

TWELFTH EDITION

PRACTICAL RESEARCH

PLANNING AND DESIGN

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Chapter 1

The Nature and Tools of Research

In virtually every subject area, our collective knowledge about the world is incomplete: Certain questions remain unanswered, and certain problems remain unsolved. Systematic research provides many powerful tools—not only physical tools but also mental and social tools—that can help us discover possible answers and identify possible solutions.

Learning Outcomes

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| <ul style="list-style-type: none">1.1 Distinguish between (a) common uses of the term <i>research</i> that reflect misconceptions about what research involves and (b) the true nature of research in academic settings.1.2 Describe the iterative, cyclical nature of research, including the steps that a genuine research project involves.1.3 Distinguish among positivism, postpositivism, constructivism, and | <ul style="list-style-type: none">pragmatism/realism as philosophical underpinnings of a research project.1.4 Identify examples of how six general research tools can play significant roles in a research project: (a) the library and its resources, (b) computer technology, (c) measurement, (d) statistics, (e) language, and (f) the human mind.1.5 Describe steps you might take to explore research in your field. |
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In everyday speech, the word *research* is often used loosely to refer to a variety of activities. In some situations the word connotes simply finding a piece of information or taking notes and then writing a so-called “research paper.” In other situations it refers to the act of informing oneself about what one does not know, perhaps by rummaging through available sources to locate a few tidbits of information. Such uses of the term can create considerable confusion for university students, who must learn to use it in a narrower, more precise sense.

Yet when used in its true sense—as a systematic process that leads to new knowledge and understandings—the word *research* can suggest a mystical activity that is somehow removed from everyday life. Many people imagine researchers to be aloof individuals who seclude themselves in laboratories, scholarly libraries, or the ivory towers of large universities. In fact, research is often a practical enterprise that—given appropriate tools—any rational, conscientious individual can conduct. In this chapter we lay out the nature of true research and describe general tools that make it possible.

WHAT RESEARCH IS NOT

Following are three statements that describe what research is not. Accompanying each statement is an example that illustrates a common misconception about research.

1. *Research is not merely gathering information.* A sixth-grader comes home from school and tells her parents, “The teacher sent us to the library today to do research,

and I learned a lot about black holes.” For this student, research means going to the library to find a few facts. This might be *information discovery*, or it might be learning *reference skills*. But it certainly is not, as the teacher labeled it, research.

2. *Research is not merely rummaging around for hard-to-locate information.* The house across the street is for sale. You consider buying it and call your realtor to find out how much someone else might pay you for your current home. “I’ll have to do some research to determine the fair market value of your property,” the realtor tells you. What the realtor calls doing “some research” means, of course, reviewing information about recent sales of properties comparable to yours; this information will help the realtor zero in on a reasonable asking price for your own home. Such an activity involves little more than searching through various files or websites to discover what the realtor previously did not know. Rummaging—whether through records in one’s own office, at a library, or on the Internet—is not research. It is more accurately called an *exercise in self-enlightenment*.

3. *Research is not merely transporting facts from one location to another.* A college student reads several articles about the mysterious Dark Lady in William Shakespeare’s sonnets and then writes a “research paper” describing various scholars’ suggestions of who the lady might have been. Although the student does, indeed, go through certain activities associated with formal research—such as collecting information, organizing it in a certain way for presentation to others, supporting statements with documentation, and referencing statements properly—these activities do not add up to true research. The student has missed the essence of research: the *interpretation* of data. Nowhere in the paper does the student say, in effect, “These facts I have gathered seem to indicate such-and-such about the Dark Lady.” Nowhere does the student interpret and draw conclusions from the facts. This student is approaching genuine research; however, the mere compilation of facts, presented with reference citations and arranged in a logical sequence—no matter how polished and appealing the format—misses genuine research by a hair. Such activity might more realistically be called *fact transcription*, *fact documentation*, *fact organization*, or *fact summarization*.

Going a little further, this student would have traveled from one world to another: from the world of mere transportation of facts to the world of interpretation of facts. The difference between the two worlds is the distinction between transference of information and genuine research—a distinction that is critical for novice researchers to understand.

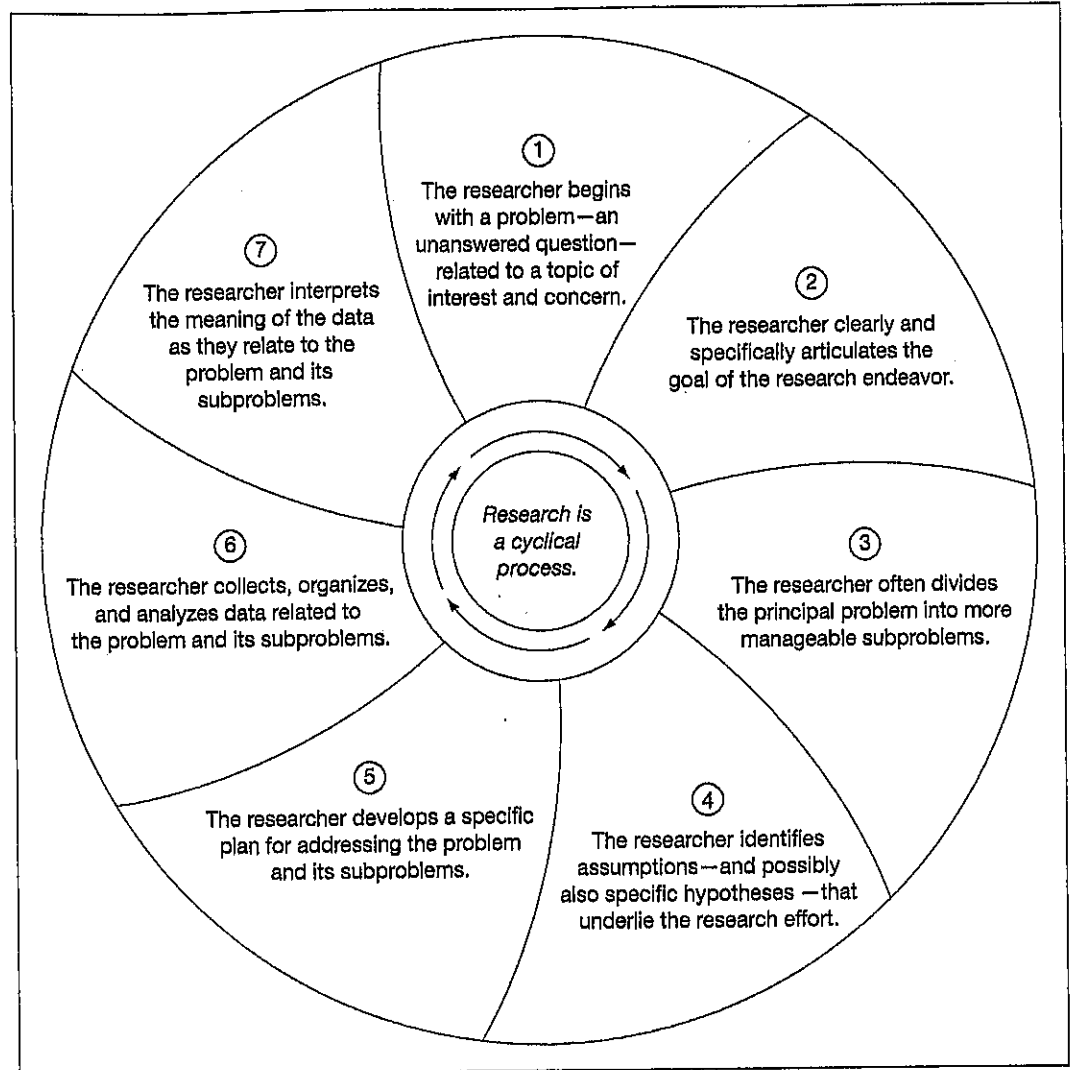
MyLab Education Self-Check 1.1

WHAT RESEARCH IS

Research is a systematic process of collecting, analyzing, and interpreting information—*data*—in order to increase our understanding of a phenomenon about which we are interested or concerned.¹ People often use a systematic approach when they collect and interpret information to solve the small problems of daily living. Here, however, we focus on *formal*

¹Some people in academia use the term *research* more broadly to include deriving new equations or abstract principles from existing equations or principles through a sequence of mathematically logical and valid steps. Such an activity can be quite intellectually challenging, of course, and is often at the heart of doctoral dissertations and scholarly journal articles in mathematics, physics, and related disciplines. In this book, however, we use the term *research* more narrowly to refer to *empirical* research—research that involves the collection and analysis of new data.

FIGURE 1.1 ■ The Research Cycle



research, research in which we intentionally set out to enhance our understanding of a phenomenon and expect to communicate what we discover to the larger scientific community.

Although research projects vary in complexity and duration, research generally involves seven distinct steps, shown in Figure 1.1. We now look at each of these steps more closely.

1. *The researcher begins with a problem—an unanswered question—related to a topic of interest and concern.* The impetus for all good research is a desire to acquire new information that advances our collective understandings of physical, biological, social, or psychological phenomena. At a minimum, good researchers are *curious* researchers: They genuinely want to learn more about a particular topic. Many of them are also motivated to identify possible solutions to local, regional, or global problems—solutions that might either directly or indirectly enhance the well-being of humankind or of the physical, biological, and social environments in which we live.

As you think about your topic of interest, consider these questions: What is such-and-such a situation like? Why does such-and-such a phenomenon occur? Might such-and-such an intervention alter the current state of affairs? What does it all mean? With questions like these, research begins.

2. *The researcher clearly and specifically articulates the goal of the research endeavor.* A critical next step is to pin down the issue or question—which we will refer to as the research problem—that the researcher will address. The ultimate goal of the research must be set forth in a grammatically complete sentence that specifically and precisely identifies the question the researcher will try to answer. When you describe your objective in clear, concrete terms, you have a good idea of what you need to accomplish and can direct your efforts accordingly.

3. *The researcher often divides the principal problem into more manageable subproblems.* From a design standpoint, it is often helpful to break a main research problem into several subproblems that, when solved, can possibly resolve the main problem.

Breaking down principal problems into small, easily solvable subproblems is a strategy we use in everyday living. For example, suppose you want to drive from your hometown to a town many miles or kilometers away. Your principal goal is to get from one location to the other as expeditiously as possible. You soon realize, however, that the problem involves several subproblems:

Main problem:	How do I get from Town A to Town B?
Subproblems:	1. What route appears to be the most direct one? 2. Is the most direct one also the quickest one? If not, what route might take the least amount of time? 3. Which is more important to me: minimizing my travel time or minimizing my energy consumption? 4. At what critical junctions in my chosen route must I turn right or left?

Thus, what initially appears to be a single question can be divided into several smaller questions that must be addressed before the principal question can be resolved.

So it is with most research problems. By closely inspecting the principal problem, the researcher often uncovers important subproblems. By addressing each of the subproblems, the researcher can more easily address the main problem. If a researcher doesn't take the time or trouble to isolate the lesser problems within the major problem, the overall research project can become cumbersome and difficult to manage.

Identifying and clearly articulating the problem and its subproblems are the essential starting points for formal research. Accordingly, we discuss these processes in depth in Chapter 2.

4. *The researcher identifies general assumptions—and possibly also specific hypotheses—that underlie the research effort.* An assumption is a condition that is taken for granted, without which the research project would be pointless. For example, imagine that your problem is to investigate whether students learn the unique grammatical structures of a language more quickly by studying only one foreign language at a time or by studying two foreign languages concurrently. What assumptions would underlie such a problem? At a minimum, you must assume that

- The teachers used in the study are competent to teach the language or languages in question and have mastered the grammatical structures of the language(s) they are teaching.
- The students taking part in the research are capable of mastering the unique grammatical structures of any language(s) they are studying.
- The languages selected for the study have sufficiently different grammatical structures that students might reasonably learn to distinguish between them.

Aside from such basic ideas as these, however, careful researchers state their assumptions, so that other people inspecting the research project can evaluate it in accordance with *their own* assumptions. For instance, a researcher might assume that

- Participants' responses in a paper-and-pencil questionnaire, face-to-face interview, or online survey are reasonably accurate indicators of their actual behaviors or opinions.
- Behaviors observed in an artificial laboratory environment can effectively reveal how people or other animal species are likely to behave in more natural, real-world settings.
- Certain assessment instruments (e.g., widely used intelligence tests, personality tests, and interest inventories) reflect relatively stable personal characteristics that are unlikely to change very much in the near future. (We examine this issue in detail in the discussion of *validity* of assessment instruments in Chapter 4.)

As you will discover in upcoming chapters, researchers can sometimes support such assumptions by citing past research findings or collecting certain kinds of data within their own research projects.

In addition to stating basic assumptions, many researchers form one or more hypotheses about what they might discover. A *hypothesis* is a logical supposition, a reasonable guess, an educated conjecture. In formal research, it might be more specifically called a research hypothesis, in that it provides a tentative explanation for a phenomenon under investigation. It may direct your thinking to possible sources of information that will aid in resolving one or more subproblems and, as a result, may also help you resolve the principal research problem. When one or more research hypotheses are proposed prior to any data collection, they are known as *a priori* hypotheses—a term whose Latin roots mean “from something before.”

Hypotheses are certainly not unique to research. In your everyday life, if something happens, you immediately try to account for its cause by making some reasonable conjectures. For example, imagine that you come home after dark, open your front door, and reach inside for the switch that turns on a nearby table lamp. Your fingers find the switch. You flip it. No light. At this point, you identify several hypotheses regarding the lamp's failure:

Hypothesis 1: A recent storm has disrupted your access to electrical power.

Hypothesis 2: The bulb has burned out.

Hypothesis 3: The lamp isn't securely plugged into the wall outlet.

Hypothesis 4: The wire from the lamp to the wall outlet is defective.

Hypothesis 5: You forgot to pay your electric bill.

Each of these hypotheses hints at a strategy for acquiring information that may resolve the nonfunctioning-lamp problem. For instance, to test Hypothesis 1, you might look outside to see whether your neighbors have lights, and to test Hypothesis 2, you might replace the current light bulb with a new one.

Hypotheses in a research project are as tentative as those for a nonfunctioning table lamp. For example, a biologist might speculate that certain human-made chemical compounds increase the frequency of birth defects in frogs. A psychologist might speculate that certain personality traits lead people to show predominantly liberal or conservative voting patterns. A marketing researcher might speculate that humor in a television commercial will capture viewers' attention and thereby will increase the odds that viewers buy the advertised product. Notice the word *speculate* in all of these examples. Good researchers always begin a project with open minds about what they may—or may *not*—discover in their data.

Hypotheses—predictions—are an essential ingredient in certain kinds of research, especially experimental research (see Chapter 7). To a lesser degree, they might guide other forms of research as well, but they are intentionally *not* identified in the early stages of some kinds of qualitative research (e.g., see the discussion of grounded theory studies in Chapter 8).

5. *The researcher develops a specific plan for addressing the problem and its subproblems.* Research is not a blind excursion into the unknown, with the hope that

the data necessary to address the research problem will magically emerge. It is, instead, a carefully planned itinerary of the route you intend to take in order to reach your final destination—your research goal. Consider the title of this text: *Practical Research: Planning and Design*. The last three words—*Planning and Design*—are especially important ones. Researchers plan their overall research design and specific research methods in a purposeful way so that they can acquire data relevant to their research problem and subproblems. Depending on the research question, different designs and methods are more or less appropriate.

In the formative stages of a research project, much can be decided: Are any existing data directly relevant to the research problem? If so, where are they, and are you likely to have access to them? If the needed data *don't* currently exist, how might you generate them? And later, after you have acquired the data you need, what will you do with them? Such questions merely hint at the fact that planning and design cannot be postponed. Each of the questions just listed—and many more—must have an answer early in the research process. In Chapter 4, we discuss several general issues related to research planning. Then, beginning in Chapter 6, we describe strategies related to various research methodologies.

You should note here that we are using the word *data* as a plural noun; for instance, we ask “Where *are* the data?” rather than “Where *is* the data?” Contrary to popular usage of the term as a singular noun, *data* (which has its origins in Latin) refers to two or more pieces of information. A single piece of information is known as a *datum*, or sometimes as a *data point*.

6. The researcher collects, organizes, and analyzes data related to the problem and its subproblems. After a researcher has isolated the problem, divided it into appropriate subproblems, identified assumptions (and possibly also *a priori* hypotheses), and chosen a suitable design and methodology, the next step is to collect whatever data might be relevant to the problem and organize and analyze those data in meaningful ways.

The data collected in research studies take one or both of two general forms. Quantitative research involves looking at amounts, or *quantities*, of one or more variables of interest. A quantitative researcher tries to measure variables in some numerical way, perhaps by using commonly accepted measures of the physical world (e.g., rulers, thermometers, oscilloscopes) or carefully designed measures of psychological characteristics or behaviors (e.g., tests, questionnaires, rating scales).

