Using the Scientific Method in Psychology

CHAPTER
5

In Chapter 3 you learned that in 1879 Wundt used the scientific method to gather new information of interest to the new discipline of psychology. Over 100 years later, psychologists continue to believe that the scientific approach is best suited for adding to our knowledge of psychological processes.

The key elements in the scientific approach are

1. Objective measurements of the phenomenon under consideration
2. The ability to verify or confirm the measurements made by other individuals
3. Self-correction of errors and faulty reasoning
4. Exercising control to rule out the influence of unwanted factors.

We will discuss each of these characteristics in the next section. For now, we will simply say that the scientific method attempts to provide objective information so that anyone who wishes to repeat the observation in question can verify it.

Components of the Scientific Method

In this section we describe the features that characterize the scientific method. We will have much more to say about these characteristics in subsequent chapters.

Objectivity

In conducting a research project, the psychologist, like the good detective, strives to be objective. For example, psychologists select research participants in such a manner as to avoid biasing factors (e.g., age or sex). Researchers frequently make their measurements with instruments in order to be as objective as possible. We describe such measurements as being **empirical** because they are based on objectively quantifiable observations.

Empirical Objectively quantifiable observations.

Confirmation of Findings

Because the procedures and measurements are objective, we should be able to repeat them and *confirm* the original results. Confirmation of findings is important for establishing the validity of research. Psychologists use the term **replication** to refer to a research study that is conducted in exactly the same manner as a previous study. By conducting a replication study, the scientist hopes to confirm previous findings. Other studies may constitute *replication with extension,* in which scientists generate new information at the same time as they confirm previous findings. For example, Matisha Montgomery, a student at the University of Central Oklahoma in Edmond, and her faculty advisor, Kathleen Donovan, replicated and extended the conditions reported to be responsible for the "Mozart effect" (the finding that participants' cognitive and spatial performance was better after they listened to music composed by Mozart). Their results indicated that students actually performed worse after listening to Mozart's music (Montgomery & Donovan, 2002).

Replication An additional scientific study that is conducted in exactly the same manner as the original research project.

Self-Correction

Because scientific findings are open to public scrutiny and replication, any errors and faulty reasoning that become apparent should lead to a change in the conclusions we reach. For example, some early American psychologists, such as James McKeen Cattell, once believed that intelligence was directly related to the quality of one's nervous system; the better the nervous system, the higher the intelligence (see Goodwin, 2005). To verify this predicted relation, Cattell attempted to demonstrate that college students with faster reaction times (therefore, having better nervous systems) earned higher grades in college (had higher levels of intelligence). However, his observations failed to support the predicted relation, and Cattell changed his view of intelligence and how to measure it.

Control

Probably no single term characterizes science better than **control**. Scientists go to great lengths to make sure their conclusions accurately reflect the way nature operates.

Imagine that an industrial psychologist wants to determine whether providing new, brighter lighting will increase worker productivity. The new lighting is installed, and the industrial psychologist arrives at the plant to monitor production and determine whether productivity increases.

Control To directly manipulate (1) a factor of interest in a research study to determine its effects or (2) other, unwanted variables that could influence the results of a research project.

PSYCHOLOGICAL DETECTIVE

There is a problem with this research project that needs to be controlled. What is the nature of this problem, and how can it be corrected?

The main problem with this research project concerns the presence of the psychologist to check on production after installation of the new lighting. If the researcher was not present to observe production before the lighting changes were made, then he or she should not be present following the implementation of these changes. If production increases following the lighting changes, is the increase due to the new lighting or to the presence of the researcher who is monitoring production? Unfortunately, there is no way of knowing. The psychologist must exercise control to make sure that the only factor that could influence productivity is the change in lighting; other factors should not be allowed to exert an influence by varying also.

This example of research on the effects of lighting on worker productivity (which is an actual research study) also illustrates another use of the term *control.* In addition to accounting for the effects of unwanted factors, *control* can refer to the direct manipulation of the factor of major interest in the research project. Because the industrial psychologist was interested in the effects of lighting on productivity, a change in lighting was purposely created (control or direct manipulation of factors of major interest), whereas other, potentially influential but undesirable factors, such as the presence of the psychologist, were not allowed to change (control of unwanted factors).

When researchers implement control by directly manipulating the factor that is the central focus of their research, we say that an experiment has been performed. Because most psychologists believe that our most valid knowledge is produced by conducting an experiment, we will give this topic additional coverage in the next section. (Although the psychological experiment may produce the most valid data, as you saw in Chapters 3 and 4 there are numerous nonexperimental research methods that also can yield important data.)

