Sources of Knowledge

There are many ways to gain knowledge, and some are better than others. As social scientist, you must be aware of each of these methods. Let's look at several ways of acquiring knowledge, beginning with sources that may not be as reliable or accurate as scientists might desire. We will then consider sources that offer greater reliability and ultimately discuss using science as a means of gaining knowledge.

Superstition and Intuition

knowledge via superstition Knowledge that is based on subjective feelings, interpreting random events as nonrandom events, or believing in magical events.

Gaining **knowledge via superstition** means acquiring knowledge that is based on subjective feelings, interpreting random events as nonrandom events, or believing in magical events. For example, you may have heard someone say "Bad things happen in threes." Where does this idea come from? As far as I know, no study has ever documented that bad events occur in threes, yet people frequently say this and act as if they believe it. Some people believe that breaking a mirror brings 7 years of bad luck or that the number 13 is unlucky. Once again, these are examples of superstitious beliefs that are not based on observation or hypothesis testing. As such, they represent a means of gaining knowledge that is neither reliable nor valid.

knowledge via intuition Knowledge gained without being consciously aware of its source.

When we gain **knowledge via intuition,** it means that we have knowledge of something without being consciously aware of where the knowledge came from. You have probably heard people say things like "I don't know, it's just a gut feeling" or "I don't know, it just came to me, and I know it's true." These statements represent examples of intuition. Sometimes we intuit something based not on a "gut feeling" but on events we have observed. The problem is that the events may be misinterpreted and not representative of all events in that category. For example, many people believe that more babies are born during a full moon or that couples who have adopted a baby are more likely to conceive after the adoption. These are examples of *illusory correlation*—the perception of a relationship that does not exist. More babies are not born when the moon is full, nor are couples more likely to conceive after adopting (Gilovich, 1991). Instead, we are more likely to notice and pay attention to those couples who conceive after adopting, and not notice those who did not conceive after adopting.

Authority

When we accept what a respected or famous person tells us, we are gaining **knowledge via authority.** You may have gained much of your own knowledge through authority figures. As you were growing up, your parents provided you with information that, for the most part, you did not question, especially when you were very young. You believed that they knew what they were talking about, and thus you accepted the answers they gave you. You have probably also gained knowledge from teachers whom you viewed as authority figures, at times blindly accepting what they said as truth. Most people tend to accept information imparted by those they view as authority figures. Historically, authority figures have been a primary means of information. For example, in some time periods and cultures, the church and its leaders were responsible for providing much of the knowledge that individuals gained throughout the course of their lives.

knowledge via authority Knowledge gained from those viewed as authority figures.

Even today, many individuals gain much of their knowledge from authority figures. This may not be a problem if the perceived authority figure truly is an authority on the subject. However, problems may arise in situations where the perceived authority figure really is not knowledgeable about the material he or she is imparting. A good example is the information given in "infomercials." Celebrities are often used to deliver the message or a testimonial concerning a product. For example, Cindy Crawford may tell us about a makeup product, or Christie Brinkley may provide a testimonial regarding a piece of gym equipment. Does Cindy Crawford have a degree in dermatology? What does Christie Brinkley know about exercise physiology? These individuals may be experts on acting or modeling, but they are not authorities on the products they are advertising. Yet many individuals readily accept what they say.

In conclusion, accepting the word of an authority figure may be a reliable and valid means of gaining knowledge, but only if the individual is truly an authority on the subject. Thus, we need to question "authoritative" sources of knowledge and develop an attitude of skepticism so that we do not blindly accept whatever is presented to us.

Tenacity

Gaining **knowledge via tenacity** involves hearing a piece of information so often that you begin to believe it is true, and then, despite evidence to the contrary, you cling stubbornly to the belief. This method is often used in political campaigns, where a particular slogan is repeated so often that we begin to believe it. Advertisers also use the method of tenacity by repeating their slogan for a certain product over and over until people begin to associate the slogan with the product and believe that the product meets its claims. For example, the makers of Visine advertised for over 40 years that "It gets the red out," and, although Visine recently changed the slogan, most of us have heard the original so many times that we probably now believe it. The problem with gaining knowledge through tenacity is that we do not know whether the claims are true. As far as we know, the accuracy of such knowledge may not have been evaluated in any valid way.

knowledge via tenacity Knowledge gained from repeated ideas that are stubbornly clung to despite evidence to the contrary.

Rationalism

knowledge via rationalism Knowledge gained through logical reasoning.

Gaining **knowledge via rationalism** involves logical reasoning. With this approach, ideas are precisely stated and logical rules are applied to arrive at a logically sound conclusion. Rational ideas are often presented in the form of a syllogism. For example:

All humans are mortal;
I am a human;
Therefore, I am mortal.

