apply this doctrine to psychology, then, we assume that human behavior is determined or caused by natural phenomena, not supernatural events. In other words, we believe that behavior is neither random nor under the control of nonnatural events. Many people confuse this doctrine with another, *predeterminism*. They are not the same. To say that behavior is determined by natural events is *not* to say that our behavior is somehow predetermined or predestined. Some religious approaches do have a predeterministic bent, but psychology does not.

To say that human behavior is determined is to say that humans behave for reasons that can be understood in terms of natural laws of the universe. We may not know what those laws are in any particular case, but we assume that those laws are operating nonetheless.

Empiricism

Scientists, including psychologists, rely on real evidence, *empirical data*, to confirm or refute claims. Intuition, faith, and even logic are not enough. There must be empirical support before a scientist will accept a claim.

Replicability

Scientists require that findings be replicable before they are accepted. A single finding may be just a fluke and not reliable. This is of particular importance in psychology because our subject matter, human behavior, is so variable. Behavior varies among people in the same or similar situations. Indeed, the behavior of one person varies even in what appear to be identical conditions.

Falsifiability

For scientists, hypotheses and theories must be **falsifiable** through empirical research. They must be testable such that they could be shown to be false. Some theories are just not refutable. Consider Freud's theory about repression. The assumption is that psychological problems of adults are rooted in childhood trauma. Is this hypothesis falsifiable? We don't think so. If an adult can recall and describe a childhood trauma, the Freudian will conclude that his or her current problems developed because of the trauma. If an adult cannot recall any trauma, the Freudian concludes that he or she has repressed the events into his or her unconscious mind. This hypothesis cannot be proven wrong. This hypothesis, like much of Freud's theory, is pseudoscience. Consider another example of pseudoscience. A psychic who is brought into a laboratory and asked to demonstrate his powers in a controlled setting and who cannot do so claims that the air of skepticism of the researchers is responsible for interfering with the *psychic forces*. The psychic wins either way. His powers are proven when he demonstrates evidence of psychic ability. His powers, however, are not disproved when he does not.

Parsimony

A scientist looks for the simplest explanation for a phenomenon. **Parsimony** means the quality of being sparing or frugal. If two explanations account for similar amounts of data but one explanation requires fewer assumptions, the scientist will favor that explanation. This is not to say that the explanation will be simple. There is nothing simple about the molecular events underlying synaptic transmission or the many factors that might cause a new parolee to reoffend. Parsimony means that few assumptions are made; instead, our explanation must be based on scientific evidence. In general, the scientist looks for the explanation that accounts for the most data with the fewest assumptions.

We have discussed the tenets of science, but what makes a science a science? You may have heard the terms *hard* and *soft* science. These terms, which we disapprove of, classify science by its subject matter. Chemistry is considered by some to be a hard science and psychology a soft science. Some people claim that chemistry is a more rigorous science than psychology. Why do they claim this? We think it lies in the variability of the behavior of the subject matter, not in the rigor of the method used. Molecules are less variable in behavior than humans are, but chemistry outside the laboratory can be just as variable as psychology. A discipline is a science if the **scientific method** is the primary method used in the research process.

CONCEPTUAL EXERCISE 1B

1. John is a volunteer at a local emergency room (ER). The medical personnel tell John that on nights when there is a full moon, there are many more shooting and knifing cases in the ER. The workers believe that the moon is the cause. John keeps records and finds that, indeed, on full-moon nights, there are many more of these cases that come into the ER than on nights with no full moon. He contacts other ERs and finds that they too report many more of these cases on those nights. He concludes that the full moon has powers that increase criminality in people. What tenet of science has John failed to follow?
2. A student conducted a survey on the Internet to measure attitudes about funding of animal research. She found that people are opposed to the use of animals in research on cosmetic products. Another student used an interview method and learned that her sample had no such opposition to the use of animals in cosmetic testing. What tenet of science is the problem here?
3. Mary, a social worker, has observed that evil people do evil things and good people do good things. She has seen many examples of this in her practice, and her colleagues report that they have, too. When a person does evil, Mary claims it is the evil within him or her that caused this behavior. Likewise, good behavior is evidence of goodness. What tenet of science has Mary ignored?