The Psychological Experiment

Experiment An attempt to determine the cause-and-effect relations that exist in nature. Involves the manipulation of an independent variable (IV), recording of changes in a dependent variable (DV), and control of extraneous variables.

In many respects you can view an **experiment** as an attempt to determine the cause-and-effect relations that exist in nature. Researchers are interested in determining those factors that result in or cause predictable events. In its most basic form, the psychological experiment consists of three related factors: the independent variable, the dependent variable, and extraneous variables.

Independent Variable

Independent variable (IV) A stimulus or aspect of the environment that the experimenter directly manipulates to determine its influences on behavior.

The factor that is the major focus of the research and that the researcher directly manipulates is known as the **independent variable (IV)**: *independent* because it can be directly manipulated by the investigator, and *variable* because it is able to assume two or more values (often called *levels*). The IV is the causal part of the relation we seek to establish. Lighting, the IV in our previous example, had two values: the original level and the new, brighter level. *Manipulation of the IV corresponds to one use of the term* control.

Dependent Variable

The **dependent variable (DV)** consists of the recorded information or results (frequently called *data;* the singular is *datum*) of the experiment. The DV is the effect half of the cause-and-effect relation we are examining. In our example, level of productivity was the DV; the researcher measured it under the two conditions of the IV (original and brighter lighting). The term *dependent* is used because if the experiment is conducted properly, changes in DV scores will result from (depend on) the manipulation of the IV; the level of productivity will depend on the changes in lighting.

Dependent variable (DV) A response or behavior that the experimenter measures. Changes in the DV should be caused by manipulation of the independent variable (IV).

Extraneous Variables

Extraneous variables are those factors, other than the IV, that can influence the DV and change the results of an experiment. Suppose an experimenter asks her participants to complete several tasks. At the conclusion of the experiment, she compares performance on the tasks and finds that there is a large performance difference among the groups. Was the difference caused by the different tasks (the IV) or by the sequence of performing the tasks (an extraneous variable)? Unfortunately, when an extraneous variable is present, we have no way of knowing whether the extraneous variable or the IV caused the effect we observe. Robyn Scali, a student at Catawba College in Salisbury, North Carolina, and her faculty advisor, Sheila Brownlow, were faced with just this problem; they asked their participants to complete three tasks. How did they deal with this potential extraneous variable? They stated, "Because any given task may have influenced performance on subsequent tasks, we presented tasks in one of six different orders, with each task appearing first, second, and third, exactly two times" (Scali & Brownlow, 2001, p. 7). Obviously, attention to extraneous variables is very important; it represents another use of the term *control.*

Extraneous variables Undesired variables that may operate to influence the dependent variable (DV) and thus invalidate an experiment.

Establishing Cause-and-Effect Relations

Why do psychologists hold experimental research in such high regard? The answer to this question involves the type of information that we gain. Although we might be very objective in making our observations and even though these observations are repeatable, unless we have directly manipulated an IV, we cannot really learn anything about cause and effect in our research project. Only when we manipulate an IV and control potential extraneous variables are we able to infer a cause-and-effect relation.

What is so important about establishing a cause-and-effect relation? Although objective, repeatable observations can tell you about an interesting phenomenon, these observations cannot tell you why that phenomenon occurred. Only when we can give a cause-and-effect explanation do we begin to answer the *why* question.

For example, Naomi Freeman, a student at Earlham College in Richmond, Indiana, and her faculty advisor, Diana Punzo, wondered whether jurors were more persuaded by eyewitness testimony or by DNA evidence. To answer this research question, they conducted an experiment (Freeman & Punzo, 2001) in which college students served as mock jurors. The student participants read one of two excerpts from a court transcript of a first-degree murder trial. In one excerpt the prosecution produced evidence from an eyewitness. In a second excerpt the prosecution produced DNA evidence. A practicing attorney assisted in the preparation of the excerpts. After the participants completed reading their particular excerpt, they indicated whether they thought the defendant was guilty.

The IV (or *cause* in the cause-and-effect relation that they were examining) was the type of evidence the prosecution presented in the transcript: eyewitness testimony or DNA evidence. At the outset of the experiment, Freeman and Punzo hypothesized that the eyewitness testimony condition would result in more guilty verdicts than the DNA condition. Why? On the basis of previous research, they believed that "although DNA evidence is extremely reliable, it is often ignored by jurors" (p. 110).