This conclusion is logically derived from the major and minor premises in the syllogism. Consider, however, the following syllogism:

Attractive people are good;
Nellie is attractive;
Therefore, Nellie is good.

This syllogism should identify for you the problem with gaining knowledge by logic. Although the syllogism is logically sound, the content of both premises is not necessarily true. If the content of the premises were true, then the conclusion would be true in addition to being logically sound. However, if the content of either of the premises is false (as is the premise "Attractive people are good"), then the conclusion is logically valid but empirically false and therefore of no use to a scientist. Logic deals with only the form of the syllogism and not its content. Obviously, researchers are interested in both form and content.

Empiricism

knowledge via empiricism Knowledge gained through objective observations of organisms and events in the real world.

Knowledge via empiricism involves gaining knowledge through objective observation and the experiences of your senses. An individual who says "I believe nothing until I see it with my own eyes" is an empiricist. The empiricist gains knowledge by seeing, hearing, tasting, smelling, and touching. This method dates back to the age of Aristotle. Aristotle was an empiricist who made observations about the world in order to know it better. Plato, in contrast, preferred to theorize about the true nature of the world without gathering any data.

Empiricism alone is not enough, however. Empiricism represents a collection of facts. If, as scientists, we relied solely on empiricism, we would have nothing more than a long list of observations or facts. For these facts to be useful, we need to organize them, think about them, draw meaning from them, and use them to make predictions. In other words, we need to use rationalism together with empiricism to make sure that we are being logical about the observations that we make. As you will see, this is what science does.

Science

knowledge via science Knowledge gained through a combination of empirical methods and logical reasoning.

Gaining **knowledge via science,** then, involves a merger of rationalism and empiricism. Scientists collect data (make empirical observations) and test hypotheses with these data (assess them using rationalism). A

hypothesis is a prediction regarding the outcome of a study. This prediction concerns the potential relationship between at least two variables (a **variable** is an event or behavior that has at least two values). Hypotheses are stated in such a way that they are testable. By merging rationalism and empiricism, we have the advantage of using a logical argument based on observation. We may find that our hypothesis is not supported, and thus we have to reevaluate our position. On the other hand, our observations may support the hypothesis being tested.

In science, the goal of testing hypotheses is to arrive at or test a **theory**—an organized system of assumptions and principles that attempts to explain certain phenomena and how they are related. Theories help us to organize and explain the data gathered in research studies. In other words, theories allow us to develop a framework regarding the facts in a certain area. For example, Darwin's theory organizes and explains facts related to evolution. To develop his theory, Darwin tested many hypotheses. In addition to helping us organize and explain facts, theories help in producing new knowledge by steering researchers toward specific observations of the world.

Students are sometimes confused about the difference between a hypothesis and a theory. A *hypothesis* is a prediction regarding the outcome of a single study. Many hypotheses may be tested and several research studies conducted before a comprehensive theory on a topic is put forth. Once a *theory* is developed, it may aid in generating future hypotheses. In other words, researchers may have additional questions regarding the theory that help them to generate new hypotheses to test. If the results from these additional studies further support the theory, we are likely to have greater confidence in the theory. However, further research can also expose weaknesses in a theory that may lead to future revisions of the theory.

hypothesis A prediction regarding the outcome of a study involving the potential relationship between at least two variables.

variable An event or behavior that has at least two values.

theory An organized system of assumptions and principles that attempts to explain certain phenomena and how they are related.

Sources of Knowledge — IN REVIEW

SOURCE	DESCRIPTION	ADVANTAGES/DISADVANTAGES
Superstition	Gaining knowledge through subjective feelings, interpreting random events as nonrandom events, or believing in magical events	Not empirical or logical
Intuition	Gaining knowledge without being consciously aware of where the knowledge came from	Not empirical or logical
Authority	Gaining knowledge from those viewed as authority figures	Not empirical or logical; authority figure may not be an expert in the area
Tenacity	Gaining knowledge by clinging stubbornly to repeated ideas, despite evidence to the contrary	Not empirical or logical
Rationalism	Gaining knowledge through logical reasoning	Logical but not empirical
Empiricism	Gaining knowledge through observations of organisms and events in the real world	Empirical but not necessarily logical or systematic
Science	Gaining knowledge through empirical methods and logical reasoning	The only acceptable way for researchers/scientists to gain knowledge

CRITICAL THINKING CHECK 1.1

Identify the source of knowledge in each of the following examples:

1. A celebrity is endorsing a new diet program, noting that she lost weight on the program and so will you.
2. Based on several observations that Pam has made, she feels sure that cell phone use does not adversely affect driving ability.
3. A friend tells you that she is not sure why but, because she has a feeling of dread, she thinks that you should not take the plane trip you were planning for next week.