In contrast, qualitative research involves looking at characteristics, or *qualities*, that cannot be entirely reduced to numerical values. A qualitative researcher typically aims to examine the many nuances and complexities of a particular phenomenon. You are most likely to see qualitative research in studies of complex human situations (e.g., people's in-depth perspectives about a particular issue, the behaviors and values of a particular cultural group) or complex human creations (e.g., television commercials, works of art). Qualitative research isn't limited to research problems involving human beings, however. For instance, some biologists study, in a distinctly qualitative manner, the complex social behaviors of other animal species; Dian Fossey's work with gorillas and Jane Goodall's studies of chimpanzees are two well-known examples (e.g., see Fossey, 1983; Goodall, 1986).

The two kinds of data—quantitative and qualitative—often require distinctly different research methods and data analysis strategies. Accordingly, three of the book's subsequent chapters focus predominantly on quantitative techniques (see Chapters 6, 7, and 11), and two others focus almost exclusively on qualitative techniques (see Chapters 8 and 12). Nevertheless, we urge you *not* to think of the quantitative–qualitative distinction as a mutually exclusive, *it-has-to-be-one-thing-or-the-other* dichotomy. Many researchers collect both quantitative and qualitative data in a single research project—an approach sometimes known as mixed-methods research (see Chapter 9). And in action research, one or more researchers—who are often practitioners in a particular helping profession (e.g., education, counseling, social work, medicine)—might use both quantitative and qualitative methods in an effort to improve current practices and desired outcomes (see Chapter 10). Good researchers tend to

be *eclectic* researchers who draw from diverse methodologies and data sources in order to best address their research problems and questions (e.g., see Gorard, 2010; Lather, 2006; Onwuegbuzie & Leech, 2005).

7. The researcher interprets the meaning of the data as they relate to the problem and its subproblems. Quantitative and qualitative data are, in and of themselves, *only* data—nothing more. The significance of the data depends on how the researcher extracts *meaning* from them. In research, uninterpreted data are worthless: They can never help us answer the questions we have posed.

Yet researchers must recognize and come to terms with the subjective and dynamic nature of interpretation. Consider, for example, the many books written on the assassination of U.S. President John F. Kennedy. Different historians have studied the same events: One may interpret them one way, and another may arrive at a very different conclusion. Which one is right? Perhaps they both are; perhaps neither is. Both may have merely posed new problems for other historians to try to resolve. Different minds often find different meanings in the same set of facts.

Once we believed that clocks measured time and that yardsticks measured space. In one sense, they still do. We further assumed that time and space were two different entities. Then along came Einstein's theory of relativity, and time and space became locked into one concept: the time-space continuum. What's the difference between the old perspective and the new one? It's the way we think about, or interpret, the same information. The realities of time and space have not changed; the way we interpret them has.

Data demand interpretation. But no rule, formula, or algorithm can lead the researcher unerringly to a correct interpretation. Interpretation is inevitably a somewhat subjective process that depends on the researcher's assumptions, hypotheses, and logical reasoning processes.

Now think about how we began this chapter. We suggested that certain activities cannot accurately be called research. At this point you can understand why. None of those activities demands that the researcher draw any conclusions or make any interpretations of the data.

We must emphasize two important points related to the seven-step process just described. First, *the process is iterative*: A researcher sometimes needs to move back and forth between two or more steps along the way. For example, while developing a specific plan for a project (Step 5), a researcher might realize that a genuine resolution of the research problem requires addressing a subproblem not previously identified (Step 3). And while interpreting the collected data (Step 7), a researcher may decide that additional data are needed to fully resolve the problem (Step 6).

Second, *the process is cyclical*. The final step in the process depicted in Figure 1.1—interpretation of the data—is not *really* the final step at all. Only rarely is a research project a one-shot effort that completely resolves a problem; more often, it is likely to unearth new questions related to the issue at hand. And if specific hypotheses have been put forth, either *a priori* or after data have been collected and analyzed, those hypotheses are rarely proved or disproved beyond a shadow of a doubt. Instead, they are either *supported* or *not supported* by the data. If the data are consistent with a particular hypothesis, the researcher can make a case that the hypothesis probably has some merit and should be taken seriously. In contrast, if the data run contrary to a hypothesis, the researcher *rejects* the hypothesis and might turn to other hypotheses as being more likely explanations of the phenomenon in question. In any of these situations, one or more additional, follow-up studies are called for.

Ultimately, then, most research studies don't bring total closure to a research problem. There is no obvious end point—no point at which a researcher can say "*Voila!* I've completely answered the question about which I'm concerned." Instead, research typically

involves a cycle—or more accurately, a *helix* (spiral)—in which one study spawns additional, follow-up studies. In exploring a topic, one comes across additional problems that need resolving, and so the process must begin anew. Research begets more research.

To view research in this way is to invest it with a dynamic quality that is its true nature—a far cry from the conventional view, which sees research as a one-time undertaking that is static, self-contained, an end in itself. Here we see another difference between true research and the nonexamples of research presented earlier in the chapter. Every researcher soon learns that genuine research is likely to yield as many problems as it resolves. Such is the nature of the acquisition of knowledge.

MyLab Education **Self-Check 1.2**

MyLab Education **Application Exercise 1.1:** Identifying Hypotheses and Assumptions

PHILOSOPHICAL ASSUMPTIONS UNDERLYING RESEARCH METHODOLOGIES

Let's return to Step 4 in the research process: *The researcher identifies assumptions—and possibly also hypotheses—that underlie the research effort.* The assumptions underlying a research project are sometimes so seemingly self-evident that a researcher may think it unnecessary to mention them. In fact, the researcher may not even be consciously aware of them. For example, two general assumptions underlie many research studies:

The phenomenon under investigation is somewhat lawful and predictable; it is *not* comprised of completely random events.

Cause-and-effect relationships can account for certain patterns observed in the phenomenon.

But are such assumptions justified? Is the world a lawful place, with some things definitely causing or influencing others? Or are definitive laws and cause-and-effect relationships nothing more than figments of our fertile human imaginations?

As we consider such questions, it is helpful to distinguish among different philosophical orientations that point researchers in somewhat different directions in their quests to make sense of our physical, biological, social, and psychological worlds.² Historically, a good deal of research in the natural sciences has been driven by a perspective known as *positivism*. Positivists believe that, with appropriate measurement tools, scientists can objectively uncover absolute, undeniable *truths* about cause-and-effect relationships within the physical world and human experience.

In the social sciences, many researchers are—and most others *should* be—less self-assured and more tentative about their assumptions. Some social scientists take a perspective known as *postpositivism*, believing that true objectivity in seeking absolute truths can be an elusive goal. Although researchers might strive for objectivity in their collection and interpretation of data, they inevitably bring certain *biases* to their investigations—perhaps biases regarding the best ways to measure certain variables or the most logical inferences to draw from patterns within the data. From a postpositivist perspective, progress toward genuine understandings of physical, social, and psychological phenomena tends to be gradual and probabilistic. For example, recall the earlier discussion of hypotheses being either *supported* or *not supported* by data. Postpositivists don't say, "I've just proven such-and-such." Rather, they're more likely to say, "This increases the probability that such-and-such is true."

²Some writers use terms such as *worldviews*, *epistemologies*, or *paradigms* instead of the term *philosophical orientations*.

Other researchers have abandoned any idea that absolute truths are somewhere “out there” in the world, waiting to be discovered. In this perspective, known as constructivism, the “realities” researchers identify are nothing more than human *creations* that can be helpful in finding subjective meanings within the data collected.³ Constructivists not only acknowledge that they bring certain biases to their research endeavors but also try to be as up-front as possible about these biases. The emphasis on subjectivity and bias—rather than objectivity—applies to the phenomena that constructivist researchers study as well. By and large, constructivists focus their inquiries on people’s *perceptions* and *interpretations* of various phenomena, including individuals’ behaviors, group processes, and cultural practices.

In yet another perspective, known as phenomenology, the focus is entirely on how human beings *experience* themselves and their world as they go through life. Researchers with this orientation typically ask the question, “What is it like to experience such-and-such?” For example, they might ask, “What is it like . . . to have attention-deficit disorder?” “. . . to run for political office?” “. . . to undergo chemotherapy?” “. . . to immigrate to an English-speaking country without any knowledge of English?” In our view, a phenomenological orientation is also a constructivist orientation, in that people’s constructed realities are essential components of their lived experiences. However, some scholars argue that the two perspectives are distinctly different entities.

Many of the quantitative methodologies described in this book have postpositivist, probabilistic underpinnings—a fact that becomes especially evident in the discussion of statistics in Chapter 11. In contrast, some qualitative methodologies have a distinctly constructivist or phenomenological bent, with a focus on ascertaining people’s beliefs, perceptions, and experiences, rather than trying to pin down absolute, objective truths that might not exist at all.

But once again we urge you *not* to think of quantitative research and qualitative research as reflecting a mutually exclusive, *either-this-or-that* dichotomy. For instance, some quantitative researchers approach a research problem from a constructivist framework, and some qualitative researchers tend to think in a postpositivist manner. Many researchers acknowledge *both* that (a) absolute truths regarding various phenomena may actually exist—even if they are exceedingly difficult to discover—and (b) human beings’ self-constructed beliefs and experiences are legitimate objects of study in their own right. You might see such labels as pragmatism and realism used in reference to this orientation (e.g., see R. B. Johnson & Onwuegbuzie, 2004; Maxwell & Mittapalli, 2010).

Presumably, most researchers hope that their findings will either directly or indirectly be useful to humankind as a whole. But some researchers focus almost exclusively on how human actions can lead to beneficial outcomes. In an orientation that goes by various names, including *action research*, *praxis*, and *social action*, a researcher places a particular human action or intervention front and center in an investigation—perhaps studying a particular approach to physical therapy, reading instruction, protection of an endangered species, or rainforest preservation—with the ultimate goal being to enhance the well-being of our planet or some of its inhabitants (e.g., see Gergen, Josselson, & Freeman, 2015). The researcher determines whether the intervention has a desired effect and then, after some analysis and reflection, may modify the intervention to further enhance its effectiveness. Clearly, these practically oriented researchers assume that some cause-and-effect relationships do exist in our world and that, more specifically, we human beings can have a beneficial impact on our physical, biological, social, or psychological environments.

MyLab Education **Self-Check 1.3**

MyLab Education **Application Exercise 1.2: Examining Philosophical Assumptions**

³In some fields (e.g., in business), this perspective is often called *interpretivism*.

TOOLS OF RESEARCH

Every professional needs specialized tools in order to work effectively. Without hammer and saw, the carpenter is out of business; without scalpel or forceps, the surgeon cannot practice. Researchers, likewise, have their own set of tools to carry out their plans. The tools that researchers use to achieve their research goals can vary considerably depending on the discipline. A microbiologist needs a microscope and culture media; an attorney needs a library of legal decisions and statute law. By and large, we don't discuss such discipline-specific tools in this book. Rather, our concern here is with general tools of research that the great majority of researchers of all disciplines need in order to collect data and derive meaningful conclusions.

We should be careful not to equate the *tools* of research with the *methodology* of research. A research tool is a specific mechanism or strategy the researcher uses to collect, manipulate, or interpret data. The research methodology is the general approach the researcher takes in carrying out the research project; to some extent, this approach dictates the particular tools the researcher selects.

Confusion between the tool and the research method is immediately recognizable. Such phrases as "library research" and "statistical research" are telltale signs and largely meaningless terms. They suggest a failure to understand the nature of formal research, as well as a failure to differentiate between tool and method. The library is merely a place for locating certain information that will be analyzed and interpreted at some point in the research process. Likewise, statistics merely provide ways to analyze and summarize data, thereby allowing us to see patterns within the data more clearly.

In the following sections, we look more closely at six general tools of research:

1. The library and its resources
2. Computer technology
3. Measurement
4. Statistics
5. Language
6. The human mind

The Library and Its Resources

Historically, many literate human societies used libraries to assemble and store their collective knowledge. For example, in the seventh century B.C., the ancient Assyrians' Library of Nineveh contained 20,000 to 30,000 tablets, and in the second century A.D., the Romans' Library of Celsus at Ephesus housed more than 12,000 papyrus scrolls and, in later years, many parchment books as well.⁴

Until the past few decades, libraries were primarily repositories of concrete, physical representations of knowledge—clay tablets, scrolls, manuscripts, books, journals, films, and the like. For the most part, any society's collective knowledge expanded rather slowly and could seemingly be contained within masonry walls. But by the latter half of the 20th century, people's knowledge about their physical and social worlds began to increase many times over, and at the present time, it continues to increase at an astounding rate. In response, libraries have evolved in important ways. First, they have made use of many emerging technologies (e.g., microforms, CDs, DVDs, online databases) to store information in more compact forms. Second, they have provided increasingly fast and efficient means of locating and

⁴ Many academic scholars would instead say "seventh century BCE" and "second century CE" in this sentence, referring to the more religion-neutral terms *Before Common Era* and *Common Era*. However, we suspect that some of our readers are unfamiliar with these terms, hence our use of the more traditional ones.

accessing information on virtually any topic. And third, many of them have made catalogs of their holdings available on the Internet. The libraries of today—especially university libraries—extend far beyond their local, physical boundaries.

We explore efficient use of a library and its resources in depth in Chapter 3. For now, we simply want to stress that the library is—and must be—one of the most valuable tools in any researcher's toolbox.

Computer Technology

As research tools, personal computers—whether they take the form of desktops, laptops, tablets, or smartphones—are now commonplace. In addition, computer software packages and applications have become increasingly user-friendly, such that novice researchers can easily take advantage of them. But like any tool—no matter how powerful—computer technology has its limitations. Yes, computers can certainly calculate, compare, search, retrieve, sort, and organize data more efficiently and accurately than you can. But in their present stage of development, they depend largely on people to give them directions about what to do.

A computer is not a miracle worker—it can't do your thinking for you. It can, however, be a fast and faithful assistant. When told exactly what to do, it is one of the researcher's best friends. Table 1.1 offers suggestions for how you might use computer technology as a research tool.

Measurement

Especially when conducting quantitative research, a researcher needs a systematic way of *measuring* the phenomena under investigation. Some common, everyday measurement instruments—rulers, scales, stopwatches—can occasionally be helpful for measuring easily observable variables, such as length, weight, or time. But in most cases, a researcher needs one or more specialized instruments. For example, an astronomer might need a high-powered telescope to detect patterns of light in the night sky, and a neurophysiologist might need a magnetic resonance imaging (MRI) machine to detect and measure neural activity in the brain.

In quantitative research, social and psychological phenomena require measurement as well, even though they have no concrete, easily observable basis in the physical world. For example, an economist might use the Dow-Jones Industrial Average or NASDAQ index to track economic growth over time, a sociologist might use a questionnaire to assess people's attitudes about marriage and divorce, and an educational researcher might use an achievement test to measure the extent to which schoolchildren have acquired knowledge and skills related to a particular topic. Finding or developing appropriate measurement instruments for social and psychological phenomena can sometimes be quite a challenge. Thus, we explore measurement strategies in some depth when we discuss the research planning process in Chapter 4.

Statistics

As you might guess, statistics are most helpful in quantitative research, although they occasionally come in handy in qualitative research as well. Statistics also tend to be more useful in some academic disciplines than in others. For instance, researchers use them quite often in such fields as psychology, medicine, and business; they use statistics less frequently in such fields as history, musicology, and literature.

Statistics have two principal functions: to help a researcher (a) describe quantitative data and (b) draw inferences from these data. Descriptive statistics help the researcher capture the general nature of the data obtained—for instance, how certain measured characteristics appear to be “on average,” how much variability exists within a data set, and how closely two

TABLE 1.1 The Computer As a Research Tool

<i>Part of the Study</i>	<i>Relevant Technological Support Tools</i>
Planning the study	• Brainstorming assistance—software used to help generate and organize ideas related to the research problem, research strategies, or both. • Outlining assistance—software used to help structure various aspects of the study and focus work efforts. • Project management assistance—software used to schedule and coordinate varied tasks that must occur in a timely manner. • Budget assistance—spreadsheet software used to help in outlining, estimating, and monitoring the potential costs involved in the research effort.
Literature review	• Literature identification assistance—online databases used to help identify relevant research studies to be considered during the formative stages of the research endeavor. • Communication assistance—computer technology used to communicate with other researchers who are pursuing similar topics (e.g., e-mail, Skype, electronic bulletin boards, list servers). • Writing assistance—software used to facilitate the writing, editing, formatting, and citation management of the literature review.
Study Implementation and data gathering	• Materials production assistance—software used to develop instructional materials, visual displays, simulations, or other stimuli to be used in experimental interventions. • Experimental control assistance—software used to physically control the effects of specific variables and to minimize the influence of potentially confounding variables. • Survey distribution assistance—databases and word-processing software used in combination to send specific communications to a targeted population. • Online data collection assistance—websites used to conduct surveys and certain other types of studies on the Internet. • Field based data collection assistance—software used to take field notes or to monitor specific types of responses given by participants in a study.
Analysis and interpretation	• Organization and transcription assistance—software used to assemble, categorize, code, integrate, and search potentially huge data sets (such as qualitative interview data or open-ended responses to survey questions). • Conceptual assistance—software used to write and store ongoing reflections about data or to construct theories that integrate research findings. • Statistical assistance—statistical and spreadsheet software packages used to categorize and analyze various types of data sets. • Graphic production assistance—software used to depict data in graphic form to facilitate interpretation.
Reporting	• Communication assistance—telecommunication software used to distribute and discuss research findings and initial interpretations with colleagues and to receive their comments and feedback. • Writing and editing assistance—word-processing software used to write and edit successive drafts of the final report. • Dissemination assistance—desktop publishing software and poster-creation software used to produce professional-looking documents and posters that can be displayed or distributed at conferences and elsewhere. • Presentation graphics assistance—presentation software used to create static and animated slides for conference presentations. • Networking assistance—blogs, social networking sites, and other Internet-based mechanisms used to communicate one's findings to a wider audience and to generate discussion for follow-up studies by others in the field.

or more characteristics are associated with one another. In contrast, inferential statistics help the researcher make decisions about the data. For example, they might help a researcher decide whether the differences observed between two experimental groups are large enough to be attributed to the differing experimental interventions rather than to a once-in-a-blue-moon fluke. Both of these functions of statistics ultimately involve summarizing the data in some way.