The Scientific Method

The method of science involves logical steps toward finding truth. The steps are as follows:

1. Assume a natural cause for the phenomenon (i.e., determinism)
2. Make an educated guess about the cause (i.e., generate a testable hypothesis)
3. Test your guess
4. Revise your hypothesis
5. Retest your guess
6. Make a conclusion

Consider a psychology student who lives in a small town in southern Alabama. She has noticed that people of the town often visit a recluse who lives outside of town when they have aches and pains. The townspeople believe that the recluse is a witch who has supernatural healing powers. Our psychology student decides to apply the

scientific method to assess the beliefs of the townspeople. (This example is a variation on one given by Willie Runquist, the PhD supervisor of Annabel Evans.)

Step 1. She assumes that there is a natural explanation for her observation that the townspeople do appear to feel better after they visit the witch.

Step 2. She has noticed that the witch always gives the townspeople a potion to drink when they visit, and she assumes that the potion contains something medicinal. She has discovered that the potion contains eye of newt, desiccated bat wings, and ground poppy seeds. She decides that the eye of newt might be the active medicinal ingredient.

Step 3. She finds a way to substitute an inert substance for the witch's supply of eye of newt. For the next week, she observes the effects of the potion on the visitors. She finds that they report that they feel better as often as they did before she made the substitution.

Step 4. She revises her hypothesis and systematically replaces the bat wing ingredient and the poppy seed ingredient.

Step 5. She observes that the townspeople no longer report that they feel better after visiting the witch when the poppy seeds have been replaced.

Step 6. She concludes that poppy seeds have a medicinal quality that promotes feelings of well-being.

Theories, Concepts, and Hypotheses

The objectives of science can be seen in theories. We use theories to describe what is known in an area, present an explanation of those findings, and make predictions for further research. A *theory* is a formal statement of how concepts are related. **Concepts** are the general category of ideas that are represented by our variables. Theories may be very general and account for many phenomena, such as Skinner's behavioral theory, with applications to all of human behavior, or more specific and limited in scope, such as Epling and Pierce's theory of activity-based anorexia.

If we were all-knowing, we would not need theories. We would know how the universe worked, and research would be predictable and boring. Fortunately for those of us who enjoy research, we do not have all the answers, so we construct theories of how we think the world works. The main advantage of a theory is that it provides an explanation of how concepts are related. So rather than having to remember a whole library of specific research findings, we need only to remember and apply the theory. The theory will describe how general concepts are related.

Theories are an integral part of the research process. In addition to explaining what we already know, we use theories to make new predictions that can be empirically tested. By using specific instances of the general concepts, we can derive new testable hypotheses. A **hypothesis** is a prediction of how concepts are related that is

often deduced from a theory. We then conduct our research to test the hypothesis. If the hypothesis is supported by the research, the theory is strengthened. On the other hand, if the hypothesis is not supported, the theory may have to be altered. Theories do not live forever. They start out wonderfully, explaining and organizing a whole collection of observations. Over their life, they gain support from some research, they may make surprising new predictions, and they may fail to explain some research findings. When enough research is compiled that does not fit the theory, a new theory will be proposed.

So what is the nature of empirical research? Where do scientists get their ideas, and how do they go about meeting their goals to describe, explain, predict, and control phenomena? Let's look at five common reasons researchers might have for conducting research.

Why We Do Research

To Evaluate a Theory

In psychology, theories abound. Theories, if they are good theories, generate testable hypotheses. Good theories allow us to test the hypotheses derived from them. Bad theories often do not. In fact, one criterion of a good theory is whether testable hypotheses can be postulated. A great deal of research in psychology is conducted to evaluate current theories about human behavior. In a classic article, Darley and Latane (1968) offered a theory about why the many people who could hear, from their apartments, a young woman being attacked outside did nothing to help her. They postulated that the responsibility to be good citizens was diffused among the many people, and as a result, no one person felt compelled to help. One hypothesis that can be derived from this theory (called the *bystander effect*) is that the greater the number of people present, the less likely any one person is to help someone in distress. And, indeed, this hypothesis has been confirmed in numerous experiments.

