Chapter 4

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Common Sources of Research Questions

The first three chapters introduced you to some broad themes in behavioral research, including the purpose of research, types of research, ethical issues, and the nature of science. Beginning with this chapter, we will focus on the details of conducting behavioral research. From a student's perspective, the thought of actually doing behavioral research seems like a daunting task. You are likely to say to yourself, "I couldn't possibly do research. I'm not a behavioral scientist. I don't even know how to get started." Well, we're here to tell you that you can do it, and it is not that difficult to get started.

Have you ever asked yourself, "I wonder why people behave that way?" If so, then you have already begun the research process. Research begins with asking questions. Curiosity about a casual observation that you have made could initiate a series of questions. For example, you may notice that youth spend much time watching television and that many of the television programs include references to sex and/or violence. So you may ask yourself, "Does watching television violence have a negative impact on personality development?" This is the beginning of a good research question. Topics for research questions often begin with your own curiosity. This curiosity may be fueled by your own personal experiences or observations. You may be interested in the topic of memory because you had a grandmother with Alzheimer's disease. You may be interested in people's perceptions of schizophrenics after taking a course in abnormal psychology. Perhaps the latest "reality show" on television stirs questions about why people behave in certain ways when placed in certain conditions. Research is so much more fun when you are pursuing a topic that fascinates you.

For most topics, it is very likely that others have already asked very similar questions and have conducted research in this area. But a good researcher knows that unanswered questions remain in every domain of psychology. So, given an area in which you are interested, what is the next step? A researcher needs to become familiar with the research findings that already exist. These findings are most likely to be reported in books and journal articles. Several strategies for obtaining this information are outlined in the following paragraphs.

Professors

Ask the faculty in the psychology department whether they have any information regarding your research question or whether they know of anyone doing research on the topic (this is also a good way to meet the faculty). Often, the research interests of the faculty are listed on a department Web site. Most faculty that we know enjoy discussing possible research topics with students and will often provide suggestions that help to shape and focus the topic. If the topic is of interest to the faculty member, he or she may suggest that you take an independent study course under his or her supervision.

You should also consider professors at other universities. You may encounter these researchers at a scientific conference where you attend their research presentation. Additionally, a search of the literature may reveal a particular researcher who has published several studies related to the topic in which you are interested. You could contact the researcher by e-mail to request a reprint of an article or to ask a few questions.

Textbooks

Look in the subject index of a textbook in your area of interest. The text will often include the names of researchers and citations of books or articles. For example, look in a Developmental Psychology textbook for “television.” You will undoubtedly find a section that discusses the impact of television on development.

Databases

Use keywords to search relevant databases. Several very good electronic databases contain references to journal articles or books. Ask your instructor or a reference librarian for the databases available on your campus. Some databases that are useful for behavioral research include PsycLit, PsycINFO, ProQuest, JSTOR Scholarly Journals, MedLine, and Sociological Abstracts. After you get access to a database, you can search it for references. You can search by author, year, or other means. Often, you will simply search for some word (or combination of words) that might appear in the title or summary. For example, you could use the PsycINFO database to search journal articles for studies related to the effect of TV violence on children. We did such a search. When we used the keyword “television,” the database produced 6,671 hits. No one wants to look through this many titles or abstracts, so we narrowed the search by using the keywords “television violence.” This search produced 156 hits, and it would not take too long to skim through those titles. A final search using the keywords “television children” produced a very manageable 17 hits. Thus, if the database finds too many articles for you to examine, narrow the search by entering additional keywords or by trying different combinations of keywords.

Internet

The Internet can be a source of research ideas. However, it takes some skill to search the Internet efficiently. First, much of the information on the Internet has no relation to science, and it can be very difficult to search a topic without hitting these sites. Second, some of the information on the Internet appears to be scientific when it is not. You must critically evaluate each site. For example, is the site located at a university or a known research agency? What are the credentials of the researcher(s)? Are there product advertisements at the site? Also, certain Internet search engines are more focused on scholarly information. As of this writing, two useful search engines are Ingenta, Galaxy and Google Scholar.

Selecting a Research Problem

Scientists select a research problem for any of several reasons. Some studies are undertaken to evaluate or to advance a particular theory. Others may be undertaken for the purpose of comparing the adequacy of two or more theories. The researcher's interest may have nothing to do with solving an existing psychological or sociological problem. As discussed in the previous chapter, terms such as *pure* or *basic research* are often used to describe research when no immediate practical application of the results is intended. In contrast, some research is undertaken because of its applied, practical nature. A social problem exists, and questions related to the problem are in need of answering. Is smoking marijuana a health hazard? Will certain changes in our educational system enhance scores on the American College Test or Student Achievement Test?