In the process of summarizing data, statistical analyses often create entities that have no counterpart in reality. Let's take a simple example: Four students have part-time jobs on campus. One student works 24 hours a week in the library, a second works 22 hours a week in the campus bookstore, a third works 12 hours a week in the parking lot, and the fourth works 16 hours a week in the cafeteria. One way of summarizing the students' work hours is to calculate the arithmetic mean.⁵ By doing so, we find that, "on average," the students work 18.5 hours a week. Although we have learned something about these four students and their working hours, to some extent we have learned a myth: None of these students has worked exactly 18.5 hours a week. That figure represents absolutely no fact in the real world.

If statistics offer only an unreality, then why use them? Why create myth out of hard, demonstrable data? The answer lies in the nature of the human mind. Human beings can cognitively think about only a very limited amount of information at any single point in time.⁶ Statistics help condense an overwhelming body of data into an amount of information that the mind can more readily comprehend and deal with. In the process, they can help a researcher detect patterns and relationships in the data that might otherwise go unnoticed. More generally, statistics *help the human mind comprehend disparate data as an organized whole*.

Any researcher who uses statistics must remember that calculating statistical values is not—and must not be—the final step in a research endeavor. The ultimate question in research is, *What do the data indicate?* Statistics yield *information* about data, but conscientious researchers are not satisfied until they determine the *meaning* of this information.

Although a book such as this one can't provide all of the nitty-gritty details of statistical analysis, we give you an overview of potentially useful statistical techniques in Chapter 11.

Language

One of humankind's greatest achievements is language. Not only does it allow us to communicate with one another, but it also enables us to think more effectively. People can often think more clearly and efficiently about a topic when they can represent their thoughts in their heads with specific words and phrases.

For example, imagine that you're driving along a country road. In a field to your left, you see an object with the following characteristics:

Black and white in color, in a splotchy pattern
Covered with a short, bristly substance
Appended at one end by something similar in appearance to a paintbrush
Appended at the other end by a lumpy thing with four smaller things coming out of its top (two soft and floppy; two hard, curved, and pointed)
Held up from the ground by four spindly sticks, two at each end

Unless you have spent most of your life living under a rock, you would almost certainly identify this object as a *cow*.

Words—even those as simple as *cow*—and the concepts that the words represent enhance our thinking in several ways (J. E. Ormrod, 2016; also see Jaccard & Jacoby, 2010):

1. *Words reduce the world's complexity.* Classifying similar objects and events into categories and assigning specific words to those categories can make our experiences easier to make sense of. For instance, it's much easier to think to yourself, "I see a herd of cows," than to think, "There is a brown object, covered with bristly stuff, appended by a paintbrush and a lumpy thing, and held up by four sticks. Ah, yes, and I also see a black-and-white spotted

⁵When the word *arithmetic* is used as an adjective, as it is here, it is pronounced with emphasis on the third syllable ("ar-ith-MET-ic").

⁶If you have some background in human memory and cognition, you may realize that we are talking about the limited capacity of *working memory* here (e.g., see Cowan, 2010; J. E. Ormrod, 2016).

object, covered with bristly stuff, appended by a paintbrush and a lumpy thing, and held up by four sticks. And over there is a brown-and-white object. . . ."

2. *Words allow abstraction of the environment.* An object that has bristly stuff, a paintbrush at one end, a lumpy thing at the other, and four spindly sticks on its underside is a concrete entity. The concept *cow*, however, is more abstract: It connotes such characteristics as *female*, *supplier of milk*, and, to the farmer, *economic asset*. Concepts and the labels associated with them allow us to think about our experiences without necessarily having to consider all of their discrete, concrete characteristics.

3. *Words enhance the power of thought.* When you are thinking about an object covered with bristly stuff, appended by a paintbrush and a lumpy thing, held up by four sticks, and so on, you can think of little else (as mentioned earlier, human beings can think about only a very limited amount of information at any one time). In contrast, when you simply think *cow*, you can easily think about other ideas at the same time (e.g., *farmer*, *milk*, *pasteurization*) and perhaps form connections and interrelationships among them in ways you hadn't previously considered.

4. *Words facilitate generalization and inference drawing in new situations.* When we learn a new concept, we associate certain characteristics with it. Then, when we encounter a new instance of the concept, we can draw on our knowledge of associated characteristics to make assumptions and inferences about the new instance. For instance, if you see a herd of cattle as you drive through the countryside, you can infer that you are passing through either dairy or beef country, depending on whether you see large udders hanging down between two of the spindly sticks.

Just as *cow* helps us categorize certain experiences into a single idea, so, too, does the terminology of your discipline help you interpret and understand your observations. The words *tempo*, *timbre*, and *perfect pitch* are useful to the musicologist. Such terms as *central business district*, *folded mountain*, and *distance to k* have special meaning for the geographer. The terms *learning outcome*, *classroom climate*, and *student at risk* communicate a great deal to the educator. Learning the specialized terminology of your field is indispensable to conducting a research study, grounding it in prior theories and research, and communicating your results to others.

Two outward manifestations of language usage are also helpful to the researcher: (a) knowing two or more languages and (b) writing one's thoughts either on paper or in electronic form.

The Benefits of Knowing Two or More Languages It should go without saying that not all important research is reported in a researcher's native tongue. Accordingly, some doctoral programs require that students demonstrate reading competency in one or two foreign languages in addition to their own language. The choice of these languages is usually linked to the area of proposed research.

The language requirement is a reasonable one. Research is and always has been a world-wide endeavor. For example, researchers in Japan have made gigantic strides in electronics and robotics. And two of the most influential theorists in child development today—Jean Piaget and Lev Vygotsky—wrote in French and Russian, respectively. Many new discoveries are first reported in a researcher's native language.

Knowing two or more languages has a second benefit as well: Words in a second language may capture the *meaning* of certain phenomenon in ways that one's native tongue may not. For example, the German word *Gestalt*—which roughly means "organized whole"—has no direct equivalent in English. Thus, many English-speaking psychologists use this word when describing the nature of human perception, enabling them to communicate the idea that people often perceive organized patterns and structures in visual data that, in the objective physical world, are *not* organized. Likewise, the Zulu word *ubuntu* defies an easy

translation into English. This word—which reflects the belief that people become fully human largely through regularly caring for others and contributing to the common good—can help anthropologists and other social scientists capture a cultural worldview quite different from the more self-centered perspective so prevalent in mainstream Western culture.

The importance of writing To be generally accessible to the larger scientific community and ultimately to society as a whole, all research must eventually be presented as a written document—a *research report*—either on paper or in electronic form. A basic requirement for writing such a report is the ability to use language in a clear, coherent manner.

Although a good deal of conventional wisdom tells us that clear thinking *precedes* clear writing, writing can in fact be a productive form of thinking in and of itself. When you write your ideas down on paper, you do several things:

You must identify the specific things you do and don't know about your topic.

You must clarify and organize your thoughts sufficiently to communicate them to your readers.

You may detect gaps and logical flaws in your thinking.

Perhaps it isn't surprising, then, that writing about a topic actually enhances the writer's understanding of the topic (e.g., Kellogg, 1994; Mueller & Oppenheimer, 2014; Shanahan, 2004).

If you wait until all your thoughts are clear before you start writing, you may never begin. Thus we recommend that you start writing parts of your research proposal or report as soon as possible. Begin with a title and a purpose statement—one or more sentences that clearly describe the primary goal(s) you hope to achieve by conducting your study. Commit your title to paper; keep it in plain sight as you focus your ideas. Although you may very well change the title later as your research proceeds, creating a working title in the early stages can provide both focus and direction. And when you can draft a clear and concise statement that begins, "The purpose of this study is to . . .," you are well on your way to planning a focused research study.

PRACTICAL APPLICATION Communicating Effectively Through Writing

In our own experiences, we authors have found that most students have a great deal to learn about what good writing entails. Yet we also know that with effort, practice, mentoring, and regular feedback, students *can* learn to write more effectively. Subsequent chapters present specific strategies for writing literature reviews (Chapter 3), research proposals (Chapter 5), and research reports (Chapter 13). Here we offer general strategies for writing in ways that can help you clearly communicate your ideas and reasoning to others. We also offer suggestions for making the best use of word-processing software.

GUIDELINES Writing to Communicate

The following guidelines are based on techniques often seen in effective writing. Furthermore, such techniques have consistently been shown to facilitate readers' comprehension of what people have written (e.g., see J. E. Ormrod, 2016).

1. *Be specific and precise.* Precision is of utmost importance in all aspects of a research endeavor, including writing. Choose your words and phrases carefully so that you communicate your *exact* meaning, not some vague approximation. Many books and online resources offer suggestions for writing clear, concise sentences and combining them into unified and coherent paragraphs (e.g., see the sources in the "For Further Reading" list at the end of the chapter).

2. *Continually keep in mind your primary objective in writing your paper, and focus your discussion accordingly.* All too often, novice researchers try to include everything they have learned—both from their literature review and from their data analysis—in their research reports. But ultimately, everything you say should relate either directly or indirectly to your research problem. If you can't think of how something relates, leave it out! You will undoubtedly have enough things to write about as it is.

3. *Provide an overview of what you will be talking about in upcoming pages.* Your readers can more effectively read your work when they know what to expect as they read. Providing an overview of what topics you will discuss and in what order—and possibly also showing how the various topics interrelate—is known as an advance organizer. As an example, Dinah Jackson, a doctoral student in educational psychology, was interested in the possible effects of *self-questioning*—asking oneself questions about the material one is studying—on college students' note taking. Jackson began her dissertation's "Review of the Literature" with the following advance organizer:

The first part of this review will examine the theories, frameworks, and experimental research behind the research on adjunct questioning. Part two will investigate the transition of adjunct questioning to self-generated questioning. Specific models of self-generated questioning will be explored, starting with the historical research on question position (and progressing) to the more contemporary research on individual differences in self-questioning. Part three will explore some basic research on note taking and tie note taking theory with the research on self-generated questioning. (Jackson, 1996, p. 17)

4. *Organize your ideas into general and more specific categories, and use headings and subheadings to guide your readers through your discussion of these categories.* We authors have read many student research reports that seem to wander aimlessly and unpredictably from one thought to another, without any obvious organizational structure directing the flow of ideas. Using headings and subheadings is one simple way to provide an organizational structure for your writing *and* make that structure crystal clear to others.

5. *Use concrete examples to make abstract ideas more understandable.* There's a fine line between being abstract and being vague. Even as scholars who have worked in our respective academic disciplines for many years, we authors still find that we can more easily understand something when the writer gives us a concrete example to illustrate an abstract idea. As an example, we return to Jackson's dissertation on self-questioning and class note taking. Jackson made the point that how a researcher evaluates, or *codes*, the content of students' class notes will affect what the researcher discovers about those notes. More specifically, she argued that only a superficial coding scheme (e.g., counting the number of main ideas included in notes) would fail to capture the true quality of the notes. She clarified her point with a concrete example:

For example, while listening to the same lecture, Student A may record only an outline of the lecture, whereas Student B may record an outline, examples, definitions, and mnemonics. If a researcher only considered the number of main ideas that students included in their notes, then both sets of notes might be considered equivalent, despite the fact that the two sets differ considerably in the type of material recorded. (Jackson, 1996, p. 9)

6. *Use figures and tables to help you more effectively present or organize your ideas and findings.* Although the bulk of your research proposal or report will almost certainly be prose, in many cases it might be helpful to present some information in figure or table form. For example, as you read this book, look at the variety of mechanisms we use to accompany our prose, including art, diagrams, graphs, and summarizing tables. We hope you will agree that these mechanisms help you understand and organize some of the ideas we present.

7. *At the conclusion of a chapter or major section, summarize what you have said.* You will probably be presenting a great deal of information in any research proposal

or report that you write. Summarizing what you have said in preceding paragraphs or pages helps your readers identify the things that are, in your mind, the most important things for them to remember. For example, in a dissertation that examined children's beliefs about the mental processes involved in reading, Debby Zambo summarized a lengthy discussion about the children's understanding of what it means to pay attention:

In sum, the students understand attention to be a mental process. They know their attention is inconsistent and affected by emotions and interest. They also realize that the right level of material, amount of information, and length of time helps their attention. The stillness of reading is difficult for some of the students but calming for others, and they appear to know this, and to know when reading will be difficult and when it will be calming. This idea is contrary to what has been written in the literature about struggling readers. (Zambo, 2003, p. 68)

8. *Anticipate that you will almost certainly have to write multiple drafts.* All too often, we authors have had students submit research proposals, theses, or dissertations with the assumption that they have finished their task. Such students have invariably been disappointed—sometimes even outraged—when we have asked them to revise their work, usually several times. The need to write multiple drafts applies not only to novice researchers but to experienced scholars as well. For instance, we would hate to count the number of times this book has undergone revision—certainly far more often than the label “12th edition” indicates! Multiple revisions enable you to reflect on and critically evaluate your own writing, revise and refocus awkward passages, get feedback from peers and advisors who can point out where a manuscript has gaps or lacks clarity, and in other ways ensure that the final version is as clear and precise as possible.

9. *Fastidiously check to be sure that your final draft uses appropriate grammar and punctuation, and check your spelling.* Appropriate grammar, punctuation, and spelling are not just bothersome formalities. On the contrary, they help you better communicate your meanings. For example, a colon announces that what follows it explains the immediately preceding statement; a semicolon communicates that a sentence includes two independent clauses (as the semicolon in this sentence does!).

Correct grammar, punctuation, and spelling are important for another reason as well: They communicate to others that you are a careful and disciplined scholar whose thoughts and work are worth reading about. If, instead, you misspell many of your words—as we are doing in this sentence—your readers may quickly discredit you as a sloppy researcher who shouldn't be taken seriously!

Many style manuals, such as those in the “For Further Reading” list at the end of this chapter, have sections dealing with correct punctuation and grammar. In addition, dictionaries and word-processing spell-check functions can obviously assist you in your spelling.

GUIDELINES Using the Tools in Word-Processing Software

Most of our readers know the basics of using word-processing software—for instance, how to “copy,” “paste,” and “save”; how to choose a particular font and font size; and how to format text as *italicized*, underlined, or **boldface**. Following are specific features and tools that you may not have routinely used in previous writing projects but that can be quite useful in writing research reports:

Outlining. An “outlining” feature lets you create bullets and subbullets to organize your thoughts.

Setting headers and footers. A “header” is a line or two at the top of the page that appears on every page; a “footer” appears at the bottom of each page. For example,

using the “insert date” function, you might create a header that includes the specific date on which you are writing a particular draft. And using an “insert page number” function will add appropriate numbers to the tops or bottoms of successive pages.

- **Creating tables.** Using a “table” feature, you can create a table with the number of rows and columns you need. You can easily adjust the widths of various columns, format the text within each table cell, add new rows or tables, and merge two or more cells into a single, larger cell. Usually, an “autoformat” option will give you many possible table formats from which to choose.
- **Inserting graphics.** You are likely to find a variety of options under an “Insert” pull-down menu. Some of these options enable you to insert diagrams, photographs, charts, and other visuals you have created elsewhere.
- **Creating footnotes.** Footnotes are easy to create using an “insert footnote” feature. Typically, you can choose the symbols to be used in designating footnotes—perhaps 1, 2, 3, . . . , a, b, c, . . . , or special symbols such as * and †.
- **Using international alphabets and characters.** Computers and computer software sold in English-speaking countries have the English alphabet as the default alphabet, but often either your word-processing software or your “system preferences” on your computer’s operating system will let you choose a different alphabet (e.g., Turkish, as in the surname Kağıtçıbaşı) or certain characters (e.g., in Chinese or Japanese) for particular words or sections of text.
- **Tracking changes.** A “track changes” feature enables you to keep a running record of specific edits you have made to a document; you can later go back and either “accept” or “reject” each change. This feature is especially useful when two or more researchers are coauthoring a report: It keeps track of who made which changes and the date on which each change was made.

We offer three general recommendations for using a word processor effectively.