The Scientific (Critical Thinking) Approach and Psychology

Now that we have briefly described what science is, let's discuss how this applies to the discipline of psychology. As mentioned earlier, many students believe that they are attracted to psychology because they think it is *not* a science. The error in their thinking is that they believe that subject matter alone defines what is and what is not science. Instead, what defines science is the manner in which something is studied. Science is a way of thinking about and observing events to achieve a deeper understanding of these events. Psychologists apply the scientific method to their study of human beings and other animals.

skeptic A person who questions the validity, authenticity, or truth of something purporting to be factual.

The scientific method involves invoking an attitude of skepticism. A **skeptic** is a person who questions the validity, authenticity, or truth of something purporting to be factual. In our society, being described as a skeptic is not typically thought of as a compliment. However, for a scientist, it is a compliment. It means that you do not blindly accept any new idea that comes along. Instead, the skeptic needs data to support an idea and insists on proper testing procedures when the data were collected. Being a skeptic and using the scientific method involve applying three important criteria that help define science: systematic empiricism, publicly verifiable knowledge, and empirically solvable problems (Stanovich, 2007).

Systematic Empiricism

systematic empiricism Making observations in a systematic manner to test hypotheses and refute or develop a theory.

As you have seen, empiricism is the practice of relying on observation to draw conclusions. Most people today probably agree that the best way to learn about something is to observe it. This reliance on empiricism was not always a common practice. Before the 17th century, most people relied more on intuition, religious doctrine provided by authorities, and reason than they did on empiricism. Notice, however, that empiricism alone is not enough; it must be **systematic empiricism.** In other words, simply observing a series of events does not lead to scientific knowledge. The observations must be made in a systematic manner to test a hypothesis and refute or develop a theory. For example, if a researcher is interested in the relationship between vitamin C and the incidence of colds, she will not simply ask people haphazardly whether they take vitamin C and how many colds they have had. This approach involves empiricism but not systematic empiricism. Instead, the researcher might design a study to assess the effects of vitamin C on colds. Her study will probably involve using a representative group of individuals, with each individual then randomly assigned to either take or not take vitamin C supplements. She will then observe whether the groups differ in the number of colds they report. We will go into more detail on designing such a study later in this chapter. By using systematic empiricism, researchers can draw more reliable and valid conclusions than they can from observation alone.

Publicly Verifiable Knowledge

Scientific research should be **publicly verifiable knowledge.** This means that the research is presented to the public in such a way that it can be observed, replicated, criticized, and tested for veracity by others. Most commonly, this involves submitting the research to a scientific journal for possible publication. Most journals are peer-reviewed—other scientists critique the research to decide whether it meets the standards for publication. If a study is published, other researchers can read about the findings, attempt to replicate them, and through this process demonstrate that the results are reliable. You should be suspicious of any claims made without the support of public verification. For example, many people have claimed that they were abducted by aliens. These claims do not fit the bill of publicly verifiable knowledge; they are simply the claims of individuals with no evidence to support them. Other people claim that they have lived past lives. Once again, there is no evidence to support such claims. These types of claims are unverifiable—there is no way that they are open to public verification.

publicly verifiable knowledge Presenting research to the public so that it can be observed, replicated, criticized, and tested.

Empirically Solvable Problems

Science always investigates **empirically solvable problems**—questions that are potentially answerable by means of currently available research techniques. If a theory cannot be tested using empirical techniques, then scientists are not interested in it. For example, the question "Is there life after death?" is not an empirical question and thus cannot be tested scientifically. However, the question "Does an intervention program minimize rearrests in juvenile delinquents?" can be empirically studied and thus is within the realm of science.

empirically solvable problems Questions that are potentially answerable by means of currently available research techniques.

When empirically solvable problems are studied, they are always open to the **principle of falsifiability**—the idea that a scientific theory must be stated in such a way that it is possible to refute or disconfirm it. In other words, the theory must predict not only what will happen but also what will not happen. A theory is not scientific if it is irrefutable. This may sound counterintuitive, and you may be thinking that if a theory is irrefutable, it must be really good. However, in science, this is not so. Read on to see why.

principle of falsifiability The idea that a scientific theory must be stated in such a way that it is possible to refute or disconfirm it.

pseudoscience Claims that appear to be scientific but that actually violate the criteria of science.