Others undertake studies to resolve inconsistencies or contradictory findings. If some research indicated that sleep following learning aids memory (which it does) and other research found that sleep hinders memory (which it doesn't), then the findings would be contradictory. If so, then little could be said regarding sleep and memory without additional research. The additional research would be directed to resolving the inconsistent findings. It would begin with a careful assessment of the two studies to determine in what ways they were similar and in what ways they were different. If important differences in procedure were found between the studies, then the contradictory findings might be due to these differences. In this case, a study could be undertaken to determine whether procedural differences were important.

Some research is conducted to extend the findings of prior research. For example, a study may show a particular effect of TV violence on 10-year-old children. You might ask whether that same effect would be observed in 5-year-old children. Also, you might be interested in extending the conditions that were tested. Perhaps you are interested in testing a type of TV violence that was not tested in another study. At other times, the findings of a particular study may seem implausible. In cases such as these, it is valuable to perform a replication study. In such a study, the method is replicated (duplicated) to determine whether the same results will be found a second time.

Obviously, research questions may be asked for many reasons. Answers to all questions cannot be provided, nor should they be. Clearly, some questions are too trivial and meaningless to bother answering.

Formulating Hypotheses

After you have reviewed the relevant literature and have a research question, you are prepared to be more specific. You want to make one or more predictions for your study. Such a prediction is called a **hypothesis.** It is an educated guess regarding what should happen in a particular situation under certain conditions. Not all studies require that you test a hypothesis; some may simply involve collecting information regarding an issue. For those that do have a hypothesis, the hypothesis should derive logically from previous findings or the predictions of a particular theory. Hypotheses should not be based simply on what the student believes should happen. A clear rationale is necessary.

An examination of publications by student researchers provides several examples of hypotheses. In a study that examined gender equity in college athletic programs, the authors predicted “female students would have more positive attitudes toward gender equity” (Teel, Fuller, & Allen, 1998, p. 20). Another study predicted “people would rate representatives of their own culture as more physically attractive than representatives of other cultures” (Khersonskaya & Smith, 1998, p. 40). As a final example, one student predicted “extroverts were more likely to be hired than introverts because of their outgoing and personable behavior” (Sheets, 1999, p. 8). You might be interested in the results of these studies. Goon et al. (1998) found that both male and female students supported gender equity in athletics. Khersonskaya and Smith (1998) did find that attractiveness ratings for American students were higher when made by American participants than by European participants. Sheets (1999) found that college men were more likely to hire extraverts but college women showed no preference.

To provide an example of hypothesis development, let’s return to our interest in the effect of TV violence on children. Studies that have been done suggest that children who frequently watch violence on television demonstrate more aggression at school. You wonder whether the effect is the same if the television viewing depicts cartoon/computer-animated characters as opposed to human actors. Based on research that suggests that children over the age of 7 understand that cartoon characters are not real, you hypothesize that the effect of TV violence on older children’s aggressive behavior at school will be less if the characters are not human. Now we have a clear prediction that we can set out to test using the scientific method.

Good hypotheses have several characteristics, including a clear rationale, an if–then format, and a clear description of the relationship between the variables of interest in your study. First, what do we mean by a clear rationale? You want to ask yourself, “Why am I predicting this effect?” It may be that you are replicating a study already reported in the literature. It may be that your prediction is a logical extension of what other researchers have published. Notice that our hypothesis in the previous paragraph was based on existing information. It may be that your prediction follows from a particular theory and provides a test of the theory. For example, one theory in social psychology states that as the number of bystanders increases near a victim, each bystander feels less responsibility to help the victim. Based on this diffusion of responsibility theory, you might predict that if a student drops her books in a crowded student center on campus, then the student will be less likely to receive help than if only a few people are in the student center.

Notice that this hypothesis provides a clear description of the relationship between the first variable (number of bystanders) and the second variable (likelihood of receiving help) and does so using an if–then format. If particular environmental conditions exist, then there will be a particular consequence in terms of human behavior. Table 4.1 provides several more examples of good hypotheses, along with several hypotheses that are not well stated.