1. **Save and back up your document frequently.** We authors can recall a number of personal horror stories we have heard (and in some cases experienced ourselves) about losing data, research materials, and other valuable information. Every computer user eventually encounters some type of glitch that causes problems in information retrieval. Whether the electricity goes out before you can save a file, a misguided keystroke leads to a system error, or your personal computer inexplicably crashes, things you have written sometimes get lost. It’s imperative that you get in the habit of regularly saving your work. Save multiple copies so that if something goes awry in one place, you will always have a backup in a safe location. Here are a few things to think about:

- Save your work-in-progress frequently, perhaps every 5 to 10 minutes. Many software programs will do this for you automatically if you give them instructions about whether and how often to do it.
- Save at least two copies of important files, and save them in different places—perhaps one file at home and another at the office, at a relative’s home, or somewhere in cyberspace. One option is to save documents on a flash drive or external hard drive. Another is to copy them to an electronic dropbox, iCloud (for Macintosh), or other Internet-based storage mechanism. One of us authors uses a flash drive to back up much of her past work (including several book manuscripts) and any in-progress work; she keeps this flash drive in her purse and takes it everywhere she goes. Also, she occasionally sends herself in-progress documents as attachments to self-addressed e-mail messages—giving her an almost-current backup version of the documents in the event that an unintended keystroke somehow wreaks havoc on what she has written.
- Save various versions of your work with distinct labels that help you identify each version—for instance, by including the date on which you completed each file.

- If your computer completely dies—seemingly beyond resuscitation—some software programs (e.g., Norton Utilities) may be able to fix the damage and retrieve some or all of the lost material. And service departments at computer retailers can often retrieve documents from the hard drives of otherwise “dead” machines.

2. *Use such features as the spell checker and grammar checker to look for errors, but do NOT rely on them exclusively.* Although computers are marvelous machines, their “thinking” capabilities have not yet begun to approach those of the human mind. For instance, although a computer can detect spelling errors, it does so by comparing each word against its internal “dictionary” of correctly spelled words. Not every word in the English language will be included in the dictionary; for instance, proper nouns (e.g., surnames such as Leedy and Ormrod) will *not* be. Furthermore, it may assume that *abut* is spelled correctly when the word you really had in mind was *about*, and it may very well not know that *there* should actually be *their* or *they’re*.

3. *Print out a paper copy for final proofreading and editing.* One of us authors once had a student who turned in a dissertation draft chock-full of spelling and grammatical errors—and this from a student who was, ironically, teaching a college-level English composition course at the time. A critical and chastising e-mail message to the student made her irate; she had checked her document quite thoroughly before submitting it, she replied, and was convinced that it was virtually error-free. When her paper draft was returned to her almost bloodshot with spelling and grammatical corrections in red ink, she was quite contrite. “I don’t know how I missed them all!” she said. When asked if she had ever edited a printed copy of the draft, she replied that she had not, figuring that she could read her work just as easily on her computer monitor and thereby save a tree or two. But in our own experience, it is *always* a good idea to read a printed version of what you have written. For some reason, reading a paper copy often alerts us to errors we have previously overlooked on the computer screen.

The Human Mind

The research tools discussed so far—the library, computer technology, measurement, statistics, and language—are effective only to the extent that another critical tool also comes into play. The human mind is undoubtedly the most important tool in the researcher’s toolbox. Nothing equals its powers of comprehension, integrative reasoning, and insight.

Over the past few millennia, human beings have developed a number of general strategies through which they can more effectively reason about and better understand worldly phenomena. Key among these strategies are critical thinking, deductive logic, inductive reasoning, scientific methods, theory building, and collaboration with other minds.

Critical Thinking

Before beginning a research project, good researchers typically look at research reports and theoretical discussions related to their topic of interest. But they don’t just accept research findings and theories at face value; instead, they scrutinize those findings and theories for faulty assumptions, questionable logic, weaknesses in methodologies, and unwarranted conclusions. And, of course, good researchers scrutinize their *own* work for the same kinds of flaws. In other words, good researchers engage in critical thinking.

In general, critical thinking involves evaluating the accuracy, credibility, and worth of information and lines of reasoning. Critical thinking is reflective, logical, and evidence-based. It also has a purposeful quality to it—that is, the researcher thinks critically in order to achieve a particular goal.

Critical thinking can take a variety of forms, depending on the context. For instance, it may involve any one or more of the following (Halpern, 1998, 2008; Mercier, Boudry, Paglieri, & Trouche, 2017; Nussbaum, 2008):

Verbal reasoning. Understanding and evaluating persuasive techniques found in oral and written language.

Argument analysis. Discriminating between reasons that do and do not support a particular conclusion.

Probabilistic reasoning. Determining the likelihood and uncertainties associated with various events.

Decision making. Identifying and evaluating several alternatives and selecting the alternative most likely to lead to a successful outcome.

Hypothesis testing. Judging the value of data and research results in terms of the methods used to obtain them and their potential relevance to certain conclusions. When hypothesis testing includes critical thinking, it involves considering questions such as these:

- Was an appropriate method used to measure a particular outcome?
- Are the data and results derived from a relatively large number of people, objects, or events?
- Have other possible explanations or conclusions been eliminated?
- Can the results obtained in one situation be reasonably generalized to other situations?

To some degree, different fields of study require different kinds of critical thinking. In history, critical thinking might involve scrutinizing various historical documents and looking for clues as to whether things *definitely* happened a particular way or only *maybe* happened that way. In psychology, it might involve critically evaluating the way in which a particular psychological characteristic (e.g., intelligence, personality) is being measured. In anthropology, it might involve observing people's behaviors over an extended period of time and speculating about what those behaviors indicate about the cultural group being studied.

Deductive Logic

Deductive logic begins with one or more *premises*. These premises are statements or assumptions that the researcher initially takes to be true. Reasoning then proceeds logically from the premises toward conclusions that—if the premises are indeed true—must *also* be true. For example,

If all tulips are plants, (Premise 1)

And if all plants produce energy through photosynthesis, (Premise 2)

Then all tulips must produce energy through photosynthesis. (Conclusion)

To the extent that the premises are false, the conclusions may also be false. For example,

If all tulips are platypuses, (Premise 1)

And if all platypuses produce energy through spontaneous combustion, (Premise 2)

Then all tulips must produce energy through spontaneous combustion. (Conclusion)

The if-this-then-that logic is the same in both examples. We reach an erroneous conclusion in the second example—we conclude that tulips are apt to burst into flames at unpredictable times—only because both of our premises are erroneous.

Let's look back more than 500 years to Christopher Columbus's first voyage to the New World. At the time, people held many beliefs about the world that, to them, were irrefutable facts: People are mortal; the Earth is flat; the universe is finite and relatively small. The terror that gripped Columbus's sailors as they crossed the Atlantic was a fear supported by deductive logic. If the Earth is flat (premise), and the universe finite and small (premise), the

Earth's flat surface must stop at some point. Therefore, a ship that continues to travel into uncharted territory must eventually come to the Earth's edge and fall off, and its passengers (who are mortal—another premise) will meet their deaths. The logic was sound; the conclusions were valid. Where the reasoning fell short was in two faulty premises: that the Earth is flat and also relatively small.

Deductive logic provides the basis for mathematical proofs in mathematics, physics, and related disciplines. It is also extremely valuable for generating research hypotheses and testing theories. As an example, let's look one more time at doctoral student Dinah Jackson's dissertation project about the possible effects of self-questioning during studying. Jackson knew from well-established theories about human learning that forming mental associations among two or more pieces of information results in more effective learning than does trying to learn each piece of information separately from the others. She also found a body of research literature indicating that the kinds of questions students ask themselves (mentally) and try to answer as they listen to a lecture or read a textbook influence both what they learn and how effectively they remember it. (For instance, a student who is trying to answer the question, "What do I need to remember for the test?" might learn very differently from the student who is considering the question, "How might I apply this information to my own life?") From such findings, Jackson generated several key premises and drew a logical conclusion from them:

If learning information in an associative, integrative manner is more effective than learning information in a fact-by-fact, piecemeal manner, (Premise 1)

If the kinds of questions students ask themselves during a learning activity influence how they learn, (Premise 2)

If training in self-questioning techniques influences the kinds of questions that students ask themselves, (Premise 3)

And if learning is reflected in the kinds of notes that students take during class, (Premise 4)

Then teaching students to ask themselves integrative questions as they study class material should lead to better-integrated class notes and higher-quality learning. (Conclusion)

Such reasoning led Jackson to form and test several hypotheses, including this one:

Students who have formal training in integrative self-questioning will take more integrative notes than students who have not had any formal training. (Jackson, 1996, p. 12)

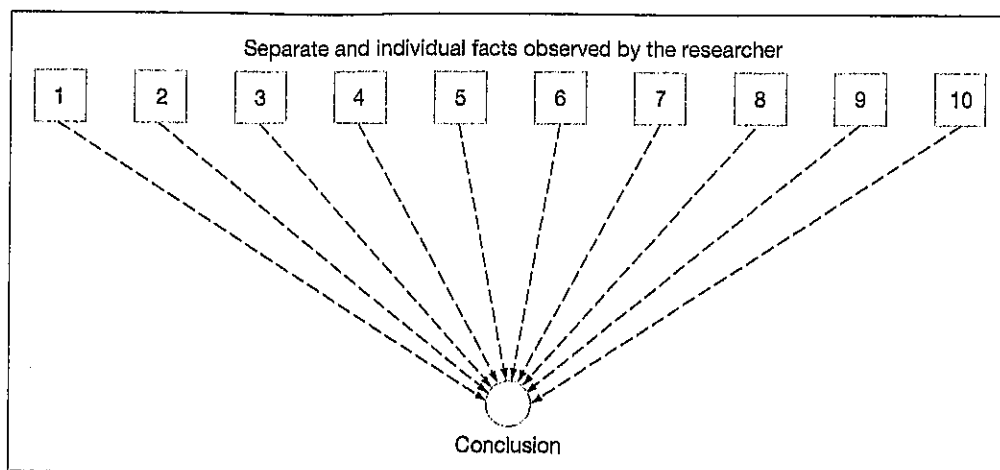
Happily for Jackson, the data she collected in her dissertation research supported this hypothesis.

Inductive Reasoning

Inductive reasoning begins not with a preestablished truth or assumption but instead with an observation. For example, as a baby in a high chair many years ago, you may have observed that if you held a cracker in front of you and then let go of it, it fell to the floor. "Hmmm," you may have thought, "what happens if I do that again?" So you grabbed another cracker, held it out, and released it. It, too, fell to the floor. You followed the same procedure with several more crackers, and the result was always the same: The cracker traveled in a downward direction. Eventually, you may have performed the same actions on other things—blocks, rattles, peas, milk—and invariably observed the same result. Eventually, you drew the conclusion that all things fall when dropped—your first inkling about a force called *gravity*. (You may also have concluded that dropping things from your high chair greatly annoyed your parents, but that is another matter.)

In inductive reasoning, people use specific instances or occurrences to draw conclusions about entire classes of objects or events. In other words, they observe a *sample* and then draw conclusions about the larger *population* from which the sample has been

FIGURE 1.2 The Inductive Process



taken. For instance, an anthropologist might draw conclusions about a certain culture after studying a certain community within that culture. A professor of special education might use a few case studies in which a particular instructional approach is effective with students who have dyslexia to recommend that teachers use the instructional approach with other students with dyslexia. A sociologist might (a) conduct three surveys (one each in 1995, 2005, and 2015) asking 1,000 people to describe their beliefs about AIDS and then (b) draw conclusions about how society's attitudes toward AIDS have changed over the 20-year period.

Figure 1.2 graphically depicts the nature of inductive reasoning. Let's look at an example of how this representation applies to an actual research project. Neurologists Silverman, Masland, Saunders, and Schwab (1970) sought the answer to a problem in medicine: How long can a person have a flat electroencephalogram (EEG) (i.e., an absence of measurable electrical activity in the brain, typically indicative of cerebral death) and still recover? Silverman and his colleagues observed 2,650 actual cases. They noted that, in all cases in which the flat EEG persisted for 24 hours or more, not a single recovery occurred. All of the data pointed to the same conclusion: *People who exhibit flat EEGs for 24 hours or longer will not recover.* We cannot, of course, rule out the unexplored cases, but *from the data observed*, the conclusion reached was that recovery is impossible. The EEG line from *every* case led to that *one* conclusion.

Scientific Method

During the Renaissance, people found that when they systematically collected and analyzed data, new insights and understandings might emerge. Thus was the scientific method born; the words literally mean "the method that searches for knowledge" (*scientia* is Latin for "knowledge" and derives from *scire*, "to know"). The scientific method gained momentum during the 16th century with such men as Paracelsus, Copernicus, Vesalius, and Galileo.

Traditionally, the term scientific method has referred to an approach in which a researcher (a) identifies a problem that defines the goal of one's quest; (b) posits a hypothesis that, if confirmed, resolves the problem; (c) gathers data relevant to the hypothesis; and (d) analyzes and interprets the data to see whether they support the hypothesis and resolve the question that instigated the research. In recent years, however, the term has been a controversial one because not all researchers follow the steps just listed in a rigid, lockstep manner; in fact, as noted earlier, some researchers shy away from forming any hypotheses about what they might find. Some of the controversy revolves around which article to use in

front of the term—more specifically, whether to say “*the* scientific method” or “*a* scientific method.” If we are speaking generally about the importance of collecting and analyzing data systematically rather than haphazardly, then saying “*the* scientific method” makes sense. If, instead, we are speaking about a specific methodology—say, experimental research or ethnographic research (described in Chapter 7 and Chapter 8, respectively), it is probably better to say “*a* scientific method.” In any event, we are talking about a somewhat flexible—although certainly also rigorous—process.

As you may already have realized, application of a scientific method usually involves both deductive logic and inductive reasoning. Researchers might develop a hypothesis either from a theory (deductive logic) or from observations of specific events (inductive reasoning). Using deductive logic, they might make predictions about the patterns they are likely to see in their data *if* a hypothesis is true, and even researchers who have not formulated hypotheses in advance must eventually draw logical conclusions from the data they obtain. Finally, researchers often use inductive reasoning to generalize about a large population from which they have drawn a small sample.

Theory Building

Psychologists are increasingly realizing that the human mind is a very *constructive* mind. People don’t just passively absorb and remember a large body of unorganized facts about the world. Instead, they pull together the things they see and hear to form well-organized and integrated understandings about a wide variety of physical and social events. Human beings, then, seem to have a natural tendency to develop *theories* about the world around them (e.g., see Bransford, Brown, & Cocking, 2000; J. E. Ormrod, 2016).

In general, a theory is an organized body of concepts and principles intended to explain a particular phenomenon. Even as young children, human beings are inclined to form their own personal theories about various physical and social phenomena—for instance, why the sun “goes down” at night, where babies come from, and why certain individuals behave in particular ways. People’s everyday, informal theories about the world aren’t always accurate. For example, imagine that an airplane drops a large metal ball as it travels forward through the air. What kind of path will the ball take as it falls downward? The answer, of course, is that it will fall downward at an increasingly fast rate (thanks to gravity) but will also continue to travel forward (thanks to inertia). Thus, its path will have the shape of a parabolic arc. Yet many college students erroneously believe that the ball (a) will fall straight down, (b) will take a straight diagonal path downward, or (c) will actually move *backward* from the airplane as it falls down (Cook & Breedin, 1994; McCloskey, 1983).

What characterizes the theory building of a good researcher is the fact that it is supported by well-documented findings—rather than by naive beliefs and subjective impressions of the world—and by logically defensible reasoning. Thus, the theory-building process involves thinking *actively* and *intentionally* about a phenomenon under investigation. Beginning with the facts known about the phenomenon, the researcher brainstorms ideas about plausible and, ideally, *best* explanations—a process that is sometimes called *abduction* (e.g., Jaccard & Jacoby, 2010; Walton, 2003). Such explanations are apt to involve an interrelated set of concepts and propositions that, taken together, can reasonably account for the phenomenon being studied.

After one or more researchers have developed a theory to explain a phenomenon of interest, the theory is apt to drive further research, in part by posing new questions that require answers and in part by suggesting hypotheses about the likely outcomes of particular investigations. For example, one common way of testing a theory is to use deductive reasoning to make a prediction (hypothesis) about what should occur *if the theory is a viable explanation of the phenomenon being examined*. As an example, let’s consider Albert Einstein’s theory of relativity, first proposed in 1915. Within the context of his theory, Einstein hypothesized that light passes through space as photons—tiny masses of spectral energy. If

light has mass, Einstein reasoned, it should be subject to the pull of a gravitational field. A year later, Karl Schwarzschild predicted that, based on Einstein's reasoning, the gravitational field of the sun should bend light rays considerably more than Isaac Newton had predicted many years earlier. In 1919 a group of English astronomers traveled to Brazil and North Africa to observe how the sun's gravity distorted the light of a distant star now visible due to a solar eclipse. After the data were analyzed and interpreted, the results clearly supported the Einstein-Schwarzschild hypothesis—and therefore also supported Einstein's theory of relativity.