Review the experiment we have just described. What extraneous variables did the researchers control? Should they have controlled any other extraneous variables? What was their DV?

Freeman and Punzo used several controls when they conducted this research. First, they randomly determined which transcript a participant read. Second, in order to create an equivalent sense of reality for the court transcript excerpts, they asked an attorney to assist in their preparation. The type of evidence should be the only difference between the excerpts.

What other controls have you thought of? How about what happens to the excerpt when a participant finishes reading it? Should the participant be allowed to keep it? Unlike the case in a real courtroom, if the excerpt is retained, the participant could refer to it when making a decision of guilty or not guilty. To control for this potential problem, all participants returned their excerpt before answering any questions. Even though they tested the participants in small groups as they completed the experiment, the experimenters made sure that each participant answered all questions independently; collaboration with other participants would nullify our confidence in the cause-and-effect relation the researchers were trying to establish.

The participants' guilty or not guilty verdict was the DV. By comparing the number of guilty verdicts between the groups, Freeman and Punzo (2001) hoped to show that the type of evidence (cause) resulted in differences in guilty verdicts (effect); recall that they believed there would be more guilty verdicts from the participants who read the eyewitness excerpt.

Just as you would at the end of a detective case, you now want to know what happened. Contrary to the initial predictions, the results showed that participants who read the DNA transcript produced significantly more guilty verdicts than did the participants who read the eyewitness transcript. By controlling extraneous variables, Freeman and Punzo (2001) established a cause-and-effect relation between type of evidence presented to mock jurors (IV) and number of guilty verdicts (DV). The greater our control of extraneous variables, the clearer our view of the cause-and-effect relation between the IV and the DV becomes. This arrangement of IV, DV, and control of extraneous variables in Freeman and Punzo's experiment is diagrammed in Figure 5-1.

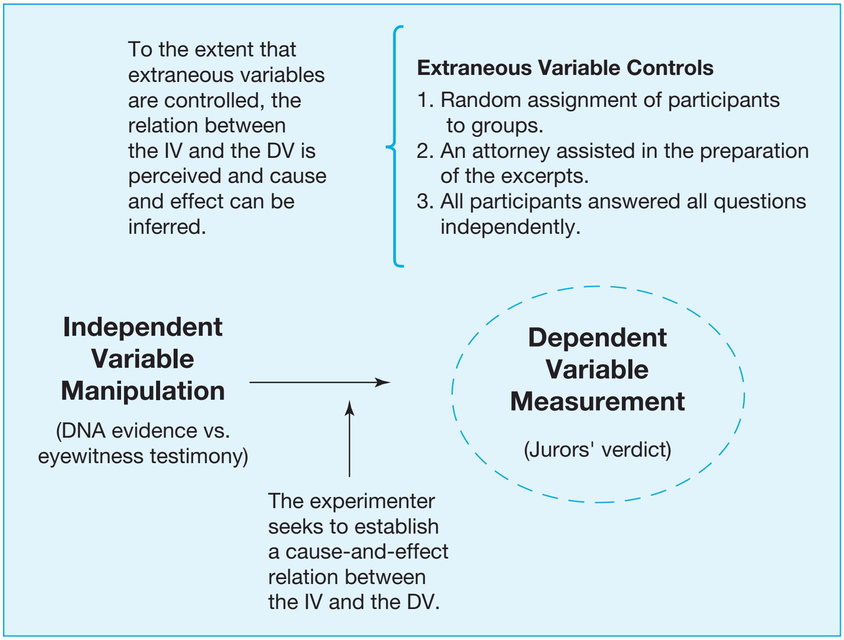

FIGURE 5-1 Diagram of the Relation of the IV, DV, and Extraneous Variable Controls in an Experiment on the Effect of DNA Evidence and Eyewitness Testimony on Jurors′ Verdicts.

As we saw in Chapter 1, the first step in the research process is identifying a problem to be investigated. Then you review the literature to determine what research has been conducted in this area. Once you have completed your literature review, your own research begins to take shape. The next task is to develop a *research hypothesis*—a formal statement of your research question—taking into account what you learned from searching the literature.

Formulating the Research Hypothesis

Recall from Chapter 1 that the hypothesis is an attempt to organize data and IV–DV relations within a specific portion of a larger, more comprehensive research area or theory. Thus, hypotheses that have been supported by experimental research can make important contributions to our knowledge base.