Table 4.1 Examples of Good and Bad Hypothesis Statements

Good Hypothesis Statement	Bad Hypothesis Statement
In the case of murder, mock juries will be more likely to convict a black defendant than a white defendant.	There is bias in the justice system.
As the number of hours in paid employment increases, the number of hours spent studying for classes will decrease.	College students shouldn't work so much.
Employees will be more productive when working under bright lights than when working under dim lights.	Employees will work differently under different lights.
In detecting enemy aircraft, a fighter pilot will react more quickly to an auditory warning signal than a visual warning signal.	A fighter pilot can be warned with either an auditory signal or a visual signal.

Variables of Interest

When researchers are manipulating an environmental condition to determine its effect on behavior, they use special terms that help describe these activities. A **variable** is any condition that can vary or change in quantity or quality. The **independent variable,** or treatment, is under the control of and administered by the experimenter. The behavior that is potentially affected by the treatment and that we measure is called the **dependent variable.** The dependent variable is always a measure of behavior that we record after first manipulating the independent variable. It is referred to as *dependent* because changes in it *depend* on the effects of the independent variable. If a systematic relationship is found between the independent and dependent variables, then we have established an empirical or causal relationship. It is also sometimes called a **functional relationship** because changes in the dependent variable are a *function* of values (different amounts) of the independent variable. From these lawful or functional relationships, we can construct theories and make predictions regarding future behavior. As we discuss independent and dependent variables, you will notice that they are always defined in precise and measurable terms. The nature and importance of these operational definitions will be highlighted in the next chapter.

The independent variable may be either qualitative or quantitative. A **qualitative variable** is one that differs in kind rather than in amount. There are different types of violent acts on television, many different kinds of psychotherapy, effects of different drugs on reaction time, and we may receive feedback or fail to receive feedback when learning a psychomotor task. All of these examples involve qualitative variables. In contrast, a **quantitative variable** differs in amount. One could examine different amounts of TV violence to which a child is exposed, different intensities of punishment, the dosage level of a drug, or the number of practice trials. Table 4.2 lists some qualitative and quantitative variables that are used as independent variables in psychological research. It should be clear by now that selecting the independent variable(s) and dependent variable(s) is a very important step in the research process.

Table 4.2 Examples of Qualitative and Quantitative Independent Variables Found in Psychological Research

A quantitative variable involves a single continuum in which different treatment levels or amounts may be administered to participants. Qualitative variables differ in kind rather than in amount.

Qualitative Independent Variables	
Variable	**Example**
Teaching method	Lecture vs. discussion
Type of therapy	Psychoanalytic vs. behavioral vs. cognitive
Type of drug	Prozac vs. Zoloft vs. Paxil (antidepressants)
Type of exercise	None vs. walking vs. swimming
Quantitative Independent Variables	
Variable	**Example**
Drug dosage	0 mg caffeine vs. 20 mg caffeine vs. 40 mg caffeine
Level of sleep deprivation	0 hrs vs. 8 hrs vs. 16 hrs vs. 24 hrs
Level of reinforcement	1 food pellet for a correct response vs. 4 food pellets
Size of the group	Group of 2 vs. group of 4 vs. group of 6

Take a look at the box “Thinking Critically About Everyday Information,” and consider the different components of the study reported there.

Thinking Critically About Everyday Information: Why We Watch So Much Television

A national news network reported the results of a study with an introduction that stated that researchers "found that switching on the tube helps distract people from their personal failings." The study was published by Moskalenko and Heine (2003) in *Personality and Social Psychology Bulletin.* According to the news report, college students took an intelligence test and received predetermined feedback regarding how well they performed. Half of the students were told that they did well, and half were told that they did poorly. All of the students then had the opportunity to watch television for up to six minutes. Results showed that those students who were told that they had done poorly on the intelligence test watched TV for more minutes and also looked at the TV longer before looking at something else. Students also reported that after watching TV they "perceived less challenge to their chosen self-image." Consider the following questions:

- What was the independent variable in the study? Was it a quantitative variable or a qualitative variable?
- What were the dependent variables in the study?
- Although not mentioned in the description above, what do you suppose was the hypothesis for the study?
- Do you believe that the conclusion as stated in the opening sentence accurately reflects the results of the study? Why or why not?
- Do the results of the study match your own personal experience? Do you believe that your own personal experiences influence whether you believe the results of a scientific study?

SOURCE: News report obtained online from http://abcnews.go.com/sections/living/Healthology/HS_TVlowesteem_030123.html on January 28, 2003

Selecting Levels of an Independent Variable

When we explore completely new areas, little information is available to provide guidelines in selecting the independent variable. When dealing with quantitative independent variables, we are faced with the additional problem of selecting appropriate values of the variable. For example, when testing a new drug, how many milligrams per pound of body weight should be used as the dosage level? This decision is important because too low a dosage may be insufficient to produce an effect, whereas too much may be harmful or even lethal. We must rely on our judgment based upon experience, conversations with our colleagues regarding potential problems, and the information that experts in related areas may be able to provide. In most instances however, our research builds on previously published research. A rich database is often available to assist in the selection of the appropriate values. In fact, most researchers choose what they consider proper values of a treatment condition based on their own experiments and the published experiments of others.