As new data emerge, a researcher may continue to revise a theory, reworking parts to better account for research findings, filling in gaps with additional concepts or propositions, extending the theory to apply to additional situations, and relating the theory to other theories regarding overlapping phenomena (Steiner, 1988; K. R. Thompson, 2006). Occasionally, when an existing theory cannot adequately account for a growing body of evidence, a good researcher casts it aside and begins to formulate an alternative theory that better explains the data.

Theory building tends to be a relatively slow process, with any particular theory continuing to evolve over a period of years, decades, or centuries. Often, many researchers contribute to the theory-building effort, testing hypotheses that the theory suggests, suggesting additional concepts and propositions to include in the theory, and conducting additional investigations to test one or more aspects of the theory in its current state. This last point brings us to yet another strategy for effectively using the human mind: collaborating with *other* minds.

Collaboration with Other Minds

As an old saying goes, two heads are better than one. Three or more heads can be even better. Any single researcher is apt to have certain perspectives, assumptions, and theoretical biases—not to mention gaps in knowledge about the subject matter—that will limit how the researcher approaches a research project. By bringing one or more professional colleagues into a project—ideally, colleagues who have perspectives, backgrounds, and areas of expertise somewhat different from the researcher's own—the researcher brings many more cognitive resources to bear on how to tackle the research problem and how to find meaning in the data obtained.

Sometimes these colleagues enter the picture as equal partners. At other times they may simply offer suggestions and advice. For example, when a graduate student conducts research for a master's thesis or doctoral dissertation, the student is, of course, the key player in the endeavor. Yet the student typically has considerable guidance from an advisor and, especially in the case of a doctoral dissertation, from a faculty committee. The prudent student selects an advisor and committee members who have the expertise to help shape the research project into a form that will truly address the research question and—more importantly—will make a genuine contribution to the student's topic of study.

Many productive researchers keep in regular communication with others who conduct research on the same or similar topics, perhaps exchanging ideas, critiquing one another's work, and directing one another to potentially helpful resources. Such ongoing communication is also a form of collaboration—albeit a less systematic one—in that everyone can benefit from and build on what other people are thinking and finding. Increasingly, computer technology is playing a central role in this cross-communication and cross-fertilization. For example, many researchers subscribe to topic-specific electronic discussion groups—you may also see such terms as *list servers*, *online discussion forums*, *bulletin boards*, and *message boards*—in which any message sent to or posted on them is available and possibly sent to all subscribers. In addition, some researchers maintain professional websites that describe their research programs and include links to relevant research reports; often you can find these web pages by going to the websites of the researchers' universities or other home institutions.

As the preceding sections should make clear, we human beings are—or at least have the potential to be—*logical, reasoning* beings. But despite our incredible intellectual capabilities—which almost certainly surpass those of all other species on the planet—we don't always reason as logically or objectively as we might. For example, sometimes we “discover” what we *expect* to discover, to the point where we don't look objectively at the data we collect. And sometimes we are so emotionally attached to particular perspectives or theories about a phenomenon that we can't abandon them when mountains of evidence indicate that we should. Figure 1.3 describes

We human beings often fall short of the reasoning capacities with which Mother Nature has endowed us. Following are seven common pitfalls to watch for in your own thinking as a researcher.

1. **Confusing what must logically be true with what seems to be true in the world as we know it—a potential pitfall in deductive reasoning.** Our usual downfall in deductive reasoning is failing to separate logic from everyday experience. For example, consider Isaac Newton's second law of motion: Force equals mass times acceleration ($F = ma$). According to this basic principle of Newtonian physics, any force applied to an object results in acceleration of the object. Using simple algebra—deductive reasoning at its finest—we can conclude that $a = F \div m$ and therefore that if there is no acceleration ($a = 0$), then there is no force ($F = 0$). This deduction makes no sense to anyone who has ever tried to push a heavy object across the floor: The object may not move at all, let alone accelerate. What explains the object's stubbornness, of course, is that other forces, especially friction with and resistance from the floor, are counteracting any force that the pusher may be applying.
2. **Making generalizations about members of a category after having encountered only a restricted subset of that category—a potential pitfall in inductive reasoning.** The main weakness of inductive reasoning is that even if all of our specific observations about a particular set of objects or events are correct, our generalizations about the category as a whole may *not* be correct. For example, if the only tulips we ever see are red ones, we may erroneously conclude that tulips can *only* be red. And if we conduct research about the political or religious beliefs of people who live in a particular location—say, people who live in Chicago—we may draw conclusions that don't necessarily apply to the human race as a whole. Inductive reasoning, then, is most likely to fall short when we gather data from only a small, limited sample and want to make *generalizations* about a larger group.
3. **Looking only for evidence that supports our hypotheses, without also looking for evidence that would disconfirm our hypotheses.** We humans seem to be predisposed to look for confirming evidence rather than disconfirming evidence—a phenomenon known as **confirmation bias**. For many everyday practical matters, this approach serves us well. For example, if we flip a light switch and fail to get any light, we might immediately think, “The light bulb has probably burned out.” We unscrew the existing light bulb and replace it with a new one—and *voilà!* We now have light. Hypothesis confirmed, problem solved, case closed. However, truly objective researchers don't just look for evidence that confirms what they believe to be true. They also look for evidence that might *disprove* their hypotheses. They secretly hope that they don't find such evidence, of course, but they open-mindedly look for it nonetheless.
4. **Confirming expectations even in the face of contradictory evidence.** Another aspect of our confirmation bias is that we tend to ignore or discredit any contradictory evidence that comes our way. For example, consider the topic of global climate change. Convincing evidence continues to mount to support the ideas that (a) the Earth's average temperature is gradually rising and (b) this temperature rise is at least partly the result of carbon emissions and other human activities. Yet some folks have great difficulty looking at the evidence objectively—perhaps the researchers incorrectly analyzed the data, they say, or perhaps the scientific community has a hidden agenda and so isn't giving us the straight scoop.
5. **Mistaking dogma for fact.** Although we might be inclined to view some sources of information with a skeptical, critical eye, we might accept others without question. For example, many of us willingly accept whatever an esteemed researcher, scholarly book, or other authority source says to be true. In general, we may uncritically accept anything said or written by individuals or groups we hold in high esteem. Not all authority figures and works of literature are reliable sources of information and guidance, however, and blind, unquestioning acceptance of them can be worrisome.
6. **Letting emotion override logic and objectivity.** We humans are emotional beings, and our emotions often infiltrate our efforts to reason and think critically. We're apt to think quite rationally and objectively when dealing with topics we don't feel strongly about and yet think in decidedly irrational ways about emotionally charged issues—issues we find upsetting, infuriating, or personally threatening.
7. **Mistaking correlation for causation.** In our efforts to make sense of our world, we human beings are often eager to figure out what causes what. But in our eagerness to identify cause-and-effect relationships, we sometimes “see” them when all we really have is two events that just happen to occur at the same time and place. Even when the two events are *consistently* observed together—in other words, when they are *correlated*—one of them doesn't necessarily cause the other. An ability to distinguish between causation and correlation is critical in any research effort, as you will discover in Chapter 6.

FIGURE 1.3 Common Pitfalls in Human Reasoning

List of pitfalls based on Chapter 8, “Common Sense Isn't Always Sensible: Reasoning and Critical Thinking” in *Our Minds, Our Memories* by J. E. Ormrod, 2011, pp. 151–183. Copyright by Pearson Education, Inc. Used by permission.

some common pitfalls in human reasoning—pitfalls we urge you to be on the lookout for and try to overcome. Good researchers are *reflective* researchers who regularly and critically examine not only their research designs and data but also their own thinking processes.

MyLab Education Self-Check 1.4

MyLab Education Application Exercise 1.3: Communicating Effectively about Research

REFLECTIONS ON NOTEWORTHY RESEARCH

The time: February 13, 1929. The place: St. Mary's Hospital, London. The occasion: the reading of a paper before the Medical Research Club. The speaker: a member of the hospital staff in the Department of Microbiology. Such was the setting for the presentation of one of the most significant research reports of the early 20th century. The report was about a discovery that has transformed the practice of medicine. Dr. Alexander Fleming presented to his colleagues his research on penicillin. The group was apathetic. No one showed any enthusiasm for Fleming's paper. Great research has frequently been presented to those who are imaginatively both blind and deaf.

Despite the lukewarm reception, Fleming knew the value of what he had done. The first public announcement of the discovery of penicillin appeared in the *British Journal of Experimental Pathology* in 1929. It is a readable report—one that André Maurois (1959) called “a triumph of clarity, sobriety, and precision.” Get it; read it. You will be reliving one of the great moments in 20th-century medical research.

Soon after Fleming's presentation of his paper, two other names became associated with the development of penicillin: Ernst B. Chain and Howard W. Florey (Chain et al., 1940; also see Abraham et al., 1941). Together they developed a pure strain of penicillin. Florey was especially instrumental in initiating its mass production and its use as an antibiotic for wounded soldiers in World War II (Coghill, 1944; also see Coghill & Koch, 1945). Reading these reports takes you back to the days when the medical urgency of dying people called for a massive research effort to make a newly discovered antibiotic available for immediate use.

On October 25, 1945, the Nobel Prize in medicine was awarded to Fleming, Chain, and Florey.

If you want to learn more about the discovery of penicillin, read André Maurois's *The Life of Sir Alexander Fleming* (1959), the definitive biography done at the behest of Fleming's widow. The book will give you an insight into the way great research comes into being.

The procedures used in groundbreaking research are identical to those every student follows in completing a dissertation, thesis, or other research project. Triggered by curiosity, all research begins with an observation, a question, a problem. Assumptions are made. Hypotheses might be formulated. Data are gathered. Conclusions are reached. What *you* do in a research project is the same as what many others have done before you, including those who have pushed back the barriers of ignorance and made discoveries that have greatly benefited humankind.

EXPLORING RESEARCH IN YOUR FIELD

Early in the chapter we mentioned that academic research is popularly seen as an activity far removed from everyday living. Even graduate students working on theses or dissertations may consider their tasks to be meaningless busywork that have little or no

relevance to the world beyond the university campus. This “busywork” conception of an academic program’s research requirement is simply not accurate. Conducting the research required to write an acceptable thesis or dissertation is one of the most valuable educational experiences a person can have. Even if you plan to become a practitioner rather than a researcher—say, a nurse, social worker, or school principal—knowledge of strong research methodologies and legitimate ways to collect and analyze data is essential for keeping up with advances in your field. The alternative—*not* being well versed in sound research practices—can lead you to base important professional decisions on faulty data, inappropriate interpretations and conclusions, or unsubstantiated personal intuitions. Truly competent and effective practitioners base their day-to-day decisions and long-term priorities on solid research findings in their field.

As a way of getting your feet wet in the world of research, take some time to read articles in research journals in your academic discipline. You can do so by spending an hour or two in the *periodicals* section of your local college or university library or, alternatively, making use of your library website’s online databases to download and read a number of articles at home.

Your professors should have suggestions about journals that are especially relevant to your discipline. Reference librarians can be helpful as well. If you are shy about asking other people for advice, you can get insights about important journals by scanning the reference lists in some of your textbooks.

Keep in mind that the quality of research you find in your explorations may vary considerably. One rough indicator of the quality of a research study is whether the research report has gained the approval of designated peers. A peer-reviewed research report—you may also see the terms *juried* and *refereed*—has been judged by respected colleagues in one’s field and deemed to be of sufficient quality and importance to warrant publication. For instance, the editors of many academic journals send submitted manuscripts to one or more reviewers who pass judgment on the manuscripts, and only manuscripts that meet certain criteria are published in the journal. A non-peer-reviewed report (a.k.a., a *nonjuried* or *nonrefereed* one) is a report that appears in a journal or on the Internet without first being screened by one or more experts. Some non-peer-reviewed reports are excellent, but others may not be.

PRACTICAL APPLICATION Identifying Important Tools in Your Discipline

We have introduced several key research tools in the preceding pages, and we describe many more specific ones in subsequent chapters. Some of the tools you learn about in this book may be somewhat new to you. How will you learn when, how, and why you should use them? One effective means of learning about important tools in your discipline is to work closely with an expert researcher in your field.

Take the time to find a person who has completed a few research projects—perhaps someone who teaches a research methods class, someone who has published in prestigious journals, someone who has successfully obtained research grants, or even someone who has recently finished a dissertation. Ideally, this individual should be someone in your own field of study. Ask the questions listed in the following checklist and, if possible, observe the person as he or she goes about research work. If you can’t locate anyone locally, it may be possible to recruit one or more willing individuals through e-mail.

CHECKLIST**Interviewing an Expert Researcher**

- _____ 1. How do you start a research project?

- _____ 2. What specific tools do you use (e.g., library resources, computer software, forms of measurement, statistics)?

- _____ 3. How did you gain your expertise with the various tools you use?

- _____ 4. What are some important experiences you suggest for a novice researcher?

- _____ 5. If I wanted to learn how to become a competent researcher, what specific tools would you suggest I work with?

MyLab Education Self-Check 1.5

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Chapter 2

The Problem: The Heart of the Research Process

The main research problem or question is the axis around which the whole research effort revolves. It clarifies the goals of the research project and can keep the researcher from wandering in tangential, unproductive directions.

Learning Outcomes

- 2.1. Identify strategies for choosing and refining an overall research problem or question.
- 2.2. Subdivide a main research problem or question into useful subproblems (or subquestions).
- 2.3. Pin down a proposed research study by (a) identifying a relevant theoretical or conceptual framework; (b) if appropriate, stating one or more *a priori* hypotheses; (c) identifying the general concepts or more-specific variables to be examined; (d) defining terms; (e) stating assumptions; (f) if applicable, identifying delimitations and limitations; and (g) explaining the study's potential importance or significance.

The heart of every research project—the axis around which the entire research endeavor revolves—is the problem or question the researcher wants to address. The first step in the research process, then, is to identify this problem or question with clarity and precision.

FINDING RESEARCH PROJECTS

Issues in need of research are everywhere. Some research projects can enhance our general knowledge about our physical, biological, social, or psychological world or shed light on historical, cultural, or aesthetic phenomena. For example, an ornithologist might study the mating habits of a particular bird species, an anthropologist might examine the moral beliefs and behaviors of a particular cultural group, and a psychologist might study the nature of people's logical reasoning processes (as one of us authors did in her doctoral dissertation). Such projects, which can advance theoretical conceptualizations about a particular topic, are known as basic research.

Other research projects address issues that have immediate relevance to current procedures, practices, and policies. For example, an agronomist might study the effects of various fertilizers on the growth of sunflowers, a nursing educator might compare the effectiveness of different instructional techniques for training future nurses, and a political scientist might determine what kinds of campaign strategies influence one or more demographic groups' voting patterns. Such projects, which can inform human decision making about practical problems, are known as applied research.

Keep in mind, however, that the line between basic research and applied research is a blurry one. Answering questions about basic theoretical issues can often inform current practices in the everyday world; for example, by studying the mating habits of an

endangered bird species, an ornithologist might lead the way in saving the species from extinction. Similarly, answering questions about practical problems may enhance theoretical understandings of particular phenomena; for example, the nursing educator who finds that one approach to training nurses is more effective than another may enhance psychologists' understanding of how, in general, people acquire new knowledge and skills.

To get an online sample of recently published research studies in your area of interest, go to Google Scholar at scholar.google.com; type a topic in the search box, and then click on some of the titles that pique your curiosity. As you scan the results of your Google search, especially look for items identified as being in pdf form, referring to portable document format; these items are often electronic photocopies of articles that have appeared in academic journals and similar sources.

You might also want to look at typical research projects for doctoral dissertations. For example, your university library probably has a section that houses the completed dissertations of students who have gone before you. Alternatively, you might go to the electronic databases in your library's catalog. Among those databases you are likely to find ProQuest Dissertations & Theses Global, which includes abstracts—and in many cases, the complete texts—for millions of dissertations and theses from around the world.

Regardless of whether you conduct basic or applied research, a research project is likely to take a significant amount of your time and energy, so whatever problem you study should be *worth* your time and energy. As you begin the process of identifying a suitable research problem to tackle, keep two criteria in mind. First, your problem should address an important question, such that the answer can actually *make a difference* in some way. And second, it should advance the frontiers of knowledge, perhaps by leading to new ways of thinking, suggesting possible applications, or paving the way for further research in the field. To accomplish both of these ends, your research project must involve not only the collection of data but also the *interpretation* of those data.

Some problems aren't suitable for research because they lack the interpretation-of-data component; they don't require the researcher to go beyond the data themselves and reveal their meaning. Following are four situations to avoid when considering a problem for research purposes.

1. *A research project should not be simply a ruse for achieving self-enlightenment.* All of us have large gaps in our knowledge that we may want to fill. But mere self-enlightenment should not be the primary purpose of a research project (see Chapter 1). Gathering information to know more about a certain topic is entirely different from looking at a body of data to discern how it contributes to the solution of a problem or to address a currently unanswered question.

A student once submitted the following statement of a research problem:

The problem of this research is to learn more about the way in which the Panama Canal was built.

For this student, the information-finding effort would provide the satisfaction of having gained more knowledge about a particular topic, but it would *not* have led to *new* knowledge.