Let's look at another example. Developmental psychologists call the emotional bond between children and their primary caregivers *attachment*. But why does this happen? Behaviorists proposed that attachment develops because the primary caregiver, usually the mother, is associated with food, a strong positive reinforcer to hungry babies. Harlow and Harlow (1966) tested this theory in a classic set of studies. Their results did not support the behaviorists' claim. Contact comfort, not feeding, was shown to be the source of attachment, at least in rhesus monkeys.

Theories provide a wealth of ideas for research topics.

To Satisfy Our Curiosity

Science often develops because scientists are very curious people. We have heard it said that you could get rid of warts by visiting a graveyard around midnight. We will not provide all the details of this activity, but chasing away evil spirits, and presumably your wart, by tossing a cat is involved (see *The Adventures of Tom Sawyer*). Spanos, Williams, and Gwynn (1990) were curious about the idea that you can rid yourself of

warts by nonmedical means; they decided to investigate whether you could get rid of warts through hypnosis. They conducted a controlled experiment in the laboratory and found support for the hypothesis. They published their results in a scientific journal. But they were more than a little embarrassed when their study made the cover of *The National Enquirer*—not exactly something you want to brag about at your university!

To Demonstrate a New Technique

As we learn new ways to do things, it is important to determine if those new ways are better than the old ways. Professors are always interested in better ways of teaching. Textbooks these days come with all sorts of fancy supplementary materials. But do they improve learning? At our school, we conducted an experiment to try to answer that question. Different groups of students taking introductory psychology received instruction with various technological accompaniments. Some received traditional lecture instruction. Some received computer-assisted instruction. We measured several variables, including performance and more psychological variables. Are you wondering what we found? Well, very simply, the students with added technology did not learn more, but they had more fun!

To Demonstrate a Behavioral Phenomenon

After observing behavior that tends to recur under certain circumstances, we need to demonstrate it under precise conditions before the phenomenon can be confidently added to the body of knowledge about a discipline. The idea that organisms do things because they receive rewards was known for a long time before Skinner demonstrated this in his laboratory. Indeed, Skinner's career was spent demonstrating the behavioral phenomena of operant conditioning.

Perhaps you have noticed that when you are out walking your dog, people seem a lot friendlier than when you are out walking alone. You could design a simple experiment to see if your perception that people are friendlier is a demonstrable phenomenon. You could take the same walk at the same time each day for several weeks, sometimes with your dog and sometimes without. You might collect data on how many people engage you in conversation and how long they talk to you, for example. If you find that when your dog is with you, more people initiate conversation more often, you have evidence of a behavioral phenomenon.

To Investigate the Conditions Influencing Behavioral Phenomena

Darley and Latane's (1968) bystander effect has been the focus of numerous experiments. Researchers have studied not only the influence of the number of bystanders on helping behavior but also many other factors, such as the apparent degree of need of the victim and the bystanders' ability to help. Skinner and others have investigated how the size, frequency, and quality of a reward (reinforcer) affect behavior, as well as many other conditions affecting operant behavior.

We have discussed some of the reasons why researchers do what they do. Now let's discuss the various ways they go about doing what they do.

Approaches to Research

Over many years of schooling, students are trained to be convergent thinkers, to converge on the one correct answer. But research requires divergent thinking. It is a creative endeavor with many approaches. Here we summarize the diversity of research by organizing various approaches on a number of typical continua you have probably come across in your undergraduate career.

Descriptive Versus Explanatory Research

Descriptive research involves describing a population of measurements. Usually, inferences are made from a representative **sample** to a **population**, except in the case of censuses, in which entire populations are measured. This is the type of research we see in the media from polling agencies, and the primary interest is in describing how the population thinks. Descriptive research has applications in business, where it is used to understand the consumer, and in social services, where you need to understand the needs of your community.

The focus of **explanatory research** is to answer "why" questions. For example, you may find that there are more women than men in your psychology program. That finding alone is a description, but you may want to know why there are more women than men. In explanatory research, you are interested in explaining why there is a gender difference. You are trying to account for the difference. The simplest explanation would be that there are just more women in the university. You could test this by comparing the gender ratio in psychology with the gender ratio in other disciplines. In this case, you are investigating a relationship between gender and university discipline. Finding a difference may lead to an explanation of why there are more women than men in your psychology program.