Pseudoscience (claims that appear to be scientific but that actually violate the criteria of science) is usually irrefutable and is also often confused with science. For example, those who believe in extrasensory perception (ESP, a pseudoscience) often argue with the fact that no publicly verifiable example of ESP has ever been documented through systematic empiricism. The reason they offer is that the conditions necessary for ESP to occur are violated under controlled laboratory conditions. This means that they have an answer for every situation. If ESP were ever demonstrated under empirical conditions, then they would say their belief is supported. However, when ESP repeatedly fails to be demonstrated in controlled laboratory conditions, they say their belief is not falsified because the conditions were not "right" for ESP to be demonstrated. Thus, because those who believe in ESP have set up a situation in which they claim falsifying data are not valid, the theory of ESP violates the principle of falsifiability.

You may be thinking that the explanation provided by the proponents of ESP makes some sense to you. Let me give you an analogous example from Stanovich (2007). Stanovich jokingly claims that he has found the underlying brain mechanism that controls behavior and that you will soon be able to read about it in the *National Enquirer*. According to him, two tiny green men reside in the left hemisphere of our brains. These little green men have the power to control the processes taking place in many areas of the brain. Why have we not heard about these little green men before? Well, that's easy to explain. According to Stanovich, the little green men have the ability to detect any intrusion into the brain, and when they do, they become invisible. You may feel that your intelligence has been insulted with this foolish explanation of brain functioning. However, you should see the analogy between this explanation and the one offered by proponents of ESP, despite any evidence to support it and much evidence to refute it.

The Scientific Approach — IN REVIEW

CRITERIA	DESCRIPTION	WHY NECESSARY
Systematic empiricism	Making observations in a systematic manner	Aids in refuting or developing a theory in order to test hypotheses
Publicly verifiable	Presenting research to the public so that it can be observed, replicated, criticized, and tested	Aids in determining the veracity of a theory
Empirically solvable	Stating questions in such a way that they are answerable by means of currently available research techniques	Aids in determining whether a theory can potentially be tested using empirical techniques and whether it is falsifiable

Basic and Applied Research

Some psychologists conduct research because they enjoy seeking knowledge and answering questions. This is referred to as **basic research**—the study of psychological issues to seek knowledge for its own sake. Most basic research is conducted in university or laboratory settings. The intent of basic research is not immediate application but the gaining of knowledge. However, many treatments and procedures that have been developed to help humans and animals began with researchers asking basic research questions that later led to applications. Examples of basic research include identifying differences in capacity and duration in short-term memory and long-term memory, identifying whether cognitive maps can be mentally rotated, determining how various schedules of reinforcement affect learning, and determining how lesioning a certain area in the brains of rats affects their behavior.

basic research The study of psychological issues to seek knowledge for its own sake.

A second type of research is **applied research,** which involves the study of psychological issues that have practical significance and potential solutions. Scientists who conduct applied research are interested in finding an answer to a question because the answer can be immediately applied to some situation. Much applied research is conducted by private businesses and the government. Examples of applied research include identifying how stress affects the immune system, determining the accuracy of eyewitness testimony, identifying therapies that are the most effective in treating depression, and identifying factors associated with weight gain. Some people think that most research should be directly relevant to a social problem or issue.

applied research The study of psychological issues that have practical significance and potential solutions.

In other words, some people favor *only* applied research. The problem with this approach is that much of what started out as basic research eventually led to some sort of application. If researchers stopped asking questions simply because they wanted to know the answer (stopped engaging in basic research), then many great ideas and eventual applications would undoubtedly be lost.

Goals of Science

Scientific research has three basic goals: (1) to describe behavior, (2) to predict behavior, and (3) to explain behavior. All of these goals lead to a better understanding of behavior and mental processes.

Description

description Carefully observing behavior in order to describe it.

Description begins with careful observation. Social scientists might describe patterns of behavior, thought, or emotions in humans. They might also describe the behavior(s) of animals. For example, researchers might observe and describe the type of play behavior exhibited by children or the mating behavior of chimpanzees. Description allows us to learn about behavior and when it occurs. Let's say, for example, that you were interested in the channel-surfing behavior of men and women. Careful observation and description would be needed to determine whether or not there were any gender differences in channel surfing. Description allows us to observe that two events are systematically related to one another. Without description as a first step, predictions cannot be made.

Prediction

prediction Identifying the factors that indicate when an event or events will occur.

Prediction allows us to identify the factors that indicate when an event or events will occur. In other words, knowing the level of one variable allows us to predict the approximate level of the other variable. We know that if one variable is present at a certain level, then it is likely that the other variable will be present at a certain level. For example, if we observed that men channel surf with greater frequency than women, we could then make predictions about how often men and women might change channels when given the chance.

Explanation

explanation Identifying the causes that determine when and why a behavior occurs.