2. *A project whose sole purpose is to compare two sets of data does not qualify as a suitable research endeavor.* Take this proposed problem for research:

This research project will compare the increase in the number of women employed over 100 years—from 1870 to 1970—with the employment of men over the same time span.

A simple table completes the project:

	1870	1970
Women employed	13,970,000	72,744,000
Men employed	12,506,000	85,903,000

The "research" project involves nothing more than a quick trip to a government website to reveal what is already known.

3. *Simply calculating a correlation coefficient between two related sets of data is not acceptable as a problem for research.* Why? Because a key ingredient in true research—*making sense* of the data—is missing. A correlation coefficient is nothing more than a statistic that expresses how closely two characteristics or other variables are associated with each other. It tells us nothing about *why* the association might exist.

Some novice researchers think that after they have collected data and performed a simple statistical procedure, their work is done. In fact, their work is *not* done at this point; it has only begun. For example, many researchers have found a correlation between the IQ scores of children and those of their parents. In and of itself, this fact is of little use. It does, however, suggest questions that a research project might address: What is the underlying *cause* of the correlation between children's and parents' intelligence test scores? Is it genetic? Is it environmental? Does it reflect some combination of genetic heritage and environment?

4. *A problem that results only in a yes-or-no answer is not a sufficient problem for a research study.* Why? For the same reason that merely calculating a correlation coefficient is unsatisfactory. Both situations simply skim the surface of the phenomenon under investigation, without exploring the mechanisms underlying it.

"Is homework beneficial to children?" That is no problem for research, at least not in the form in which it's stated. The researchable issue is not whether homework is beneficial, but wherein the benefit of homework—if there is one—lies. Which components of homework are beneficial? Which ones, if any, might be counterproductive? If we knew the answers to these questions, then teachers could better structure homework assignments to enhance students' learning and classroom achievement.

There is so much to learn—there are so many important questions unanswered—that we should look for significant problems and issues and not dwell on those that will make little or no contribution. Good research, then, begins with identifying a good question to ask—ideally, a question that no one has ever thought to ask before. Researchers who contribute the most to our understanding of our physical, biological, psychological, and social worlds are those who pose questions that lead us into entirely new lines of inquiry. To illustrate, let's return to that correlation between the IQ scores of children and those of their parents. For many years, psychologists bickered about the relative influences of heredity and environment on intelligence and other human characteristics. They now know not only that heredity and environment *both* influence virtually every aspect of human functioning but also that they *influence each other's influences* (for a good, down-to-earth discussion of this point, see Lippa, 2002). Rather than ask the question "How much do heredity and environment each influence human behavior?" a more fruitful question is "How do heredity and environment *interact* in their influences on behavior?"

PRACTICAL APPLICATION Identifying and Presenting the Research Problem or Question

How can a beginning researcher formulate an important and useful research problem or question? Here we offer guidelines both for choosing an appropriate problem or question and for pinning it down sufficiently to focus the research effort.

GUIDELINES Choosing an Appropriate Problem or Question

Choosing a good research problem or question requires genuine curiosity about unanswered questions. But it also requires enough knowledge about a topic to identify the kinds of investigations that are likely to make important contributions to one's field. Here we offer several strategies that are often helpful for novice researchers.

1. *Look around you.* In many disciplines, questions that need answers—phenomena that need explanation—are everywhere. For example, let's look back to the early 17th century, when Galileo was trying to make sense of a variety of earthly and celestial phenomena. Why did large bodies of water (but not small ones) rise and fall in the form of tides twice a day? Why did sunspots consistently move across the sun's surface from right to left, gradually disappear, and then, about 2 weeks later, reappear on the right edge? Furthermore, why did sunspots usually move in an upward or downward path as they traversed the sun's surface, while only occasionally moving in a direct, horizontal fashion? Galileo correctly deduced that the various "paths" of sunspots could be explained by the facts that both the Earth and sun were spinning on tilted axes and that—contrary to popular opinion at the time—the Earth revolved around the sun, rather than vice versa. Galileo was less successful in explaining tides, mistakenly attributing them to natural "sloshing" as a result of the Earth's movement through space, rather than to the moon's gravitational pull.

We do not mean to suggest that novice researchers should take on such monumental questions as the nature of the solar system or oceanic tides. But smaller problems suitable for research exist everywhere. Perhaps you might see them in your professional practice or in everyday events. Continually ask yourself questions about what you see, hear, and read: Why does such-and-such happen? What makes such-and-such tick? What are people thinking when they do such-and-such?

2. *Read the existing research literature about a topic.* One essential strategy is to find out what things are already known and believed about your topic of interest—a topic we address in more detail in Chapter 3. Little can be gained by reinventing the wheel. In addition to telling you what is already known, the existing literature about a topic is likely to tell you what is *not* known in the area—in other words, what still needs to be done. For instance, your research project might

- Address the suggestions for future research that another researcher has identified
- Replicate a research project in a different setting or with a different population
- Consider how various subpopulations might behave differently in the same situation
- Apply an existing perspective or theory to a new situation
- Explore unexpected or contradictory findings in previous studies
- Challenge research findings that seem to contradict what you personally know or believe to be true (Neuman, 2011)

Reading relevant literature has other advantages as well. It can give you a conceptual or theoretical framework on which you can build a rationale for your study; we talk more about such frameworks later in the chapter. Reading the literature can also offer potential research designs and data-collection strategies. And it can help you interpret your results and relate them to previous research findings in your field.

As you read about other people's research related to your topic, *take time to consider how you can improve your own work because of it.* Ask yourself: What have I learned that I would (or would not) want to incorporate into my own research? Perhaps it is a certain way of writing, a specific method of data collection, or a particular approach to data analysis. You should constantly question and reflect on what you read.

We also urge you to *keep a running record of helpful journal articles and other sources.* Include enough information that you will be able to track each source down again—perhaps including the author's name, the title and year of the journal or book, key words and phrases that capture the focus of the work, and (if applicable) the appropriate library call number or Internet address. You may think you will always be able to recall where you found a helpful source and what you learned from it. However, our own experiences tell us that you probably *will* forget a good deal of what you read unless you keep a record of it.

3. *Seek the advice of experts.* Another simple yet highly effective strategy for identifying a research problem or question is to ask an expert: What needs to be done? What burning

questions are still out there? What previous research findings don't seem to make sense? Your professors will almost certainly be able to answer each of these questions, as will other scholars you might contact through e-mail or meet on campus and elsewhere.

Some beginning researchers—including many students—are reluctant to approach well-known scholars for fear that these scholars don't have the time or patience to talk with novices: Quite the opposite is true: Most experienced researchers are happy to talk with people who are just starting out. In fact, they may feel flattered that you're familiar with their work and would like to extend or apply it in some way.

4. *Attend professional conferences.* Many researchers have great success finding new research projects at national or regional conferences in their discipline. By scanning the conference program and attending sessions of interest, they can learn "what's hot and what's not" in their field. Furthermore, conferences are places where novice researchers can make contacts with more experienced individuals in their field—where they can ask questions, share ideas, and exchange e-mail addresses that enable follow-up communication.

5. *Choose a topic that intrigues and motivates you.* As you read the professional literature, attend conferences, and talk with experts, you will uncover a number of potential research problems or questions. At some point you need to pick just *one* of them, and your selection should be based on what you personally want to learn more about. Remember, the project you are about to undertake will take you many months, quite possibly a couple of years or even longer. So it should be something you believe is worth your time and effort—even better, one you're truly passionate about. Peter Leavenworth, at the time a doctoral student in history, explained the importance of choosing an interesting dissertation topic this way: "You're going to be married to it for a while, so you might as well enjoy it."

6. *Choose a topic that other individuals will find interesting and worthy of attention.* Ideally, your work should not end simply with a thesis, dissertation, or other unpublished research report. If your research adds an important piece to what the human race knows and understands about the world, then you will, we hope, want to share your findings with a larger audience. In other words, you will want to present what you have done at a regional or national conference, publish an article in a professional journal, or both (we talk more about doing such things in Chapter 13). Conference coordinators and journal editors are often quite selective about the research reports they accept for presentation or publication, and they are most likely to choose those reports that will have broad appeal.

Future employers may also make judgments about you, at least in part, based on the topic you have chosen for a thesis or dissertation. Your résumé or curriculum vitae will be more apt to attract their attention if, in your research, you're pursuing an issue of broad scientific or social concern—especially one that is currently a hot topic in your field.

7. *Be realistic about what you can accomplish.* Although it's important to address a problem or question that legitimately needs addressing, it's equally important that your research project be a *manageable* one. For example, how much time will it take you to collect the necessary data? Will you need to travel great distances to acquire the data? Will you need expensive equipment? Will the project require knowledge and skills far beyond those you currently have? Asking yourself and then answering such questions can help you keep your project within reasonable, accomplishable bounds.

GUIDELINES Writing a Purpose Statement

Remember, the heart of any research project is your problem or question, along with the goal or goals you intend to pursue in your efforts to address the problem or question. At every step in the process, successful researchers ask themselves: What am I doing? For what

purpose am I doing it? Such questions can help you focus your efforts toward achieving your ultimate purpose for gathering data: to address the problem.

Thus, after identifying a research problem or question, you must articulate it in such a way that *it is carefully phrased and represents the one or more goals of the total research effort*. Following are several general guidelines to help you do that in the overall purpose statement that introduces your project to others.

1. *Describe your problem or question clearly and completely.* When introducing your research problem or question to others—for instance, when you present it in the introductory purpose statement in your research proposal—you should state it so clearly that anyone else can understand the issue you want to investigate. However, you can state your problem or question clearly only when you also state it completely. At a minimum, you should describe it in one or more *grammatically complete sentences*. As examples of what *not* to do, we present four meaningless half-statements—verbal fragments that only hint at a purpose. Ask yourself whether you understand exactly what each student researcher plans to do.

From a student in sociology:

Welfare on children's attitudes.

From a student in music:

Palestrina and the motet.

From a student in economics:

Busing of schoolchildren.

From a student in social work:

Retirement plans of adults.

All four statements lack clarity. It is imperative to think in terms of specific, researchable goals expressed in complete sentences. We take the preceding fragments and develop each of them into one or more complete sentences that describe a researchable problem or question.

Welfare on children's attitudes becomes:

What effect does welfare assistance to parents have on the attitudes of their children toward work?

Palestrina and the motet becomes:

This study will analyze the motets of Giovanni Pierluigi da Palestrina (1525?–1594) written between 1575 and 1580 to discover their distinctive contrapuntal characteristics and will contrast them with the motets of his contemporary William Byrd (1542?–1623) written between 1592 and 1597. During the periods studied, each composer was between 50 and 55 years of age.

Busing of schoolchildren becomes:

What factors must be evaluated and what are the relative weights of those several factors in constructing a formula for estimating the cost of busing children in a midwestern metropolitan school system?

Retirement plans of adults becomes:

How do adults' retirement plans compare with the actual realization, in retirement, of those plans in terms of self-satisfaction and self-adjustment? What does an analysis of the difference between anticipation and realization reveal for a more intelligent approach to planning?

Notice that in the full statements of these problems and questions, the areas studied are carefully limited so that the studies are of manageable size. The author of the Palestrina—

Byrd study carefully limited the motets that would be studied to those written when each composer was between 50 and 55 years of age. A glance at the listing of Palestrina's works in *Grove's Dictionary of Music and Musicians* demonstrates how impractical it would be for a student to undertake a study of all the Palestrina motets. He wrote 392 of them!

2. *Think through the feasibility of the project that your purpose statement implies.* Novice researchers sometimes identify a research problem or question without thinking about its implications. Consider the following purpose statement in a research proposal submitted by a student whom we will call John:

This study proposes to study the science programs in the secondary schools in the United States for the purpose of . . .

Let's think about that. The United States has somewhere around 40,000 public and private secondary schools. These schools, north to south, extend from Alaska to Florida; east to west, from Maine to Hawaii. How does John intend to contact each of these schools? By personal visit? At best, he might be able to visit two or three schools per day, so if he worked 365 days a year—in which case many school officials would have to agree to meet with him on a weekend or holiday—he would need more than 40 years to collect his data. And even if John had an exceptionally long life—not to mention exceptional persistence—the financial outlay for his project would be exorbitant.

"But," John explains, "I plan to gather the data by sending a questionnaire." Fine! Each letter, with an enclosed questionnaire and a return postage-paid envelope, might cost two dollars to mail. At best, he could expect only a 50% return rate on the first mailing, so one or more follow-up mailings would be required for nonreturnees. And we would need to figure in the cost of envelopes, stationery, printing, and data analysis.

A faster and less expensive option, of course, would be to conduct the survey by e-mail, possibly with a hotlink to an interactive website. In that case, John would need to track down the name and chief administrator of every one of those 40,000 schools. How long might it take him to do that? And how many of his e-mail messages might be automatically relegated to an administrator's spam box and thus never opened and read?

Obviously, John didn't intend to survey every secondary school in the United States, yet that's what he wrote that he would do.

3. *Say precisely what you mean.* You can't assume that others will be able to read your mind. People will always take your words at their face value: You mean what you say—that's it. In the academic community, a basic rule prevails: *Absolute honesty and integrity are assumed in every statement a scholar makes.*

Look again at John's purpose statement. We could assume that John means to fulfill precisely what he has stated (although we would doubt it, given the time and expense involved). Had he intended to survey only *some* schools, he should have said so plainly:

In this study, I propose to survey the science programs in selected secondary schools throughout the United States for the purpose of . . .

Or perhaps he could have limited his study to a specific geographical area or to schools serving certain kinds of students. Such an approach would give the purpose statement constraints that the original statement lacked and would communicate to others what John intended to do—what he realistically *could* commit to doing. Furthermore, it would have preserved his reputation as a researcher of integrity and precision.

Ultimately, an imprecise purpose statement can lead others to have reservations about the quality of the overall research project. If a researcher cannot be meticulous and precise in describing the problem or question to be addressed, others might wonder whether the researcher is likely to be any more meticulous and precise in gathering and interpreting data. Such uncertainty and misgivings are serious indeed, for they reflect on the basic integrity of the whole research effort.

Another potential difficulty is this one: A researcher *talks about the problem or question* but never actually *states what it is*. Recognizing that the problem or question needs to be considered within a certain context or background—which it usually does—the researcher launches into a generalized discussion, continually obscuring the problem or question, never clearly articulating it. Take, for example, the following introductory paragraph for a research proposal:

The upsurge of interest in reading and learning disabilities found among both children and adults has focused the attention of educators, psychologists, and linguists on the language syndrome. In order to understand how language is learned, it is necessary to understand what language is. Language acquisition is a normal developmental aspect of every individual, but it has not been studied in sufficient depth. To provide us with the necessary background information to understand the anomaly of language deficiency implies a knowledge of the developmental process of language as these relate to the individual from infancy to maturity. Grammar, also an aspect of language learning, is acquired through pragmatic language usage. Phonology, syntax, and semantics are all intimately involved in the study of any language disability.

Can you find a statement of the problem here? Several problems are suggested, but none is articulated with sufficient clarity that we might put a finger on it and say, "There, that is the problem."

Earlier in this chapter we have suggested that you look at examples of dissertations that students have completed at your university and elsewhere. Look at the abstracts for a few of those dissertations and notice the directness with which the goals of the research projects are set forth. The purpose of a study should be presented in the first sentence or two: "The purpose of this study was to . . ." No mistaking it, no background buildup necessary—just a straightforward plunge into the task at hand. All research problems and purpose statements should be described with the same clarity.

4. State the problem or question in a way that reflects an open mind about its solution. In our own research methods classes, we have occasionally seen research proposals in which the authors write that they intend to *prove* that certain statements are true. For example, a student once proposed the following research project:

In this study, I will prove that obese adults experience greater psychological distress than adults with a healthy body mass index.

This is not a research question; it is a presumed—and quite presumptuous!—*answer* to a research question. If this student already knew the answer to her question, why was she proposing to study it? Furthermore, as noted in Chapter 1, it is quite difficult to prove something definitively, beyond a shadow of a doubt. We might obtain data consistent with what we believe to be true, but in the world of research, we can rarely say with 100% certainty that it *is* true.

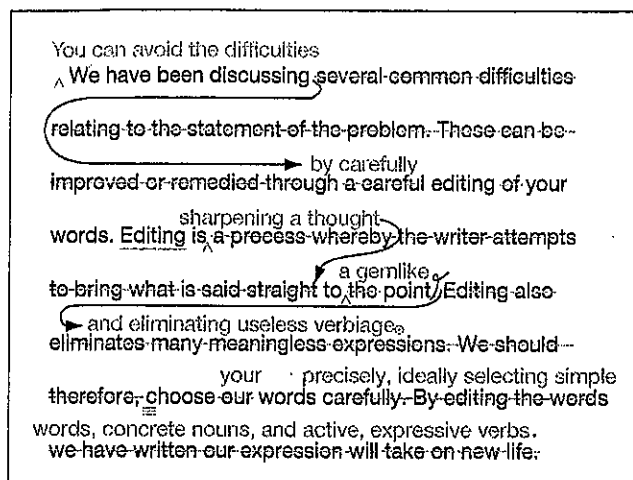
Good researchers try to keep open minds about what they might find. Perhaps they will find the result they hope to find, perhaps not. Any hypothesis should be stated as exactly that—a *hypothesis*—rather than as a foregone conclusion. As you will see later in the chapter, hypotheses play important roles in many quantitative research proposals. However, they should not be part of the problem statement.