Because you have yet to conduct your research project, the **research** or **experimental hypothesis** is your *prediction* about the relation that exists between the IV that you are going to manipulate and the DV that you will record. If the results of your experiment support the research hypothesis, then it has the potential to make a contribution to theory; you have some grounds on which to infer a cause-and-effect relation. In order to understand the nature of the research hypothesis, we will examine some of its general characteristics.

Research or **experimental hypothesis** The experimenter′s predicted outcome of a research project.

Characteristics of the Research Hypothesis

For the detective and the psychologist, all acceptable research hypotheses share certain characteristics: They are stated in a certain manner, they involve a certain type of reasoning, and they are presented in a certain format.

Types of Statements

Because a research hypothesis is nothing more than a statement of what you believe will occur when you conduct an experiment, you must carefully consider the statements used in constructing it.

Synthetic statement Statements that can be either true or false.

Analytic statement Statements that are always true.

Contradictory statement Statements that are always false.

Synthetic, Analytic, and Contradictory Statements A statement can be one of three types: synthetic, analytic, or contradictory.

Synthetic statements are those statements that can be *either true or false*. The statement "Abused children have lower self-esteem" is synthetic because, although there is a chance that it is true, there also is a chance that it is false.

Analytic statements are those statements that are *always true*. For example, "I am making an *A* or I am not making an *A*" is an analytic statement; it is always true. You are either making an *A or* you are not making an *A*; no other possibilities exist.

Contradictory statements are those statements that are *always false*. For example, "I am making an *A and* I am not making an *A*" is a contradictory statement; it is always false. You cannot make an *A* and not make an *A* at the same time.

PSYCHO-LOGICAL DETECTIVE

Review the three types of statements presented above. Which one is best suited for use in a research hypothesis?

When you conduct an experiment, you are attempting to establish the existence of a cause-and-effect relation. At the outset of the experiment you do not know whether your prediction is correct or not. Therefore, synthetic statements, which can be true or false, must constitute the research hypothesis. If your research hypothesis is an analytic or contradictory statement, there is no need (or way) to conduct research on that topic. You already know what the outcome will be merely by reading the statements.

General implication form Statement of the research hypothesis in an "if . . . then" form.

General Implication Form As we mentioned previously, you must be able to state the research hypothesis in **general implication form** ("if . . . then" form). The "if" portion of such a statement refers to the IV manipulation you are going to make, and the "then" portion refers to the DV changes you expect to observe. An example of a general implication form statement would be the following:

> If students in one group of third-graders receive an M&M® each time they spell a word correctly, then their spelling performance will be better than that of a group of third-graders who do not receive an M&M for each correctly spelled word.

If you have read articles in psychological journals, you are probably saying to yourself, "I don't recall seeing many statements in general implication form." You are probably correct; most researchers do not formally state their research hypothesis in strict general implication form. For example, the hypothesis about the third-graders and their spelling performance might have been stated like this:

> Third-graders who receive an M&M each time they spell a word correctly will spell better than third-graders who do not receive an M&M for each correctly spelled word.

Regardless of how the research hypothesis is stated, it must be restatable in general implication form. If it cannot be stated in this manner, there is a problem with either your IV manipulation or the DV you have chosen to measure.

PSYCHO-LOGICAL DETECTIVE

Starting with "If students in one group of third-graders . . . ," read the last general implication statement again. What IV is the researcher manipulating? What is the DV? In addition to being stated in general implication form, is this statement synthetic, analytic, or contradictory?

Whether the students receive an M&M after correctly spelling a word is the IV. The spelling performance of the two groups of third-graders is the DV. Because this statement has the potential to be true or false, it is synthetic.

The use of synthetic statements presented in general implication form highlights two additional, but related, characteristics of the research hypothesis. The **principle of falsifiability**, the first characteristic, means that when an experiment does not turn out as you predicted, this result is seen as evidence that your hypothesis is false. If, after the experiment, the two groups of third-graders do not differ in spelling ability, then you must conclude you made a bad prediction; your research hypothesis was not an accurate portrayal of nature. Even though you do not want such results to occur, your research must be capable of producing results that do not support your experimental hypothesis.

Principle of falsifiability Results not in accord with the research hypothesis are taken as evidence that this hypothesis is false.