Finally, **explanation** allows us to identify the causes that determine when and why a behavior occurs. To explain a behavior, we need to demonstrate that we can manipulate the factors needed to produce or eliminate the behavior. For example, in our channel-surfing example, if gender predicts channel surfing, what might cause it? It could be genetic or environmental. Maybe men have less tolerance for commercials and thus channel surf at a greater rate. Maybe women are more interested in the content of commercials and are thus less likely to change channels. Maybe the attention span of women is longer. Maybe something associated with having a Y chromosome increases channel surfing, or something associated with having two X chromosomes leads to less channel surfing. Obviously there are a wide variety of possible explanations. As scientists, we test these possibilities to identify the best explanation of why a behavior occurs. When we try to identify the best explanation for a behavior, we must systematically eliminate any alternative explanations. To eliminate alternative explanations, we must impose control over the research situation. We will discuss the concepts of control and alternative explanations shortly.

An Introduction to Research Methods in Science

The goals of science map very closely onto the research methods scientists use. In other words, there are methods that are descriptive in nature, predictive in nature, and explanatory in nature. We will briefly introduce these methods here; the remainder of the text covers these methods in far greater detail.

Descriptive Methods

Psychologists use three types of descriptive methods. First is the **observational method**—simply observing human or animal behavior. Psychologists approach observation in two ways. **Naturalistic observation** involves observing how humans or animals behave in their natural habitat. Observing the mating behavior of chimpanzees in their natural setting is an example of this approach. **Laboratory observation** involves observing behavior in a more contrived and controlled situation, usually the laboratory. Bringing children to a laboratory playroom to observe play behavior is an example of this approach. Observation involves description at its most basic level. One advantage of the observational method, as well as other descriptive methods, is the flexibility to change what you are studying. A disadvantage of descriptive methods is that the researcher has little control. As we use more powerful methods, we gain control but lose flexibility.

A second descriptive method is the **case study method.** A case study is an in-depth study of one or more individuals. Freud used case studies to develop his theory of personality development. Similarly, Jean Piaget used case studies to develop his theory of cognitive development in children. This method is descriptive in nature because it involves simply describing the individual(s) being studied.

observational method Making observations of human or animal behavior.

naturalistic observation Observing the behavior of humans or animals in their natural habitat.

laboratory observation Observing the behavior of humans or animals in a more contrived and controlled situation, usually the laboratory.

case study method An in-depth study of one or more individuals.

survey method Questioning individuals on a topic or topics and then describing their responses.

sample The group of people who participate in a study.

population All of the people about whom a study is meant to generalize.

random sample A sample achieved through random selection in which each member of the population is equally likely to be chosen.

The third method that relies on description is the **survey method**—questioning individuals on a topic or topics and then describing their responses. Surveys can be administered by mail, over the phone, on the Internet, or in a personal interview. One advantage of the survey method over the other descriptive methods is that it allows researchers to study larger groups of individuals more easily. This method has disadvantages, however. One concern is whether the group of people who participate in the study (the **sample**) is representative of all of the people about whom the study is meant to generalize (the **population**). This concern can usually be overcome through random sampling. A **random sample** is achieved when, through random selection, each member of the population is equally likely to be chosen as part of the sample. Another concern has to do with the wording of questions. Are they easy to understand? Are they written in such a manner that they bias the respondents' answers? Such concerns relate to the validity of the data collected.

Predictive (Relational) Methods

correlational method A method that assesses the degree of relationship between two variables.

Two methods allow researchers not only to describe behaviors but also to predict from one variable to another. The first, the **correlational method,** assesses the degree of relationship between two measured variables. If two variables are correlated with each other, then we can predict from one variable to the other with a certain degree of accuracy. For example, height and weight are correlated. The relationship is such that an increase in one variable (height) is generally accompanied by an increase in the other variable (weight). Knowing this, we can predict an individual's approximate weight, with a certain degree of accuracy, based on knowing the person's height.

One problem with correlational research is that it is often misinterpreted. Frequently, people assume that because two variables are correlated, there must be some sort of causal relationship between the variables. This is not so. *Correlation does not imply causation*. Please remember that a correlation simply means that the two variables are related in some way. For example, being a certain height does not cause you also to be a certain weight. It would be nice if it did because then we would not have to worry about being either underweight or overweight. What if I told you that watching violent TV and displaying aggressive behavior were correlated? What could you conclude based on this correlation? Many people might conclude that watching violent TV causes one to act more aggressively. Based on the evidence given (a correlational study), however, we cannot draw this conclusion. All we can conclude is that those who watch more violent television programs also tend to act more aggressively. It is possible that violent TV causes aggression, but we cannot draw this conclusion based only on correlational data. It is also possible that those who are aggressive by nature are attracted to more violent television programs, or that some other "third" variable is causing both aggressive behavior and violent TV watching. The point is that observing a correlation between two variables means only that they are related to each other.