Let's rewrite the preceding purpose statement, this time omitting any expectation of results that the research effort might yield:

In this study, I will investigate the possible relationship between body mass index and psychological stress, as well as two more specific psychological factors (depression and anxiety) that might underlie such a relationship.

Such a statement clearly communicates that the researcher is open-minded about what she may or may not find.

FIGURE 2.1 Editing to Clarify Your Writing: An Example



5. *Edit your work.* You can avoid the difficulties we have been discussing by carefully editing your words. *Editing* is sharpening a thought to a gemlike point and eliminating useless verbiage. Choose your words precisely, ideally selecting simple words, concrete nouns, and active, expressive verbs.

The sentences in the preceding paragraph began as a mishmash of foggy thought and jumbled verbiage. The original version of the paragraph contained 71 words. These were edited down to 41 words, yielding a reduction of about 40% and a great improvement in clarity and readability. Figure 2.1 shows the original version and how it was edited. The three lines under the *c* in *choose* mean that the first letter should be capitalized. We present some of the common editing marks when we discuss editing in more detail in Chapter 5.

Notice the directness of the edited copy. For example, we replaced an unnecessarily wordy phrase—"a process whereby the writer attempts to bring what is said straight to the point"—with just seven words: "sharpening a thought to a gemlike point." And we replaced the last two sentences with a single sentence that pinned down what good word choice might involve: "simple words, concrete nouns, and active, expressive verbs."

Editing almost invariably improves your thinking and your prose. Many students think that any words that approximate a thought are adequate to convey it to others. This is not so. Approximation is never precision.

The following checklist can help you present a research statement that is clear, precise, and accurate.

CHECKLIST

Evaluating a Purpose Statement

1. Write a purpose statement for a research study that reveals the problem or question to be addressed.

- _____ 2. Review your purpose statement and ask yourself three questions:
- Are the problem/question and purpose presented in one or more complete, grammatical sentences?
 - Is it clear how the area of study will be limited or focused?
 - Is it clear that you have an open mind about results that the research effort might yield?
- _____ 3. On the basis of your answers to the questions in Item 2, edit your purpose statement as necessary.
- _____ 4. Look at your edited statement and reflect on three additional questions:
- Does the answer to your problem or question have the potential for providing important and useful information?
 - Will the result be more than a simple exercise in gathering information, answering a yes-or-no question, or making a simple comparison?
 - Is the project focused enough to be accomplished with a reasonable expenditure of time, money, and effort?
- _____ 5. Looking at your statement once more, consider this: Is the problem or question really what you want to investigate?
- _____ 6. Show some of your colleagues or fellow students your work. Ask them to consider the questions listed in Items 2 and 4 and then to give you their comments. With your compiled feedback, rewrite your purpose statement once again:

MyLab Education Self-Check 2.1**MyLab Education Application Exercise 2.1: Stating the Research Problem**

DIVIDING THE MAIN RESEARCH PROBLEM OR QUESTION INTO SUBPROBLEMS

Many research problems and questions are too large or complex to be solved without subdividing them. A good strategy, then, is to divide and conquer. Almost any general problem or question can be broken down into smaller units, or subproblems—sometimes in the form of more specific questions—that are easier to address and resolve. Furthermore, by viewing the main problem or question through its subproblems or more specific questions, a researcher can often get a better idea of how to approach the entire research endeavor. To keep our discussion simple, we will use the term *subproblems* to encompass both declarative subproblem statements and specific questions that a researcher intends to address.

Subproblems Versus Pseudo-Subproblems

The researcher must distinguish subproblems that are integral parts of the main problem from things that look like problems but are really nothing more than procedural issues. The latter, which we might call *pseudo-subproblems*, involve decisions a researcher must make before being able to effectively address the general research problem and its subproblems. Consider the following as examples:

- ❑ Would a quantitative approach, a qualitative approach, or a mixed-methods approach be most suitable for addressing the problem?
- ❑ If a sample must be chosen from a larger population, what is the best way to choose the sample, and how large should it be?
- ❑ What specific methods should be used to collect data?
- ❑ What procedures should be used to analyze the data?

For each pseudo-subproblem, you must decide whether (a) a little common sense and some creative thinking might help in solving it, or (b) you lack the knowledge to address the difficulty. In the latter case, you have several options:

1. Turn to the index of this text to see whether your pseudo-subproblem is discussed.
2. Peruse the "For Further Reading" lists at the end of each chapter in this book to see whether they include sources that might help you, and consult general research methods books in your discipline.
3. Search your university library's catalog and online databases to find potentially helpful books and journal articles. If your library doesn't own what you need, you can typically obtain it through interlibrary loan.
4. Seek the suggestions and advice of more experienced researchers in your field. Recall a point previously made in Chapter 1: One of the most effective strategies for using the human mind is *collaborating with other minds*.

Characteristics of Subproblems

Following are four key characteristics of subproblems.

1. *Each subproblem should be a researchable issue in its own right.* A subproblem should constitute a logical subdivision that can be investigated as a distinct project within the larger research endeavor. The solutions to the subproblems, taken together, can then be combined to address and possibly resolve the main problem or question.

It is essential that each subproblem be stated clearly and succinctly. As mentioned earlier, a subproblem is often stated in the form of a question. A question tends to focus the researcher's attention more directly on the research target of the subproblem than does a declarative statement. As we have seen, a questioning, open-minded attitude is the mark of a true researcher.

2. *Each subproblem must be clearly tied to the interpretation of data.* Just as is true for the main problem, each subproblem should involve interpretation as well as collection of data. This fact may be expressed as a part of each subproblem statement, or it may be reflected in a separate but related subproblem.

3. *The subproblems must add up to the totality of the problem.* After you have stated the subproblems, check them against the statement of the main problem (or question) to make sure that (a) they don't extend beyond the main problem and (b) they address all significant aspects of the main problem.

4. *Subproblems should be small in number.* If the main problem or question is carefully stated and properly limited to a feasible research effort, the researcher will find that it usually contains two to six subproblems. Sometimes a researcher will come up with as many

as 10, 15, or 20 subproblems. If you find yourself in this situation, you should study the individual subproblems to see whether (a) some are actually procedural issues (i.e., pseudo-subproblems), (b) some might reasonably be combined into larger subproblems, or (c) the main problem or question is more complex than you originally believed. If the last of these is true, you may want to reconsider whether the solution to your overall problem or question is realistically achievable given the time and resources you have.

Identifying Subproblems

To identify subproblems, you must begin with the main problem or question itself. Write it down, and then carefully scrutinize it to identify more specific problems that should be isolated for in-depth study. All of the subproblems should, in total, comprise your overall problem or question.

You can use either paper and pencil or mind-mapping software to help you identify your subproblems. We briefly describe each of these strategies.

Taking a Paper-and-Pencil Approach

Using this approach, you write your main problem or question on paper and then box off the subproblem areas. More specifically, you might follow these steps:

1. Write your problem or question on a clean sheet of paper, leaving considerable space between the lines.
2. Critically examine what you've written in Step 1 to identify specific topics that require in-depth treatment in order for your overall problem or question to be resolved. Draw a box around each topic.
3. Make sure that the text within each box includes one or more words that indicate the need for data interpretation (e.g., *analyze*, *discover*, *compare*). Underline these words.
4. Arrange the entire problem or question—which now has its subproblems in boxes—in a graphic that shows the structure of the whole research design.

We use a problem in musicology to illustrate this technique. More specifically, we revisit the motets-of-Palestrina problem, which in this case is described within the context of a purpose statement:

This study will analyze the motets of Giovanni Pierluigi da Palestrina (1525?–1594) written between 1575 and 1580 to discover their distinctive contrapuntal characteristics and will contrast them with the motets of his contemporary William Byrd (1542?–1623) written between 1592 and 1597. During the periods studied, each composer was between 50 and 55 years of age.

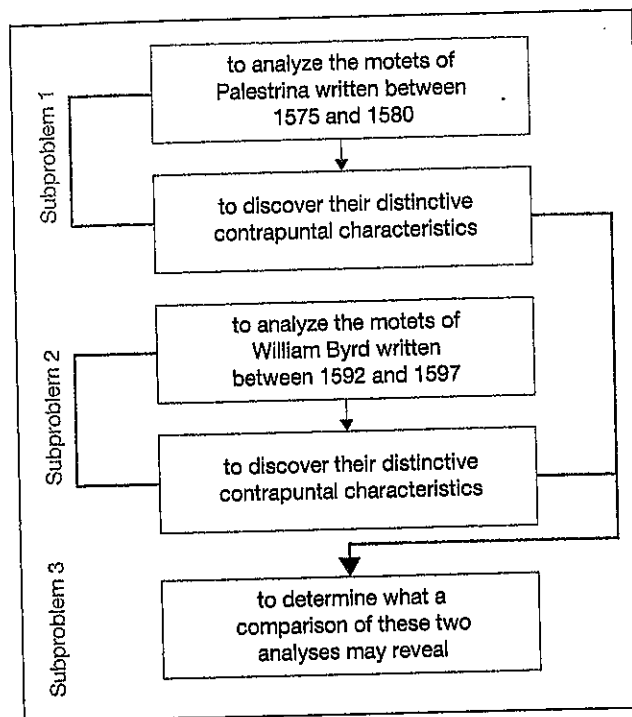
Let's first delete the factual matter, such as lifespan dates and the fact that the two men were contemporaries. These facts merely help in giving a rationale for certain elements within the problem. Modified to reflect its essential parts, the motet problem becomes the following:

The purpose of this study will be to analyze the motets of Palestrina written between 1575 and 1580 to discover their distinctive contrapuntal characteristics, to analyze the same characteristics in the motets of William Byrd written between 1592 and 1597, and to determine what a comparison of these two analyses may reveal.

Notice that we have broken up the "will contrast them with" phrase in the original statement into two distinct tasks, *analyzing* Byrd's motets in the same manner that Palestrina's motets have been analyzed and then *comparing* the two analyses. The three underlined phrases in the revised problem statement reflect three subproblems, each of which involves interpretation of data that is necessary for resolving the main research problem.

Let's now arrange the problem so that we can see exactly what the overall research design will be. Figure 2.2 is a graphic depiction of the problem. We have divided the problem into three subproblems. The first and second of these are parallel in structure: The

FIGURE 2.2 A
Structural Representation
of the Palestrina-Byrd
Problem



analytical aspect of the subproblem is stated in one box, and the purpose of the analysis is stated in the box right below it. Addressing the third subproblem involves comparing the analyses conducted for the two preceding subproblems to determine what similarities and differences may exist. The last of the three subproblems—the comparison step—should ultimately resolve the main research problem.

Using Mind-Mapping (Brainstorming) Software

Some computer software programs can facilitate the process of breaking problems into subproblems; you might see these referred to as either *mind-mapping* or *brainstorming* software. Three commercially available, downloadable programs are Inspiration, iMindMap, and XMind. Alternatively, you can find a variety of free software programs (*freeware*) on the Internet; examples are Coggle (coggle.it), FreeMind (freemind.sourceforge.net), and Popplet (popplet.com). Such programs allow you to brainstorm research ideas and construct graphic networks of interrelated concepts, terms, and principles. For example, you can start by putting your main problem, idea, or concept inside a box or oval in a prominent place on your computer screen. As you brainstorm other, related ideas, you put those on the screen as well, and you can draw lines or arrows to show connections among your various ideas. In some programs, you can also label the lines or arrows, perhaps using such phrases as “which includes,” “can have an effect on,” or “is a subproblem of.” And virtually all of these programs enable you to print out your diagram or export it to a word-processing document or other computer file.

As an illustration, we take a remark that, at one time or another, many middle school and high school students make about some of their peers: “No one likes the popular kids.” On the surface, this remark is self-contradictory: By definition, the word *popular* means “well liked.” What dynamic might underlie so many adolescents’ dislike of so-called “popular” classmates? Herein lies a genuine research problem, which we might pose in the form of a question:

Why do many adolescents claim to dislike allegedly “popular” students?

Using Inspiration® 9, we can put this question in an oval, as shown at the top of Figure 2.3. To fully address the problem, we probably want to determine (a) what kinds of students are

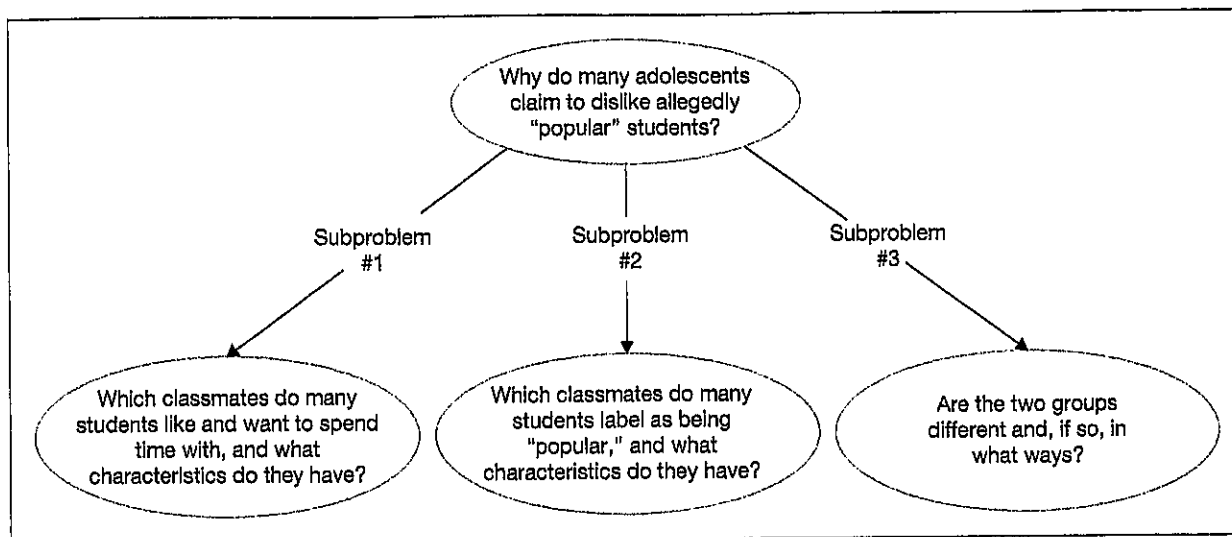


FIGURE 2.3 Translating the Common Adolescent Assertion that “No One Likes the Popular Kids” Into a Main Research Question and Three Subproblems

truly popular ones, in the sense that peers like them and enjoy being in their company; (b) what kinds of students peers refer to as “popular” ones; and (c) what differences, if any, exist between the two groups. We can state these three issues as subproblems, also shown in Figure 2.3.

In fact, some researchers have already addressed and answered the four questions presented in Figure 2.3. More specifically, genuinely popular students are seen as being kind, trustworthy, and socially skillful. Some of these students are also labeled as being popular, but other allegedly “popular” students are perceived as being stuck-up, exclusive, and in some cases, mean and aggressive (e.g., see Mayeux, Houser, & Dyches, 2011).

MyLab Education Self-Check 2.2

MyLab Education Application Exercise 2.2: Identifying Research Subproblems

EVERY RESEARCH PROBLEM NEEDS FURTHER DELINEATION

Up to this point, we have been discussing only the research problem (or question), a purpose statement (which usually encompasses the problem), and the problem’s subparts. The purpose statement identifies the one or more goals of the research effort, and the subproblems suggest ways of approaching those goals in a manageable, systematic way. But goals alone are not enough. To fully understand a proposed research project, we need other information as well. Both the researcher and the people reading the research proposal should ultimately have a clear understanding of every detail of the process.

At the beginning of any research endeavor, the researcher should minimize possible misunderstandings by

- Identifying a general theoretical or conceptual framework
- If appropriate, stating one or more *a priori* hypotheses
- Identifying the general concepts and possibly also specific variables that are the focus of the investigation
- Defining terms
- Stating underlying assumptions
- If applicable, identifying delimitations and limitations

Such things comprise the *setting of the problem*. We look at each of them in more detail in the following sections. We also include a section on "Importance of the Study" because this topic typically appears in proposals, dissertations, journal articles, and other lengthy research reports.