Often research may contain aspects that are both descriptive and explanatory. For example, researchers studying drug use in schools may want to describe the prevalence of drug use and also try to account for why some students take drugs and others do not.

Quantitative Versus Qualitative Research

In essence, **quantitative research** in psychology measures differences in the *amount* of behavior. What causes people to become *more* or *less* aggressive? What factors *increase* or *decrease* interpersonal attraction? Does a particular treatment *reduce* symptoms of depression? Do children diagnosed with autism engage in *less* play behavior than children not diagnosed with autism? In other words, we are measuring the quantity of a behavior, often because we wonder what causes the behavior to increase or decrease in quantity.

Qualitative research in psychology, on the other hand, describes differences in the *kind* or *quality* of behavior. What does aggressive behavior *look like* compared with nonaggressive behavior? What is *the nature* of interpersonal attraction? What do depressed people *think* or *say about themselves*? What *kinds* of play behavior are typical of children diagnosed with autism? It is the nature or quality of the behavior that interests the qualitative researcher.

Quantitative research always involves numbers that reflect the amount of behavior. Qualitative research often involves narrative descriptions of what behavior looks like. A tally of how many self-harm behaviors Susie exhibits in a day would be quantitative data. A description of the nature of those self-harm behaviors would be qualitative data.

Basic Versus Applied Research

The distinction between **basic or pure research** and **applied research** is best made by examining the motives of the researchers. In basic research, the researcher may have no application in mind but is interested in answering a question simply to satisfy his or her curiosity. In applied research, the researcher is looking at applying the knowledge to somehow benefit humankind.

Basic or pure research may seem esoteric and may leave people scratching their heads, wondering why this type of research should be funded. Particularly in times of fiscal restraint, should governments be funding research that is only going to increase our understanding of something but has no application in daily life? The answer, of course, is yes! Applied research typically involves the application of basic principles discovered by basic researchers. Without basic research, there is nothing to apply; both are important.

An example of applied research that is becoming more and more common is program evaluation. As the name implies, program evaluation involves the application of various research approaches to measure the effectiveness of a program. Not implied in the name is the importance of objective evaluation in the development of a program and its integration as an ongoing part of the program. This applied research is usually a requirement of any program supported by the government or developed by industry and is discussed in greater detail in Chapter 12.

Cross-Sectional Versus Longitudinal Research

Most research in psychology that looks at age differences is cross-sectional. A cross section of different ages is studied at one point in time. The goal is usually to understand developmental or maturational differences between the ages. A potential problem with this research is that there may be other variables that are confounded with age. This problem has been called the *cohort effect* because a cohort of same-aged individuals will share variables related to their history. Differences between age groups, then, are confounded with differences in history. Imagine that we asked 30-, 40-, and 70-year-olds about their attitudes about monogamy. If we found that 70-year-olds have much more liberal attitudes, could we conclude that this is a maturational effect?

Probably not. People who are in their 70s today spent their formative years during the 1960s, a very sexually free time in our history.

A solution is to study a single age cohort over a number of years. With longitudinal research, everyone has a similar history, but the research is going to take years! This raises problems of cost and the tracking of participants over time.

Field Versus Laboratory Research

The distinction between field and laboratory research highlights a difference of control. In the laboratory, researchers may have total control over most variables, whereas in the field, they may have difficulty controlling even a few. The control afforded by laboratory research makes it more likely that you will detect a treatment effect or a relationship between variables. But the artificiality of the laboratory may mean that your results do not generalize to the real world. On the other hand, there is nothing artificial about research in the field, but your lack of control of variables may mean that you do not obtain significant results. The decision to conduct research in the laboratory or in the field is a trade-off, then, among artificiality (high in the lab, low in the field), control over variables (high in the lab, low in the field), and generalizability (low in the lab, high in the field).

We have discussed why researchers do what they do and the general approaches taken by researchers in the social sciences. Regardless of the approach that a researcher takes, the process of planning and conducting research follows a logical series of steps.

Steps in Planning and Doing Research

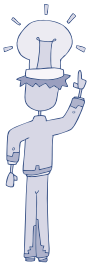
Most of you will be expected to conduct some sort of research project in your methods course. Here we will discuss how to start thinking about doing research.