Some obvious guidelines should be considered when choosing values of an independent variable. As we shall see, a minimum of two groups is necessary to determine whether the independent variable has an effect. One of these groups would receive the treatment (experimental group), and the other group would either not receive the treatment (control group) or receive a different level of the treatment. If you use more than two groups in an effort to ascertain whether increasing levels of the independent variable systematically influence behavior, the choice of values for the independent variable requires more thought.

Let's direct our attention to the first of these problems: determining whether an experimental variable has an effect. If we use only two levels (values) of the experimental treatment and they are too similar, what risk do we run? The treatment may not affect behavior differentially, and your efforts to establish a relationship may fail. You would wrongly conclude that the treatment is not worthy of further study. To counter this risk, the first thought that often comes to mind is to select extreme values of the independent variable. The logic is straightforward and simple: The greater the difference in value between the experimental conditions, the greater the probability of showing that the independent variable has an effect. Therefore, choose two points along the continuum that are extreme values. Under certain circumstances, the logic is good and would provide an efficient way of determining whether the independent variable is powerful and worthy of additional investigation. Unfortunately, this simple logic could also result in coming to a wrong conclusion, depending on the relationship between the independent and dependent variable.

The reason for the problem is that a variety of relationships may exist. Some of these are depicted in Figure 4.1. The graphs in Figure 4.1 are constructed so that increasing levels of the independent variable are shown from left to right on the horizontal (x) axis and increasing levels of the dependent variable are shown from bottom to top on the vertical (y) axis. When the relationship between the dependent and independent variable is **monotonic,** the curve is either continuously rising throughout (A and B in Figure 4.1) or continuously falling throughout (D and E in Figure 4.1). When the relationship is **nonmonotonic,** the curve rises at certain points and falls at other points (C and F in Figure 4.1).