The correlation between height and weight, or violent TV and aggressive behavior, is a **positive relationship:** As one variable (height) increases, we observe an increase in the second variable (weight). Some correlations indicate a **negative relationship,** meaning that as one variable increases, the other variable systematically decreases. Can you think of an example of a negative relationship between two variables? Consider this: As mountain elevation increases, temperature decreases. Negative correlations also allow us to predict from one variable to another. If I know the mountain elevation, it will help me predict the approximate temperature.

positive relationship A relationship between two variables in which an increase in one variable is accompanied by an increase in the other variable.

negative relationship A relationship between two variables in which an increase in one variable is accompanied by a decrease in the other variable.

Besides the correlational method, a second method that allows us to describe and predict is the quasi-experimental method. The **quasi-experimental method** allows us to compare naturally occurring groups of individuals. For example, we could examine whether alcohol consumption by students in a fraternity or sorority differs from that of students not in such organizations. You will see in a moment that this method differs from the experimental method, described later, in that the groups studied occur naturally. In other words, we do not control whether or not people join a Greek organization. They have chosen their groups on their own, and we are simply looking for differences (in this case, in the amount of alcohol typically consumed) between these naturally occurring groups. This is often referred to as a **subject** or **participant variable—**a characteristic inherent in the participants that cannot be changed. Because we are using groups that occur naturally, any differences that we find may be due to the variable of being or not being a Greek member, or they may be due to other factors that we were unable to control in this study. For example, maybe those who like to drink more are also more likely to join a Greek organization. Once again, if we find a difference between these groups in amount of alcohol consumed, we can use this finding to predict what type of student (Greek or non-Greek) is likely to drink more. However, we cannot conclude that belonging to a Greek organization *causes* one to drink more because the participants came to us after choosing to belong to these organizations. In other words, what is missing when we use predictive methods such as the correlational and quasi-experimental methods is control.

quasi-experimental method Research that compares naturally occurring groups of individuals; the variable of interest cannot be manipulated.

participant (subject) variable A characteristic inherent in the participants that cannot be changed.

When using predictive methods, we do not systematically manipulate the variables of interest; we only measure them. This means that, although we may observe a relationship between variables (such as that described between drinking and Greek membership), we cannot conclude that it is a causal relationship because there could be other *alternative explanations* for this relationship. An **alternative explanation** is the idea that it is possible that some other, uncontrolled, extraneous variable may be responsible for the observed relationship. For example, maybe those who choose to join Greek organizations come from higher-income families and have more money to spend on such things as alcohol. Or maybe those who choose to join Greek organizations are more interested in socialization and drinking alcohol before they even join the organization. Thus, because these methods leave the possibility for alternative explanations, we cannot use them to establish cause-and-effect relationships.

alternative explanation The idea that it is possible that some other, uncontrolled, extraneous variable may be responsible for the observed relationship.

Explanatory Method

experimental method A research method that allows a researcher to establish a cause-and-effect relationship through manipulation of a variable and control of the situation.

When using the experimental method, researchers pay a great deal of attention to eliminating alternative explanations by using the proper controls. Because of this, the **experimental method** allows researchers not only to describe and predict but also to determine whether a cause-and-effect relationship exists between the variables of interest. In other words, this method enables researchers to know when and why a behavior occurs. Many preconditions must be met for a study to be experimental in nature; we will discuss many of these in detail in later chapters. Here, we will simply consider the basics—the minimum requirements needed for an experiment.

The basic premise of experimentation is that the researcher controls as much as possible to determine whether a cause-and-effect relationship exists between the variables being studied. Let's say, for example, that a researcher is interested in whether taking vitamin C supplements leads to fewer colds. The idea behind experimentation is that the researcher manipulates at least one variable (known as the **independent variable**) and measures at least one variable (known as the **dependent variable**). In our study, what should the researcher manipulate? If you identified *amount of vitamin C*, then you are correct. If amount of vitamin C is the independent variable, then number of colds is the dependent variable. For comparative purposes, the independent variable has to have at least two groups or conditions. We typically refer to these two groups or conditions as the control group and the experimental group. The **control group** is the group that serves as the baseline or "standard" condition. In our vitamin C study, the control group does not take vitamin C supplements. The **experimental group** is the group that receives the treatment—in this case, those who take vitamin C supplements. Thus, in an experiment, one thing that we control is the level of the independent variable that participants receive.

independent variable The variable in a study that is manipulated by the researcher.

dependent variable The variable in a study that is measured by the researcher.

control group The group of participants that does not receive any level of the independent variable and serves as the baseline in a study.

experimental group The group of participants that receives some level of the independent variable.