Selecting a Research Topic

From Life Experience

Very often, some life event inspires a researcher. Many years ago, one of your authors met a man who could not remember anything he had just learned. She had to introduce herself to him every time she met with him because he could not remember ever having met her before. She found this to be such an interesting phenomenon that she decided, when she began her graduate training, that she would focus on human memory.

Have you noticed that people in elevators rarely make eye contact with you? Have you ever found yourself trapped on the phone by a telemarketer, unable to just hang up? These kinds of personal experiences are a great source of research ideas. As psychology students know, Pavlov did not set out to discover the basic laws of classical conditioning. He was not even interested in psychology. But he noticed something odd in the behavior of his dogs when doing research on digestion. This personal experience led him to begin investigation into an entirely new area.



CONCEPTUAL EXERCISE 1C

1. A researcher has participants rate their mood on a scale after viewing different color combinations. She wonders how color combinations make people feel. How would you classify this research?
   - Descriptive or explanatory?
   - Quantitative or qualitative?
   - Basic or applied?
2. A clinical psychologist, after reading the research on color and mood, decides to conduct his therapy sessions in two rooms, one painted in warm colors that tend to be calming, and one painted in colors that have no effect on mood. He hopes that his clients will be more forthcoming in the warm room. How would you classify this research?
   - Descriptive or explanatory?
   - Basic or applied?
   - Laboratory or field?
3. A developmental psychologist compares the risky decision making of preteens and teens. How would you classify this research?
   - Descriptive or explanatory?
   - Cross-sectional or longitudinal?

From Existing Research

Students planning a research project must read the existing literature in the area. After all, you don't want to reinvent the wheel! Once you have an idea about the general area you are interested in, you should read what has been found already. No doubt, as you read the research, you will think of potentially interesting variables, populations, or methods that have not been investigated. The existing research is a great source of ideas for research topics. Understanding empirical research articles can be challenging if you are not already familiar with the topic, but the next chapter (Chapter 2) will provide help. There we will give you an overview of the parts of a research article and describe, at a conceptual level, the most common statistical analyses you will likely read about.

Common Sense

Psychology, more than other sciences, yields research topics based on common sense or folk wisdom. Earlier, we talked about commonsense folk wisdoms such as *Absence makes the heart grow fonder* and *Out of sight, out of mind*. Research topics can be generated from common sense, and, indeed, a lot of research has been done to test the veracity of folk wisdom.

A New Technology

New technology can be a source of research topics. MRI (magnetic resonance imaging), for example, has allowed researchers to investigate what is going on in the brain during

various activities. This kind of research was not possible before the development of the technology. The Internet is an obvious example of new technology that has allowed researchers to collect data that they could not easily have collected previously.

In psychology, interesting research topics are all around us. "Why do people do what they do?" is a question we have all asked ourselves. No matter what has inspired your research question, at some point you will need to think about hypotheses that you can test.

Generating Testable Hypotheses

To generate testable hypotheses, you must *operationalize* your concepts. An **operational definition** is a description of how a concept will be measured. We talked a bit about the Harlows' research earlier. One of their research questions was "Is contact comfort a source of attachment in monkeys?" How did they make the concepts *contact comfort* and *attachment* measurable? Read on.

They created what they called a surrogate "mother monkey" made of wire and a second made of soft fabric. In essence, their operational definition of *high-contact comfort* was the soft, cuddly "mother," and their operational definition of *low-contact comfort* was the cold wire "mother." *Attachment* was operationalized as the "mother" the infant clung to when stressed.

Students often ask us how they can tell whether an operational definition is a good one or not. This is an excellent question. Just because one researcher has an operational definition of a concept does not guarantee that it is a good operational definition. We usually advise students to read the literature in the area and see what most researchers tend to do, check whether measures of reliability and validity have been taken, and go from there.

Once you have defined your research topic and generated testable hypotheses, you then must determine which variables you are going to manipulate, which variables you will control, and which variables you will measure.