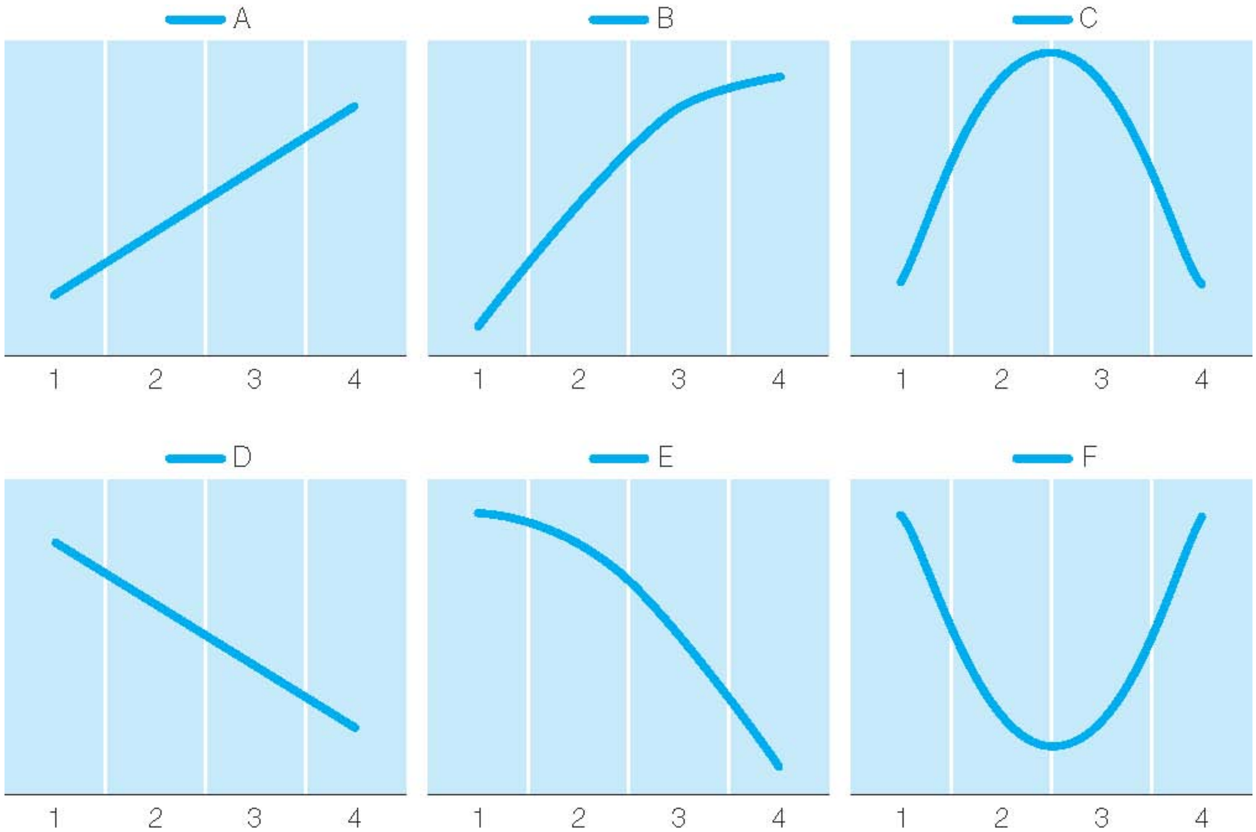

Figure 4.1 Illustration of various types of relationships between the independent variable (IV) and the dependent variable (DV). Curves A, B, D, and E depict monotonic relationships; C and F show nonmonotonic relationships. In graphing relationships, the horizontal axis (*x*-axis) depicts values for the IV and the vertical axis (*y*-axis) depicts values for the DV.

As you might expect, monotonic functions generally do not create difficulties for experiments that use the extreme group approach. With monotonic functions, any two separated values on the horizontal axis could result in finding a difference between groups. Therefore, when the relationship is monotonic, the major limitation of the extreme group approach is that the shape of the relationship or function cannot be established with two groups. Obviously, the effects of intermediate values cannot be determined with only two values of an independent variable.

However, if the relationship between the independent and the dependent variable is nonmonotonic (C and F in Figure 4.1), simply using two groups at extreme points could lead to grossly inaccurate conclusions. For example, an interesting idea that relates effectiveness of performance to level of motivation and task difficulty has come to be called the Yerkes–Dodson Law (Yerkes & Dodson, 1908). The notion described by this “law” is that the optimal level of motivation depends on task difficulty: The more difficult or complex the task, the lower will be the optimal level of motivation needed. According to the law, performance is poor with little motivation; as motivation increases, performance also increases—but only to a point. Beyond that point, depending on the task difficulty, further increases in motivation lead to a deterioration in performance. The so-called Yerkes–Dodson Law has not yet received convincing support, but the idea is intuitively reasonable, and some supportive data are available. On this view, optimal performance does not require the highest levels of motivation; in fact, too much motivation can result in inferior performance. When performance (*x*-axis) is plotted against motivation (*y*-axis), the relationship resembles an inverted U.

With this sort of relationship, simply using two groups at extreme points could be quite misleading. If the relationship between the independent and the dependent variable is nonmonotonic (C or F in Figure 4.1), a study using only two groups could easily conclude that the independent variable has no effect on behavior. If values 1 and 4 on the horizontal axis are selected, then both groups would perform in the same manner and no difference would be detected. The same would be the case with values 2 and 3. Finding no difference, the investigator might well conclude that the independent variable has no effect. Some promising research might wind up in the circular file when, in fact, it should be pursued.

The safest way to avoid the problem is to test at least three values of the independent variable. Selecting three points will not necessarily reveal the shape of the relationship, but it will help you to avoid coming to incorrect conclusions in the event that a nonmonotonic relationship exists. The choice between using two values or more than two values often depends on the information available, the importance of the problem, and the cost of doing research.

Selecting a Dependent Variable

The selection of a dependent variable is not in the least a casual matter. Indeed, it is immensely important. It reflects our underlying assumption that the study of behavior is the doorway toward measuring psychological states. Moreover, it is the measure we use to ascertain whether the independent variable has an effect.

Generally, we choose a dependent measure because we judge that it will reveal unobservable but inferable processes that affect it and other behavioral measures. We often assume that our dependent variable reflects some underlying psychological state. For example, emotional processes are often inferred from changes in heart rate, respiration, or sweat gland activity. We might infer stress from ulceration or from adrenal activity. The process of learning is inferred from the elimination of errors, correct anticipation of words, and conditioned responses.