Because you use a synthetic statement for your research hypothesis, your results will never prove its truth absolutely; this is the second characteristic of the research hypothesis. Assume you did find that third-graders who received M&Ms spelled better than third-graders who did not receive M&Ms. Later you decide to replicate your experiment. Just because you obtained positive results the first time you conducted the experiment does not prove that your research hypothesis is unquestionably true and that you will always obtain positive results. When you conduct a replication, or any experiment for that matter, your hypothesis contains a synthetic statement that is either true or false. Thus, you can never absolutely prove a research hypothesis; you simply cannot yet disprove it. Certainly, as the number of experiments that support the research hypothesis increases, your confidence in the research hypothesis increases.

Types of Reasoning

In stating your research hypothesis, you also must be aware of the type of reasoning or logic you use. As we will see, inductive and deductive reasoning involve different processes.

Inductive logic
Reasoning that proceeds from specific cases to general conclusions or theories.

Inductive Logic **Inductive logic** involves reasoning from specific cases to general principles. Inductive logic is the process that is involved in the construction of theories; the results of several independent experiments are considered simultaneously, and general theoretical principles designed to account for the behavior in question are derived.

For example, John Darley and Bibb Latané (1968) were intrigued by a famous incident that occurred in 1964 in the Queens section of New York: A young woman named Kitty Genovese was stabbed to death. Given the number of murders that take place each year in any large city, this event may not seem especially noteworthy. An especially horrifying aspect of this murder, however, was the fact that the killer attacked the young woman *three separate times* in the course of half an hour and that 38 people witnessed the attacks or heard the young woman's screams. The killer was frightened off twice when people turned their lights on or called from their windows; however, both times he resumed his attack. None of the people who witnessed the attack came to the victim's aid, and no one called the police while she was being attacked. Why?

Darley and Latané reported the results of several experiments they conducted. On the basis of their results, they theorized that individuals are more likely to give assistance if they are alone than if others are present. The finding that groups of bystanders are less likely than individuals to aid a person in trouble is known as the *bystander effect*. The development of this principle is an example of the use of inductive reasoning; several specific results were combined to formulate a more general principle.

Deductive logic
Reasoning that proceeds from general theories to specific cases.

Deductive Logic **Deductive logic** is the converse of inductive logic; we reason from general principles to specific conclusions or predictions. Deductive logic is the reasoning process we use in formulating our research hypothesis. By conducting a search of the literature, we have assembled a large amount of data and considered several theories. From this *general* pool of information we seek to develop our research hypothesis, a statement about the relation between a *specific* IV and a *specific* DV. For example, on the basis of previous research conducted on the bystander effect, a social psychologist might make the following deductive statement:

> If a person pretends to have a seizure on a subway, that person will receive less assistance when there are more bystanders present.

PSYCHO-LOGICAL DETECTIVE

Read the preceding statement once again. Is this statement acceptable as a research hypothesis?

Yes, this statement would appear to be acceptable as a research hypothesis. It is a synthetic statement (it can be true or false) presented in general implication form ("if . . . then"). Moreover, deductive logic is involved: We have gone from a general body of knowledge (about the bystander effect) to make a specific prediction concerning a specific IV (number of bystanders present) and a specific DV (receiving assistance).

Certainly we are not maintaining that deductive and inductive reasoning are totally separate processes. They can, and do, interact with each other. As you can see from Figure 5-2, the results of several initial experiments in a particular research area may lead to the development of a theory in that area (inductive reasoning).