Classifying Variables

Research in psychology involves various kinds of variables. There are variables you want to manipulate (independent variables) to see if they affect other variables that you measure (dependent variables). Then there are variables you want to control (control variables). Researchers must determine how they will define these variables so that they can be measured and controlled. The Harlows, as we discussed earlier, in one experiment, manipulated the contact comfort of the surrogate mother monkey—this was an independent variable (high- and low-contact comfort). The attachment behavior of the infant (i.e., which surrogate the infant clung to when stressed) was the dependent variable. The size of the surrogate mother, the type of event that produced stress, and the size of the cage were control variables in that they were constant. Researchers have to consider the potentially important variables when they decide how to test their hypotheses.

You have your hypothesis, and you have decided what variables you will measure and control. Now you must select the research design.

Selecting an Appropriate Design

Selecting an appropriate design is a complex task. You will need to consider all sorts of things as you make this decision. Practical factors, such as time, money, and facilities; the nature of your research question; and the kinds of variables you intend to measure must be taken into account when you select a design. The research design often dictates the analysis. You must think about how the data can be analyzed, given your measures and design. You do not want to find yourself in a position of having collected data that cannot be analyzed the way you intended.

Once the research design has been selected, you need to figure out how to carry it out.

Planning the Method and Carrying It Out

The method should be carefully planned in advance. How will you select your participants? Where and when will you gather your data? How many participants will you need? What are the ethical considerations of your research? Who is responsible for reviewing the ethics of your research? Although the method should be planned in advance, you will need to allow for adjustments if something does not go as you expected. Perhaps you discover that your first couple of participants misinterpreted an instruction. How will you deal with that?

The data have been collected. Now what?

Analyzing Results

The design and the nature of the measures you took will determine the appropriate analysis. In Chapter 13, we will cover the statistical analyses that students are most likely to need for their research projects. Once the data have been analyzed, it is time to interpret the findings and draw conclusions.

Drawing Conclusions

The next step of the research endeavor is to interpret the results and draw conclusions. This is not easy. Researchers must be careful not to go too far from their results. There is a fine line between justifiable conclusions and wild speculation. Your conclusions must include a discussion of how your results fit into the literature. How do your results support the conclusions of other researchers, and how do they disagree with others' findings? Do they support one theory but not another?

Sharing Your Findings

Of course, researchers do not keep their findings to themselves. Communicating with others is an important part of the research process. Researchers share their work primarily by publishing in journals and presenting their work at conferences. In this way, the research community remains up to date about what is going on in the field. In Chapter 14, we will discuss this important part of the research endeavor.

In the preceding sections, we have tried to give you some idea about how psychologists go about doing research and some tips to help you as a student plan a research project. Our intention was to orient you to a way of thinking before you begin your methods course in depth. Keep these ideas in mind as you study the rest of this book.

Chapter Summary

Our knowledge of the world comes from many sources. Believing that something is true because it has always been that way is a belief based on *tradition*. Believing that something is true because an "expert" said so is a belief based on *authority*. Believing that something is true because it feels true is a belief based on *intuition*. Tradition, authority, and intuition are flawed sources of knowledge. Knowledge gained through personal experience can be very powerful for the individual, but it is not objective. *Reasoning* (i.e., beliefs based on *rational thought*) and *empiricism* (i.e., beliefs based on measured observations) are better sources of knowledge.

Acquiring knowledge via interaction between empiricism and logic is the way of science. Scientists are critical thinkers and apply critical thinking skills in their research. *Critical thinking* is a process involving objectivity and unemotional examination of the available evidence. Alternative explanations are considered, uncertainty is tolerated, and *skepticism* is maintained.

The *goals of science* include description, explanation, prediction, and control.

Scientists assume that events in the world have natural causes (*determinism*). Scientists are empiricists; they rely on real observations to assess claims. Scientific findings must be replicated before they are incorporated into the body of knowledge. Hypotheses derived from scientific theory must be refutable through empirical research (*falsifiability*), and scientific explanations should require few assumptions (*parsimony*).

Science is defined by its method of hypothesis testing in the search for truth. A theory formally states how *concepts* (ideas) are related. *Theory building* yields *hypotheses*, which are tested, revised, and retested. This is the *scientific method*.

Researchers conduct their studies to evaluate theories, to satisfy their curiosity, to demonstrate a new technique or behavioral phenomenon, or to investigate the factors that influence behavioral phenomena.