There must be no ambiguity concerning the identification of the dependent variable. Its occurrence or nonoccurrence must be ascertainable according to clearly defined criteria. For example, the dependent measure in an operant conditioning apparatus is any response (usually a lever press or key peck) that closes the microswitch and permits its delivery of reinforcement. Such measures as speed of responding, latency, time to complete a task, eye blinks, errors, heart rate, weight gain, lever press, or key peck can be unambiguously defined and reliably recorded. The reliability of a measure is its ability to give the same result on each occasion. (Note that this is an important concept that will be highlighted in the next chapter.) Such unambiguous measures are not always possible. Some dependent measures require the judgment of observers. What about such measures as self-mutilating behavior in an autistic child, risk taking, aggression, and disruptive classroom behavior? High agreement (reliability) among observers must be achieved before the experiment begins. Special techniques are used to accomplish such reliability. (Chapter 6 will discuss this issue in more detail.)

We should also note that automated responses such as a pigeon key peck or a rat lever press may be unambiguous in terms of a switch closure but ambiguous in terms of what produced the closure. A rat, for example, may produce a switch closure in many ways— with the left paw, the right paw, chin, tail, shoulder, or rump. The experimenter may be interested in the entire class of responses referred to as lever presses, or may be interested only in paw presses.

Characteristics of a Good Dependent Variable

A good dependent variable must be accurately recorded and reliably measured. This is another way of saying it must be *objective* and *quantifiable.* In addition, it must be sufficiently sensitive to detect small changes in the independent variable, yet not so sensitive that it is affected by the slightest uncontrolled factors in the environment.

Further, a good measure should have a “low floor” and a “high ceiling.” In other words, the dependent variable should permit a wide range of values or change. Imagine a task so difficult that few individuals are capable of achieving it. For example, in a test of the effectiveness of vitamin supplements on physical strength, the experimenter sets a criterion of bench-pressing 250 pounds or more. In this situation, very few participants would reach criterion even if the supplement actually increased physical strength. The “floor” was simply set too high. In contrast, if the task had been to bench press 10 pounds, the “ceiling” would have been so low that virtually all participants would achieve criterion whether or not the experimental variable affected physical strength.

Floor effects and **ceiling effects** occur sometimes when giving examinations to students. If an exam is so easy that all students correctly answered every test item (all received a score of 100% correct), then the exam may not have discriminated those knowing the material from those not knowing it. In this case, the ceiling was too low. Students “topped out” and could not go higher. On the other hand, if the exam was so difficult that all students answered every test item incorrectly (all received a score of 0% correct), then again the exam did not discriminate those knowing the material from those not knowing. In this case, the floor was too high; everyone “bottomed out” and could not go lower. The sensitivity of the measuring instrument is always reduced when either floor or ceiling effects are prominent. In the event of too high a floor or too low a ceiling, the range of possible values of the dependent variable is so truncated that it loses its capacity to discriminate among various treatment conditions.

When we observe behavior, human or nonhuman, we find that many different forms of behavior occur—it appears continuous but changing. Even when we observe an organism for a short time, we see different *frequencies* of behaviors such as walking, talking, writing, or grooming. At the same time, physiological changes also occur. The responses that we observe occur for different *durations* with differing *intensities.* Deciding what particular response to measure can be a difficult task. As we noted, selecting an insensitive dependent variable or one unresponsive to the independent variable may cause us to fail in our efforts.

There are several reliable and sensitive measures that you should keep in mind when planning your research. Researchers frequently use these measures because of their sensitivity, reliability, and ease of measurement. They are (1) *accuracy* of responding, (2) *frequency* of responding, (3) *latency* (or speed) of responding, (4) *duration* of responding, and (5) *intensity* of responding. All five of these measures are sometimes taken within a given experiment. Accuracy of responding simply refers to whether the participant is responding correctly. Frequency of responding may refer to the number of times a behavior occurs. Also, a rate of responding measure can be derived if responses per unit of time are recorded. Latency usually refers to the time it takes to initiate a response following the onset of a signal. This measure can be converted to a speed measure by calculating the reciprocal of latency. Intensity of responding, sometimes referred to as amplitude or magnitude of responding, relates to the vigor of the response. Finally, duration or time measures reflect how long a response continues—how long it takes to consume the food, solve the puzzle, or calculate the solution, or how much time is spent in one condition compared to others.

Multiple Dependent Variables

Most experiments record only one dependent variable. One reason for this relates to interpreting what the different measures mean. Does each behavior recorded measure the same thing? That is, does each measure reflect the same inferred or assumed underlying processes? For example, is kicking a vending machine that fails to deliver a candy bar the same inferred underlying measure of frustration as other measures such as cussing at the machine or repeatedly pushing the selector button? A second reason is that when more than one measure is recorded, traditional statistics require a separate statistical analysis for each measure. These multiple analyses, in turn, make it difficult to interpret the true probability (p)

value for a significant outcome. However, excellent statistical techniques are now available for assessing multiple dependent variables.