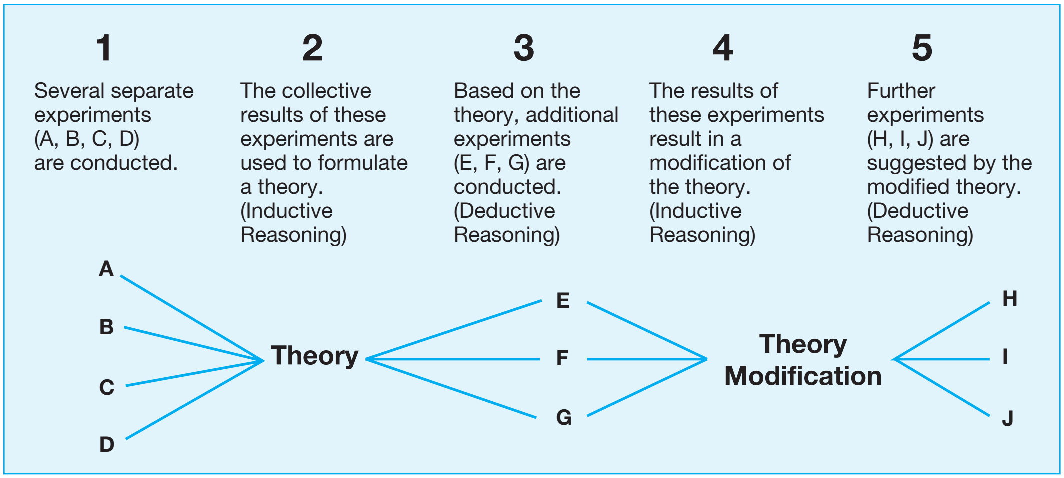

FIGURE 5-2 The Relations Between Deductive and Inductive Reasoning.
Source: Wann, D. L. & Dolan, T. J. (1994). "Spectator's evaluations of rival and fellow fans." *The Psychological Record, 44,* 351–358.

In turn, an examination of that theory and past research may suggest a specific research project (deductive reasoning) that needs to be conducted. The results of that project may result in modification of the theory (inductive reasoning), which prompts the idea for several additional research projects (deductive reasoning), and so forth. Clearly, the research process we described in Chapter 1 is based on the interplay between these two types of logical reasoning.

A New View of Hypothesis Testing

Robert Proctor and John Capaldi, psychologists at Purdue University, have presented a new view of hypothesis testing that warrants considerable thought. They based their comments on the premise that research methodology is not a static, finished process; it is constantly in a state of change and flux. Principles may be rejected or modified. The data that researchers gather really determine the methods that are accepted and continue to be used.

They contend that hypothesis testing is not a simple affair; it "is a great deal more complicated than it seems on the surface" (Proctor & Capaldi, 2001, p. 179). Several factors can determine what the researcher does when an experimental hypothesis is confirmed (or disconfirmed). For example, the *importance* of the research problem may determine whether a researcher sticks with the problem, even if a specific hypothesis is disconfirmed. Likewise, the *promise* of the research program to answer theoretical questions may determine whether that research program flourishes.

Early in the developmental stages of a theory, hypothesis testing actually may be harmful. Because the researchers do not know all of the relevant variables (IVs, DVs, and, especially, extraneous variables), it may be very easy to disconfirm an experimental hypothesis and thereby disconfirm the theory. Proctor and Capaldi also argue that researchers are never really able to achieve a clear-cut test of a hypothesis. Why? No hypothesis is ever tested in complete isolation; we are always testing other things at the same time. For example, the adequacy of our research equipment is tested at the same time as we test a hypothesis. If the hypothesis was disconfirmed, was it due to an incorrect hypothesis or inadequate equipment? Likewise, we always make auxiliary assumptions, such as the effectiveness of randomization as a control technique, when we test a hypothesis. If these auxiliary assumptions are incorrect, we may reject a valid experimental hypothesis.

What should researchers do? Proctor and Capaldi suggest that researchers use more inductive logic when a research area is new, because there is a high probability of disconfirming hypotheses when they might be true. Their suggestion is to let the data be your guide. Sherlock Holmes made this point quite eloquently when he said, "I make a point of never having any prejudices, and of following docilely wherever fact may lead me" (Doyle, 1927, p. 407). The empirical results of your research will help reveal important relations. Hypothesis testing is important and valuable when it works; however, researchers must be sensitive to the drawbacks associated with it.

Directional Versus Nondirectional Research Hypotheses

Directional research hypothesis Prediction of the specific outcome of an experiment.

Finally, we must consider whether we are going to predict the direction of the outcome of our experiment in our research hypothesis. In a **directional research hypothesis** we specify the outcome of the experiment. For example, if we test two groups, we could entertain *one* of the following directional hypotheses:

Group A will score significantly higher than Group B.

or

Group B will score significantly higher than Group A.

In either case, we are directly specifying the direction we predict for the outcome of our experiment. (Note that although we can entertain either of these directional hypotheses, we cannot consider both of them at the same time.)

Nondirectional research hypothesis A specific prediction concerning the outcome of an experiment is not made.

On the other hand, a **nondirectional research hypothesis** does not predict the exact directional outcome of an experiment; it simply predicts that the groups we are testing will differ. Using our two-group example once again, a nondirectional hypothesis would indicate that

Group A's scores will differ significantly from Group B's.

For this hypothesis to be supported, Group A can score either significantly higher or significantly lower than Group B.