A researcher's goal may be to describe a *population* by measuring the entire population or by inferring the nature of the population from a representative *sample* (*descriptive research*), or the goal may be to explain relationships (*explanatory research*). *Quantitative* researchers in psychology are interested in differences in the amount of behavior, whereas *qualitative* researchers are interested in differences in the kind or quality of behavior. *Basic* or *pure research* is conducted to increase the body of knowledge of the discipline; *applied* researchers use that knowledge to improve things in the world. Researchers interested in age differences may study people of different ages (*cross-sectional research*) or may study the same people at different stages in their lives (*longitudinal research*). Laboratory research allows better control over variables, but field research allows a more natural setting for the behavior.

Planning research involves several steps, including selecting a research topic from theory, previous research, experience, or common sense; generating testable hypotheses using *operational definitions* of concepts; classifying variables; selecting the design; carefully considering the ethics; carrying out the research; analyzing the results; and drawing conclusions.

CHAPTER RESOURCES

Answers to Conceptual Exercises

Note: There may be other good answers to some of the conceptual exercises. If your answer differs from ours, do not assume that it is necessarily wrong. Consult with your instructor.

Conceptual Exercise 1A

1. Although some people may have experienced this, this belief, like all truisms, comes from tradition.
2. As in the first example, this belief is primarily traditional.
3. This belief may have several sources, including tradition and authority.
4. This belief is best described as an intuitive belief based in religion, perhaps.
5. Some people may have acquired this belief from authority. For others, this belief comes from personal experience and, for some, from science.

Conceptual Exercise 1B

1. John has failed to follow the tenet of determinism. He should have assumed a natural cause for the phenomenon. It is likely that on nights when the moon is full, there is more crime committed because there is more light to conduct crime by! This explanation is a deterministic one, a tenet of science.
2. This finding lacks replicability.
3. This example demonstrates a lack of falsifiability. The hypothesis is not refutable.

Conceptual Exercise 1C

1. This example is descriptive of how people feel when they look at different colors. It is quantitative; she is collecting ratings. This is basic research. No application has been discussed.
2. This is descriptive. The therapist has not tried to explain why color affects mood. It is applied because he is using the finding to help in therapy. It is field research conducted in the natural therapy setting.
3. This is descriptive and cross-sectional.

FAQ

Q1: Dr. Linus Pauling was the only person to have won two unshared Nobel Prizes; he lived to age 93 and wrote a book about vitamin C and the common cold. If he thinks that taking vitamins makes you healthier, it must be true. Right?

A1: Wrong! Although Pauling may have been an authority, science requires replicated research before a finding is accepted, and so far, the research in this area has produced mixed results. This does not mean that we should be cynical; amazing discoveries are made all the time. But we should remain skeptical until there is consensus in the literature.

Q2: I believe in auras because I have experienced them. Isn't that empiricism?

A2: Although we cannot argue with your experiences, this is not scientific evidence. In science, the evidence must be based on observations that can be independently verified. This is not possible with your experiences.

Q3: What is wrong with understanding the world through logical reasoning?

A3: Nothing, as long as there are no errors in your reasoning. Indeed, this is how new predictions are formulated from theories. But science also requires an empirical test of logically derived statements.

Q4: The assumption of determinism holds that events have natural causes. Isn't it also possible that there are forces of nature that we are not aware of?

A4: Indeed, before the discovery of atomic particles, nuclear forces were unimagined. Yes, there certainly could be forces that are unknown to us, but that does not mean that we can use them to explain events. Until we have established that they exist, they cannot be used in scientific explanations.

Q5: What is this idea of falsifiability; don't we want to prove things in science?

A5: Yes, we do want to find evidence to support our theory, but a theory may only approximate the truth. We are interested in discovering the limits of a theory. Where does the theory break down and not account for our findings? That is, what motivates us to alter a theory or construct a new theory? Often, research involves pitting two theories against one another, each making a different prediction of outcomes. Science moves ahead when we test our theories, and that requires predictions that are falsifiable.

Q6: Is a research hypothesis just a guess of how things will turn out?

A6: A research hypothesis is not just a guess; it is an educated guess. The distinction is important because a hypothesis is a prediction based on a theory, which in turn is based on empirical research. It is a guess based on the scientific literature.

Q7: Which is better, quantitative or qualitative research?