Two, three, or more dependent variables are recorded and analyzed in a single procedure referred to as a *multivariate analysis*. Multiple measures may vary together, thus suggesting a common underlying process for all measures. When they do not vary together, different processes are suggested. Both theoretical and practical considerations determine the number of measures used. A discussion of statistical procedures for analyzing concurrently several dependent measures is too advanced for a first course in research methods. Suffice it to say there are advantages to this type of analysis.

Aside from statistical advantages, however, there are other reasons for recording two or more dependent variables. It may be that under the conditions of your experiment, a single dependent measure may not show any systematic relationship to your independent variable. Your measure may be too insensitive or too variable. If you record other, different measures, your chances of finding a systematic relationship may be increased. In addition, recording more than a single dependent variable will allow you to evaluate the relationship among them. You have little to lose and much to gain by recording more than a single dependent variable, unless doing so is inconvenient, time consuming, or expensive.

Response Classes of Dependent Variables

The number of dependent measures recorded by researchers is determined by both theoretical and practical considerations. Investigators studying behavior, whether in a laboratory or an applied setting, generally use three major classes of responses. These three classes of responses are motor responses, physiological measures, and self-report measures. Whatever measure is used, great care must be taken when measuring and recording the response. It is not uncommon for researchers to record different classes of responses within the same experiment. Each has advantages and disadvantages associated with its use.

Motor responses involve the skeletal muscle system in some way. These responses may vary in terms of accuracy, frequency, latency, duration, or intensity. Some examples of motor responses are walking, talking, drinking, eating, crying, fighting, running, smiling, studying, smoking, gambling, freezing, jumping, bar pressing, playing, key pecking, and choosing. When motor responses are automatically recorded, mechanically or electronically, errors due to the human observer are virtually eliminated. However, only some motor responses can be automated; observers must record other responses. Relying on observers to note and record our dependent variables is a serious issue for a considerable amount of research being done in psychology today. The issue is that human observers are not perfectly reliable at the task and thus represent an imperfect measuring instrument. (This issue will be discussed in more detail in Chapter 6.)

Physiological measures can be taken from the surface of the body or from within the body. Measures taken from the surface of the body include brain activity—measured by electroencephalogram, PET scan (positron emission tomography), or MRI (magnetic resonance imaging)—sweat gland activity, muscle activity, heart rate, blood pressure, blood vessel constriction and dilation, and skin temperature. Measures taken from within the body include activity of neural cells and levels of various substances. The researcher may sample blood, urine, or saliva to determine levels of blood sugar, neurotransmitters, and hormones. Physiological measures generally require more equipment and a degree of technical expertise.

With self-report measures, participants verbalize how they are reacting to the experimental conditions. Participants verbalize whether they are anxious, concerned, aroused, depressed, happy, and so on. Exposure to different conditions presumably has an effect on how the participants react, and they are asked to self-monitor their reactions and then to report them to the investigator. It is obvious that self-report measures are susceptible to distortion on the part of the participant. Further, some researchers believe that the very task of asking participants to monitor and verbalize their reactions may alter the measure; instead of reacting to the independent variable, they may be reacting to instructions. For this reason, some researchers are reluctant to use self-report measures alone; they attempt to correlate self-report measures with physiological responses. Because physiological responses are generally not under voluntary control, they are presumably less susceptible to the criticism directed toward self-report measures.

As we have suggested several times, researchers generally measure several dependent variables in their research. These measures may be within the same class or across classes. It may be especially important to record several dependent measures when your knowledge of the independent variable is limited, when the effects are difficult to predict, or when you are interested in a possible relationship among several dependent variables.

In closing this section, we want to emphasize that whether they are using human or nonhuman participants, experimenters should strive to record dependent measures that are not distressing to their participants. In choosing both dependent and independent variables, researchers should keep careful consideration of ethical principles foremost in mind.

Case Analysis

A researcher wonders how well the sense of smell functions during sleep. In general, we know that our sensory systems operate at a higher threshold during sleep. That is, a more intense stimulus is required to elicit a response during sleep than during wakefulness. Furthermore, we are less responsive during some stages of sleep than during others. Experiments using sounds suggest that we are less responsive during stages 3 and 4 sleep (deep sleep) than during stages 1, 2, or REM sleep (lighter sleep). Thus, the researcher predicts that research participants will be less responsive to odors during stages 3 and 4 sleep than during the other stages of sleep.