What else should we control to help eliminate alternative explanations? Well, we need to control the type of participants in each of the treatment conditions. We should begin by drawing a random sample of participants from the population. After we have our sample of participants, we have to decide who will serve in the control group versus the experimental group. To gain as much control as possible and eliminate as many alternative explanations as possible, we should use **random assignment**—assigning participants to conditions in such a way that every participant has an equal probability of being placed in any condition. Random assignment helps us to gain control and eliminate alternative explanations by minimizing or eliminating differences between the groups. In other words, we want the two groups of participants to be as alike as possible. The only difference we want between the groups is that of the independent variable we are manipulating—amount of vitamin C. After participants are assigned to conditions, we keep track of the number of colds they have over a specified time period (the dependent variable).

random assignment Assigning participants to conditions in such a way that every participant has an equal probability of being placed in any condition.

Let's review some of the controls we have used in the present study. We have controlled who is in the study (we want a sample representative of the population about whom we are trying to generalize), who participates in each group (we should randomly assign participants to the two conditions), and the treatment each group receives as part of the study (some take vitamin C supplements and some do not). Can you identify other variables that we might need to consider controlling in the present study? How about amount of sleep received each day, type of diet, and amount of exercise (all variables that might contribute to general health and well-being)? There are undoubtedly other variables we would need to control if we were to complete this study. We will discuss control in greater detail in later chapters, but the basic idea is that when using the experimental method, we try to **control** as much as possible by manipulating the independent variable and controlling any other extraneous variables that could affect the results of the study. Randomly assigning participants also helps to control for participant differences between the groups. What does all of this control gain us? If, after completing this study with the proper controls, we found that those in the experimental group (those who took vitamin C supplements) did in fact have fewer colds than those in the control group, we would have evidence supporting a cause-and-effect relationship between these variables. In other words, we could conclude that taking vitamin C supplements reduces the frequency of colds.

control Manipulating the independent variable in an experiment or any other extraneous variables that could affect the results of a study.

An Introduction to Research Methods — IN REVIEW

GOAL MET	RESEARCH METHODS	ADVANTAGES/DISADVANTAGES
Description	Observational method	Allows description of behavior(s)
	Case study method	Does not support reliable predictions
	Survey method	Does not support cause-and-effect explanations
Prediction	Correlational method	Allows description of behavior(s)
	Quasi-experimental method	Supports reliable predictions from one variable to another
		Does not support cause-and-effect explanations
Explanation	Experimental method	Allows description of behavior(s)
		Supports reliable predictions from one variable to another
		Supports cause-and-effect explanations

CRITICAL THINKING CHECK 1.3

1. In a recent study, researchers found a negative correlation between income level and incidence of psychological disorders. Jim thinks this means that being poor leads to psychological disorders. Is he correct in his conclusion? Why or why not?
2. In a study designed to assess the effects of smoking on life satisfaction, participants were assigned to groups based on whether or not they reported smoking. All participants then completed a life satisfaction inventory.
   a. What is the independent variable?
   b. What is the dependent variable?
   c. Is the independent variable a participant variable or a true manipulated variable?

3. What type of method would you recommend researchers use to answer the following questions?
   a. What percentage of cars run red lights?
   b. Do student athletes spend as much time studying as student nonathletes?
   c. Is there a relationship between type of punishment used by parents and aggressiveness in children?
   d. Do athletes who are randomly assigned to use imaging techniques perform better than those who are not randomly assigned to use such techniques?
4. Your mother claims that she has found a wonderful new treatment for her arthritis. She read "somewhere" that rubbing vinegar into the affected area for 10 minutes twice a day would help. She tried this and is convinced that her arthritis has been lessened. She now thinks that the medical community should recommend this treatment. What alternative explanation(s) might you offer to your mother for why she feels better? How would you explain to her that her evidence is not sufficient for the medical/scientific community?

Doing Science

Although the experimental method can establish a cause-and-effect relationship, most researchers would not wholeheartedly accept a conclusion from only one study. Why is that? Any one of a number of problems can occur in a study. For example, there may be control problems. Researchers may believe they have controlled everything but miss something, and the uncontrolled factor may affect the results. In other words, a researcher may believe that the manipulated independent variable caused the results when, in reality, it was something else.