A7: We think the best answer to this is that it is not a contest. Our bias is toward quantitative

(Continued)

(Continued)

methods, but we see more and more qualitative research being published. Each approach has its place.

Q8: I'm still not clear on the cohort effect. Can you give another example?

A8: The cohort effect is a problem where age differences are confounded with history. For example, suppose you wanted to look at age differences in people's view of war. You may find that older people have very different views from younger people. This may be an age effect, but it may also reflect the fact that older people have survived World War II or other conflicts and that may have shaped their views. The difference may be the shared experience of the cohort and not an age effect.

Q9: Is it OK to select a research topic based on something you saw on TV?

A9: Absolutely! The most important factor in selecting a research topic is your interest. Researchers are usually motivated by a genuine interest in the topic. Of course, you need to read the scientific literature to get a better understanding of what has been done in the area and what is known about the topic. We provide more information on selecting a research topic in the next chapter.

Chapter Exercises

1. For each of the following statements, indicate the likely source of the belief:
   a. Teenagers are hormonally challenged.
   b. Because all little boys like to play rough, my boy will like to play rough.
   c. Overexposure to sunlight causes skin cancer.
   d. The sun sets in the west.
   e. Men never ask for directions.
2. List and briefly describe the key elements of critical thinking.
3. For each of the following questions, identify the goal of the research (i.e., description, explanation, prediction, or control):
   a. What are violent criminals like?
   b. Is there a connection between children's diet and their school performance?
   c. Are violent criminals more likely than nonviolent criminals to have been abused as children?
   d. Can we develop programs to reduce the likelihood of criminal behavior in victims of child abuse?
4. List and briefly describe each tenet of science. Also include why these tenets are important.
5. List five questions that cannot be answered by science. For each question, discuss whether science ever could provide an answer and, if so, what would be needed.
6. Briefly, what is the difference between a theory and a hypothesis? Can you provide an example of each?
7. Are the following best described as descriptive or explanatory research questions? Why do you think so?

   a. What gambling strategies do men use?
   b. Is parenting style linked to self-esteem in adolescent children?

8. Are the following best described as qualitative or quantitative research questions? Why do you think so?
   a. What are the major themes of the dreams of clinically depressed individuals?
   b. Do clinically depressed people exhibit more negative self-talk than nondepressed people do?

9. Are the following best described as basic or applied research questions? Why do you think so?
   a. What learning styles do first-year psychology students use?
   b. Which learning style typically used by first-year psychology students is the most effective in performance outcomes?

10. Are the following best described as longitudinal or cross-sectional research questions? Why do you think so?
    a. Do people become more tolerant as they age?
    b. Are young people more tolerant than middle-aged people?

11. List one advantage of field research over laboratory research. List one advantage of laboratory research over field research.

Chapter Projects

1. Peruse the letters to the editor of your local newspaper. Identify a letter that describes a belief that you suspect is based on one of the sources of beliefs discussed in this chapter. Why do you think this is the case?
2. Obtain a copy of a popular magazine. Find an article of your choice that is based on opinion. Identify the sources of belief used by the author. Do you think the writer was a critical thinker? Explain your answer.
3. Select a major psychological theory. Generate three testable hypotheses.
4. Read a research paper in a scientific journal. Generate a testable hypothesis from the research.
5. In our introductory psychology classes, we often do the following demonstration: We ask for eight or so volunteers. Each student is given a coin. We turn our back to the students and instruct them to clench the fist holding the coin and place the fist next to their head. We then ask them to try sending thoughts to us about which hand is holding the coin. We hem and haw for a while. We then tell the students to drop the hand and hold out both fists in front of them. We quickly turn around and identify which hand is the one holding the coin. We are always accurate. The students are required to generate a scientific hypothesis for our ability to do this. Use the steps of the scientific method to plan a way to test your hypothesis. Try to find more than one hypothesis that could explain our "magical" ability, and identify how you could test each.

Ancillaries

SAGE edge provides a personalized approach to help students accomplish their coursework goals in an easy-to-use learning environment. The site includes **flashcards** for key term practice, **learning objectives** to reinforce key materials, along with **open access media** for concept exploration. Visit the site at **https://edge.sagepub.com/rooney4e**.