The researcher devises a system for delivering odors while college students sleep in the laboratory. Peppermint fragrance is delivered at specific times through a modified oxygen mask that the students wear while they sleep. Electrodes are attached to each student's scalp, face, and chin to determine sleep staging. Electrodes are also attached to each student's chest to record heart rate. A change in heart rate following presentation of the odor is used to indicate that the participant detected the odor.

Critical Thinking Questions

1. What is the research hypothesis?
2. What is the independent variable?
3. What is the dependent variable?
4. From which response class does the dependent variable come?
5. Is the independent variable a qualitative variable or a quantitative variable? Explain.
6. Why might the researchers want to use multiple dependent variables?
7. Describe one limitation of this study.

General Summary

We are all amateur researchers in the sense that we ask questions about human behavior and thought. Quality research involves a more systematic approach. A good researcher understands that a research question begins with an idea and is then shaped by information from other professionals and sources. The research question evolves into a more specific research hypothesis that predicts a particular relationship between the independent and dependent variables. The researcher carefully selects appropriate levels of the independent variable and decides on the most appropriate type of dependent variable, whether it be a motor response, physiological response, or self-report. In the next chapter, we will explore all of these variables in more detail, including the development of detailed definitions and strategies for measurement.

Detailed Summary

1. Research questions are developed by using sources that include curiosity, professors, textbooks, journals, databases, and the Internet.
2. Keywords based on your research topic are used to search the literature for information and prior research on the topic.

3. Research questions can be designed to evaluate a theory, to compare two or more theories, to address a practical problem, to resolve inconsistencies in the literature, to replicate a prior study, or to investigate a particular question that has not yet been studied.
4. Research questions lead to a hypothesis that states the predicted outcome for the study.
5. Good hypotheses have several characteristics, including a clear rationale, an if–then format, and a clear description of the relationship between the variables of interest in the study.
6. The independent variable (treatment) is the variable that is under the control of and manipulated by the experimenter. The behavior that is affected by the treatment and that we measure is called the dependent variable.
7. A qualitative independent variable is one for which the levels represent different and distinct categories. A quantitative independent variable is one for which the levels represent different amounts of that variable.
8. Selection of the levels of a quantitative independent variable depends to some degree on the estimated nature of the functional relationship between the independent and dependent variables. Two levels may be sufficient for some monotonic (single-direction) relationships, but three or more levels may be necessary for nonmonotonic relationships (the curve changes direction). A good dependent variable should be objective, quantifiable, reliable, and sufficiently sensitive to changes in the independent variable.
9. The dependent variable should be selected so as to avoid floor effects and ceiling effects—that is, a limited range of values.
10. Dependent variables often measure accuracy, latency, duration, or intensity of responding. In many situations, multiple dependent variables can be recorded to provide more information about the relationship between the independent and dependent variables.
11. The three major classes of dependent variables are motor responses, physiological responses, and self-report responses. Each has advantages and disadvantages.

Key Terms

ceiling effect

dependent variable

floor effect

functional relationship

hypothesis

independent variable

monotonic relationship

nonmonotonic relationship
qualitative variable
quantitative variable
variable

Review Questions / Exercises

1. Go to a relatively busy area of your college campus and observe some aspect of human behavior. Based on these observations, write a research question that could be tested. Also, write a specific hypothesis that follows the guidelines discussed in this chapter.
2. Consider a research topic in which you are interested, and conduct a database search for journal articles on that topic using one or more of the databases available on your library website. Develop a set of keywords that you believe represent your topic. Use these keywords to search the database. If your search results in more than 20 hits, continue using particular combinations of keywords until your search results in fewer than 20 hits. Review these titles, and select one article to read. Apply the critical thinking questions from the case analysis in this chapter to the article that you have read.
3. Using the same database search or a new search, locate an experiment and print the citation (including the abstract). Identify the independent variable and the dependent variable. Determine whether the independent variable is a qualitative variable or a quantitative variable.
4. Provide a brief description of your own idea for an experiment on the topic of human memory. Write the hypothesis, and identify the independent variable. How many levels will your independent variable have? Specify the levels, and explain why you chose them.
5. Provide a brief description of your own idea for an experiment on the topic of sleep. Write the hypothesis, and identify the dependent variable(s). Is your experiment one in which it could be advantageous to have multiple dependent variables? Explain. Why do you believe that your dependent variable(s) is (are) good? Identify the response class for each dependent variable.