Another reason for caution in interpreting experimental results is that a study may be limited by the technical equipment available at the time. For example, in the early part of the 19th century, many scientists believed that studying the bumps on a person's head allowed them to know something about the internal mind of the individual being studied. This movement, known as phrenology, was popularized through the writings of physician Joseph Gall (1758–1828). Based on what you have learned in this chapter, you can most likely see that phrenology is a pseudoscience. However, at the time it was popular, phrenology appeared very "scientific" and "technical." Obviously, with hindsight and with the technological advances that we have today, the idea of phrenology seems somewhat laughable to us now.

Finally, we cannot completely rely on the findings of one study because a single study cannot tell us everything about a theory. The idea of science is that it is not static; the theories generated through science change. For example, we often hear about new findings in the medical field, such as

"Eggs are so high in cholesterol that you should eat no more than two a week." Then, a couple of years later, we might read "Eggs are not as bad for you as originally thought. New research shows that it is acceptable to eat them every day." People may complain when confronted with such contradictory findings: "Those doctors, they don't know what they're talking about. You can't believe any of them. First they say one thing, and then they say completely the opposite. It's best to just ignore all of them." The point is that when testing a theory scientifically, we may obtain contradictory results. These contradictions may lead to new, very valuable information that subsequently leads to a theoretical change. Theories evolve and change over time based on the consensus of the research. Just because a particular idea or theory is supported by data from one study does not mean that the research on that topic ends and that we just accept the theory as it currently stands and never do any more research on that topic.

Proof and Disproof

When scientists test theories, they do not try to prove them true. Theories can be supported based on the data collected, but obtaining support for something does not mean it is true in all instances. Proof of a theory is logically impossible. As an example, consider the following problem, adapted from Griggs and Cox (1982). This is known as the Drinking Age Problem (the reason for the name will become readily apparent).

> Imagine that you are a police officer responsible for making sure that the drinking age rule is being followed. The four cards on the next page represent information about four people sitting at a table. One side of a card indicates what the person is drinking, and the other side of the card indicates the person's age. The rule is: "If a person is drinking alcohol, then the person is 21 or over." In order to test whether the rule is true or false, which card or cards below would you turn over? Turn over only the card or cards that you need to check to be sure.

Drinking a beer	16 years old	Drinking a Coke	22 years old

Does turning over the beer card and finding that the person is 21 years of age or older prove that the rule is always true? No—the fact that one person is following the rule does not mean that it is always true. How, then, do we test a hypothesis? We test a hypothesis by attempting to falsify or disconfirm it. If it cannot be falsified, then we say we have support for it. Which cards would you choose in an attempt to falsify the rule in the Drinking Age Problem? If you identified the beer card as being able to falsify the rule, then you were correct. If we turn over the beer card and find that the individual is under 21 years of age, then the rule is false. Is there another card that could also falsify the rule? Yes, the 16 years of age card can. How? If we turn that card over and find that the individual is drinking alcohol, then the rule is false. These are the only two cards that can potentially falsify the rule. Thus, they are the only two cards that need to be turned over.

Even though disproof or disconfirmation is logically sound in terms of testing hypotheses, falsifying a hypothesis does not always mean that the hypothesis is false. Why? There may be design problems in the study, as described earlier. Thus, even when a theory is falsified, we need to be cautious in our interpretation. The point to be taken is that we do not want to completely discount a theory based on a single study.

The Research Process

The actual process of conducting research involves several steps, the first of which is to identify a problem.

Summary

We identified different areas within the discipline of psychology in which research is conducted, such as psychobiology, cognition, human development, social psychology, and psychotherapy. We discussed various sources of knowledge, including intuition, superstition, authority, tenacity, rationalism, empiricism, and science. We stressed the importance of using the scientific method to gain knowledge in psychology. The scientific method is a combination of empiricism and rationalism; it must meet the criteria of systematic empiricism, public verification, and empirically solvable problems.

We outlined the three goals of science (description, prediction, and explanation) and related them to the research methods used by social scientists. Descriptive methods include observation, case study, and survey methods. Predictive methods include correlational and quasi-experimental methods. The experimental method allows for explanation of cause-and-effect relationships. Finally, we introduced some practicalities of doing research, discussed proof and disproof in science, and noted that testing a hypothesis involves attempting to falsify it.

KEY TERMS

knowledge via superstition
knowledge via intuition
knowledge via authority
knowledge via tenacity
knowledge via rationalism
knowledge via empiricism
knowledge via science
hypothesis
variable
theory
skeptic
systematic empiricism
publicly verifiable knowledge
empirically solvable problems
principle of falsifiability
pseudoscience
description
prediction
explanation
basic research
applied research
observational method
naturalistic observation
laboratory observation
case study method
survey method
sample
population
random sample
correlational method
positive relationship
negative relationship
quasi-experimental method
participant (subject) variable
alternative explanation
experimental method
independent variable
dependent variable
control group
experimental group
random assignment
control