Review the differences between directional and nondirectional hypotheses. How would you write a directional research hypothesis for the M&Ms and third-grade spelling experiment we described earlier? How would you write a nondirectional hypothesis for this same experiment?

A directional hypothesis might read as follows:

> If students in one group of third-graders receive an M&M each time they spell a word correctly, then their spelling performance *will be better* than that of a group of third-graders who do not receive an M&M for each correctly spelled word.

Of course, you might predict that receiving M&Ms would cause spelling performance to decrease and fall below that of the group that did not receive the M&Ms. In either instance, you would be using a directional hypothesis.

A nondirectional hypothesis would read as follows:

> If students in one group of third-graders receive an M&M each time they spell a word correctly, then their spelling performance *will differ* from that of a group of third-graders who do not receive an M&M for each correctly spelled word.

In this instance, we are simply predicting that the two groups will perform differently.

Which type of hypothesis, directional or nondirectional, should you choose? If the theory you are testing calls for it, and you are *relatively certain* of your prediction, then you may want to use a directional hypothesis. For reasons we will discuss later, your chances of finding a statistically significant result are increased when you use a directional hypothesis. However, if you adopt a directional hypothesis, there is no changing your mind. If the results turn out exactly opposite to your prediction, the only thing you can say is that you were wrong and that nature doesn't operate as you thought it did. Because nature has a way of playing cruel tricks on our predictions, most researchers take a more conservative approach and state a nondirectional research hypothesis. Even though it may be slightly more difficult to achieve statistical significance, there is less potential for disappointment with the outcome of the research project when you use a nondirectional hypothesis.

REVIEW SUMMARY

1. Three characteristics of the scientific method are the use of (a) objective (**empirical**) findings that can be (b) confirmed by others and (c) corrected, if necessary, by subsequent research.
2. **Control** also is a distinguishing characteristic of science. Control can refer to (a) procedures for dealing with undesired factors in an experiment and/or (b) manipulation of the factor of main interest in an experiment.
3. Experimenters seek to establish cause-and-effect relations between variables they manipulate **(independent variables** or **IVs)** and behavioral changes **(dependent variables** or **DVs)** that result from those manipulations. Control also is exercised over **extraneous variables** (unwanted factors) that can influence the dependent variable.

4. Once the literature review is complete, the researcher is ready to develop a **research** or **experimental hypothesis**—the predicted outcome of the experiment.
5. The research hypothesis contains **synthetic statements** that can be either true or false and is stated in **general implication form** ("if . . . then").
6. The **principle of falsifiability** indicates that, when an experiment does not turn out as predicted, the truthfulness of the research hypothesis is discredited. Because a research hypothesis is composed of synthetic statements, it can never be absolutely proved; it can only be disproved.
7. The development of the research hypothesis involves the use of **deductive logic** in which we reason from general principles to specific cases. When we reason from specific cases to general principles, we use **inductive logic**.
8. A **directional research hypothesis** is used when the *specific* direction or nature of the outcome of an experiment is predicted. When the experimenter does not predict the specific nature of the group differences, only that they *will differ*, a **nondirectional research hypothesis** is used.

Check Your Progress

1. What are (describe) the components of the scientific method?
2. Explain what is meant by the "self-correcting nature of science."
3. A researcher conducts a study to confirm the effects of a previously tested drug. This is an example of
   a. objectivity
   b. replication
   c. control
   d. repeated measures
4. Explain the nature of the cause-and-effect relations that psychological research attempts to establish.
5. Leo conducts a study that examines the effects of extracurricular involvement on levels of self-esteem. In this study, extracurricular involvement serves as the
   a. dependent variable
   b. independent variable
   c. extraneous variable
   d. intrinsic variable
6. ________ are always true.
   a. Synthetic statements
   b. Contradictory statements
   c. Statements presented in general implication form
   d. Analytic statements

7. Why are synthetic statements used in the experimental hypothesis?

8. Describe general implication form. Be thorough.

9. Which of the following is *not* associated with the principle of falsifiability?
   a. synthetic statements
   b. general implication form
   c. experimental hypothesis
   d. analytic statements

10. The construction of theories involves ________ logic; the development of the experimental hypothesis involves ________ logic.

11. Concerning research hypotheses, most researchers
    a. state a directional research hypothesis
    b. state a nondirectional research hypothesis
    c. do not use a research hypothesis
    d. use a research hypothesis that makes no prediction

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