Identifying a Relevant Theoretical or Conceptual Framework

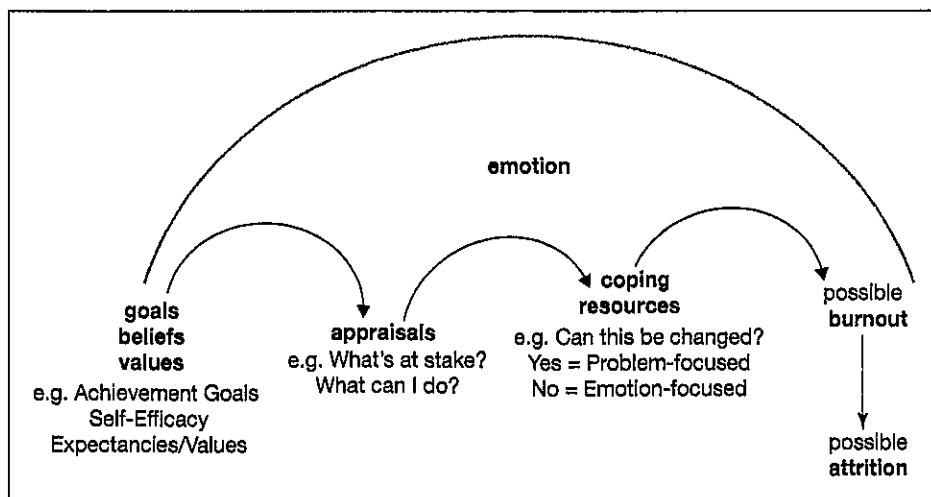
Many researchers tie their research studies to a particular theoretical framework—that is, to a preexisting or newly proposed set of concepts and principles that, in combination, might shed light on cause-and-effect and certain other relationships within the phenomenon under investigation. Such a framework may provide a basis for one or more *a priori* hypotheses about what the data might reveal and to some degree guides the research design and data analyses. In some cases, a researcher's main research problem is to find support for or to disconfirm a particular theory. Alternatively, the research problem might involve comparing the relative efficacy of two or more different theories in explaining new data regarding the issue at hand.

Whereas a theoretical framework implicitly includes possible explanations of cause-and-effect relationships, a conceptual framework simply identifies key concepts and inter-concept connections that, taken as a whole, provide a helpful "lens" through which the researcher looks at certain processes within the phenomenon under investigation and can impose some sort of *meaning* on the phenomenon. Here we authors ask you to recall our seemingly silly discussion of the concept *cow* in Chapter 1. As illustrated in that discussion, the many concepts central to various topics and academic disciplines—and possibly also one or more new concepts that a researcher creates—can help the researcher and other individuals both (a) think more clearly and abstractly about a phenomenon and (b) draw inferences about how those concepts are likely to manifest themselves in new situations.

Oftentimes researchers create diagrams or other graphics that present their conceptual frameworks in visual form. For example, Figure 2.4 shows a general conceptual framework that educational psychologist Hadley Solomon has used in her research regarding possible reasons that some teachers prematurely leave the teaching profession. As shown at the top of the graphic, Dr. Solomon proposes that *emotion* plays a key role in teachers' decisions to retire early or move on to other career paths. She further proposes that motivational variables (*goals, beliefs, and values*) are influential, and she ties these concepts to three theoretical orientations in the motivation literature (listed in small font at the lower left side). Teachers'

FIGURE 2.4 A Conceptual Framework that Might Be Used in an Investigation of Possible Reasons Underlying Teacher Burnout and Departure from the Teaching Profession

Source: Created by and used with permission from Hadley Solomon.



goals, beliefs, and values might influence their *appraisals* of how effective they can be in their work with students—more specifically, how important their work is and how much control they have over what they can accomplish. Their appraisals, in turn, can influence how well and in what ways they think they can *cope* with the obstacles they face in their efforts to enhance students' achievement and general well-being; if teachers determine that the obstacles are insurmountable, they may experience *burnout* and possibly leave the teaching profession (*attrition*).

We urge you not to agonize over the distinction we're making between theoretical and conceptual frameworks here. Other scholars whose work we have read have distinguished between them differently than we do here. And still others seem to use the two terms interchangeably. Obviously, the terms overlap in meaning, with virtually any theoretical framework having a conceptual framework at its core. And as illustrated in Figure 2.4, a general conceptual framework might include one or more theoretical frameworks.

Stating Hypotheses

As noted in Chapter 1, hypotheses are intelligent, reasonable guesses about how a research problem or question might be resolved. Our focus here is on *a priori* hypotheses—those that a researcher poses in advance, usually in conjunction with the overall research problem or question and its subproblems. When several hypotheses are posed in a research proposal, there is often a one-to-one correspondence between subproblems and their corresponding hypotheses, in which case there are as many hypotheses as there are subproblems.

Hypotheses can guide the researcher toward choosing particular types of research designs, collecting particular kinds of data, and analyzing those data in particular ways. The data may, in turn, support or not support each hypothesis. We must emphasize once again that researchers can rarely, if ever, *prove* their hypotheses. Ultimately, *a priori* hypotheses are nothing more than *tentative propositions set forth to assist in guiding the investigation of a research problem or question*.

A researcher who deliberately sets out to “prove” a hypothesis doesn't have the objective, impartial open-mindedness so important for good research. The researcher might bias the procedure by looking only for data that would support the hypothesis (recall the discussion of *confirmation bias* in Figure 1.3 of Chapter 1). Difficult as it may be at times, we must let the chips fall where they may. Hypotheses have nothing to do with proof. Rather, their acceptance or rejection depends on what the data—and the data alone—ultimately reveal.

A priori hypotheses are essential to most experimental research (see Chapter 7), and they are sometimes posed in other kinds of quantitative research as well. In contrast, many researchers who conduct strictly qualitative studies intentionally *do not* speculate in advance about what they will find, in large part as a way of keeping open minds about where their investigations will take them and what patterns they will find in their data.

Distinguishing Between Research Hypotheses and Null Hypotheses in Quantitative Research

Up to this point, we have been talking about *research* hypotheses—those educated guesses that researchers hope their data might support. But because researchers can never really prove a hypothesis, they often set out to cast doubt on—and therefore to *reject*—an opposite hypothesis. For example, imagine that a team of social workers believes that one type of after-school program for teenagers (Program A) is more effective in reducing high school dropout rates than is another program (Program B). The team's research hypothesis is:

Teenagers enrolled in Program A will graduate from high school at a higher rate than teenagers enrolled in Program B.

Because the social workers can't actually prove this hypothesis, they instead try to discredit an opposite hypothesis:

There will be no difference in the high school graduation rates of teenagers enrolled in Program A and those enrolled in Program B.

If, in their research, the social workers find that there *is* a substantial difference in graduation rates between the two programs—and in particular, if the graduation rate is higher for students in Program A—they can reject the no-difference hypothesis and thus have, by default, supported their research hypothesis.

When we hypothesize that there will be *no* differences between groups, *no* consistent relationships between variables, or, more generally, *no* patterns in the data, we are forming a null hypothesis. Most null hypotheses are *not* appropriate as *a priori* hypotheses. Instead, they are used primarily during statistical analyses; we support a research hypothesis by showing, statistically, that its opposite—the null hypothesis—probably is *not* true. Accordingly, we examine null hypotheses again in our discussion of statistics in Chapter 11.

Identifying the General Concepts and Possibly Also Specific Variables That Are the Focus of the Investigation

At a minimum, a researcher must identify certain general concepts that underlie a proposed research study. The conceptual framework presented in Figure 2.4 includes many concepts: *emotion, goals, beliefs, values, appraisals*, and so on. And the research question and subquestions presented in Figure 2.1 imply two distinct concepts: *genuinely popular students* (as reflected in peers' positive perceptions of them) and *allegedly "popular" students*.

Many researchers identify, in advance, certain specific variables that will be systematically studied. We have occasionally used the term *variable* in earlier discussions in this chapter and in Chapter 1, but we haven't yet explained what we've meant by the term. We do so now: A variable is any characteristic, experience, behavior, or outcome in a research investigation that, by its very nature, has two or more possible values. For example, variables in studies of how well seeds germinate might include amounts of sun and water, kinds of soil and fertilizer, presence or absence of various parasites and microorganisms, genetic makeup of the seeds, speed of germination, and hardiness of the resulting plants. Variables in studies of how effectively children learn in classrooms might include instructional methods used; teachers' educational backgrounds, emotional warmth, and beliefs about classroom discipline; and children's existing abilities and personality characteristics, prior learning experiences, reading skills, study strategies, and achievement test scores.

The terms *concept* and *variable* overlap, to be sure, and thus we authors urge you not to worry too much about how they might be somewhat different entities. But in our experience, quantitative researchers are more likely to use the term *variable*, in large part because they often pin down in advance exactly what characteristics, experiences, behaviors, and/or outcomes they intend to examine and in what precise ways they plan to assess those things. Explicit identification of variables at the beginning of a study is most common in experimental studies (see Chapter 7) and certain kinds of descriptive studies (see Chapter 6). In contrast, many qualitative researchers prefer to let important concepts or variables "emerge" as data are collected (e.g., see the discussion of grounded theory studies in Chapter 8).

Whenever a research project involves an investigation of a possible cause-and-effect relationship—as is typically true in experimental studies—at least two variables must be specified up front. A variable that the researcher studies as a possible cause of something else—in many cases, this is one that the researcher directly manipulates—is called an independent variable. A variable that is potentially caused or influenced by the independent variable—that "something else" just mentioned—is called a dependent variable because its status *depends* to some degree on the status of the independent variable. In research in the social sciences and education, the dependent variable is often some form of human behavior.

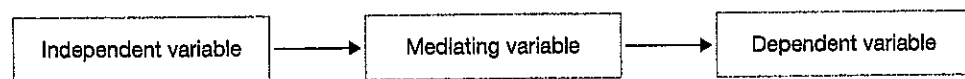
In medical research, it might be people's physical health or well-being. In agricultural research, it might be quality or quantity of a particular crop. In general, a cause-and-effect relationship can be depicted like this:



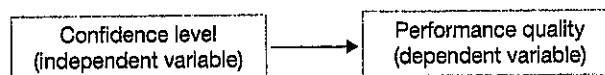
To illustrate the two kinds of variables, let's take an everyday situation. One hot summer morning you purchase two identical cartons of chocolate ice cream at the supermarket. When you get home, you put one carton in your refrigerator freezer but absentmindedly leave the other one on the kitchen counter. You then go out for a few hours. When you return home, you discover that the ice cream on the counter has turned into a soupy mess. The ice cream in the freezer is still in the same condition it was when you purchased it. Two things vary in this situation. One, the temperature at which the ice cream is stored, is the independent variable. The other, the consistency of the ice cream, depends on the temperature and is therefore the dependent variable.

Now let's consider an example in medical research. Imagine that you want to compare the relative effectiveness of two different drugs that are used to treat high blood pressure. You take a sample of 60 men who have high blood pressure and randomly assign each man to one of two groups: The men in one group take one drug, and the men in the second group take the other drug. Later, you compare the blood pressure measurements for the men in the two groups. In this situation, you are manipulating the particular drug that each man takes; the drug, then, is the independent variable. Blood pressure is the dependent variable: It is presumably influenced by the drug taken, and so its measured value depends to some extent on the drug.

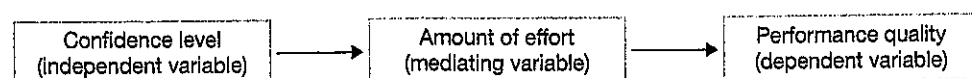
A research question or *a priori* hypothesis may occasionally specify other variables as well. For example, a mediating variable (also known as an *intervening variable*) might help explain *why* a certain independent variable has the effect that it does on a dependent variable. In particular, the independent variable influences the mediating variable, which in turn influences the dependent variable. Thus, the independent variable's influence on the dependent variable is an *indirect one*, as follows:



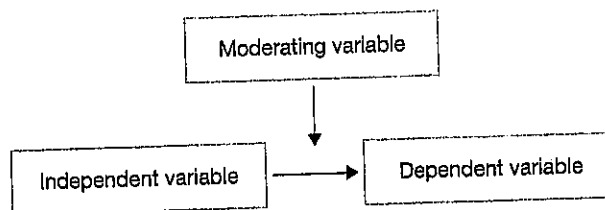
For example, consider the common finding that people who are confident in their ability to perform a particular new task do, on average, actually perform the task better than less-confident people, even if the two groups of people had the same ability levels prior to engaging in the task. Looking at the situation from a simple independent-and-dependent-variables perspective, the situation would be depicted this way:



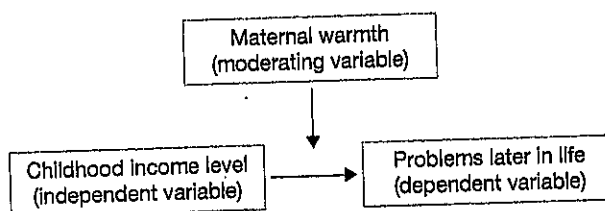
But *why* does this relationship exist? One likely mediating variable is that highly confident people exert more effort in performing the new task than do people with less confidence (e.g., Bandura, 1997; Schunk & Pajares, 2005). The mediating variable, then, is *amount of effort*, as follows:



Still another variable of potential interest is a *moderating variable*—a variable that, although not intervening between the independent and dependent variables, influences the nature and strength of their cause-and-effect relationship, as shown in the next diagram:



As an illustration, consider the fact that, on average, children from very-low-income homes are more likely to have difficulties in adolescence and adulthood; for instance, compared to their financially more advantaged peers, they are less likely to complete high school and more likely to get in trouble with the law. Yet some very poor youngsters are resilient to their circumstances: They do quite well in life, sometimes going on to become physicians, lawyers, college professors, or other successful professionals. One factor that apparently increases the odds of resilience—in other words, it *reduces* the cause-and-effect relationship between childhood poverty and later problems—is a warm, supportive mother (Kim-Cohen, Moffitt, Caspi, & Taylor, 2004). Maternal warmth is a moderating variable: It affects the *nature of the relationship* between family income level and adult problems, like this:



The distinction between mediating and moderating variables is an important but often confusing one; even some experienced researchers get them confused (Holmbeck, 1997). A helpful way to keep them straight is to remember that an independent variable may potentially influence a mediating variable but does *not*, in and of itself, influence a moderating variable. For example, in the earlier *mediating variable* example, a high self-confidence level might increase the amount of effort exerted, but in the *moderating variable* example, we would certainly not suggest that having a low income either increases or decreases (i.e., has an effect on) a mother's warmth toward her children. Rather, moderating variables provide potential *contexts or conditions* that alter—that is, they *moderate*—an independent variable's effects. When researchers refer to *risk factors* or *protective factors* in their research reports, they are talking about moderating variables—variables that affect the likelihood that certain cause-and-effect relationships will come into play.

Identifying independent and dependent variables is often quite helpful in choosing both (a) an appropriate research design and (b) an appropriate statistical analysis. However, an important caution is in order here. In particular, *identifying independent and dependent variables does not guarantee that the research data will support the existence of a cause-and-effect relationship*. We return to this point in the discussion of correlational research in Chapter 6.

At various points in the book we present exercises to help you apply concepts and ideas we have presented. In the first of these exercises, which follows, you can gain practice in distinguishing among independent, dependent, mediating, and moderating variables.

CONCEPTUAL ANALYSIS EXERCISE Identifying Independent, Dependent, Mediating, and Moderating Variables

Following are eight purpose statements for hypothetical research projects. Each one of them implies one or more independent variables and one or more dependent variables. Some of them also imply one or more mediating or moderating variables. We ask you to identify the independent and dependent variables—and, if applicable, any mediating and/or moderating variables—in each problem. We warn you that some of these scenarios may challenge you, as the writer's hypotheses may lie well below the surface of the words. We encourage you, then, to try to put yourself in each researcher's mind and guess what the person is probably thinking about a possible cause-and-effect relationship in the phenomenon under investigation. The answers appear after the "For Further Reading" list at the end of the chapter.

1. In this study, I will examine the possible effects of regular physical exercise on the health and longevity of laboratory rats.
2. In this study, I will investigate the extent to which placing recycling bins in convenient locations in classroom buildings affects college students' recycling behaviors.
3. In this study, I will examine the relationship between the amount of cell-phone use while driving and the frequency of car accidents.
4. I propose to study the degree to which test anxiety may influence test performance by increasing the frequency of distracting thoughts.
5. This investigation will examine the extent to which a supportive student-teacher relationship reduces the negative emotional impact of peer bullying on a child's emotional well-being.
6. I will investigate the degree to which male and female adolescents choose gender-stereotypical careers in three different countries: Canada, Lebanon, and Japan.
7. This study will investigate the extent to which a particular tumor-suppressing gene reduces the risk of getting melanoma [a potentially deadly form of skin cancer] after a history of frequent exposure to sunlight.
8. In this study, I will investigate the possible relationship between body mass index and psychological stress, as well as two more specific psychological factors (depression and anxiety) that might underlie such a relationship. (You previously saw this problem statement in the guidelines for "Stating the Research Problem" earlier in the chapter.)

Defining Terms

What, precisely, do the terms in the overall research problem or question, purpose statement, and subproblems actually mean? For example, if we say that the purpose of the research is to analyze the *contrapuntal* characteristics of motets, what are we talking about? What are *contrapuntal characteristics*? Or if we say that a study will investigate the relationship between people's self-confidence levels and the quality of their performance on a task, we need to pin down what we mean by both *self-confidence* and *performance quality*. Without knowing explicitly what specific terms mean—or, more specifically, what the *researcher* means by them—we cannot properly evaluate the researcher's proposed study.

Sometimes novice researchers rely on dictionary definitions, which are rarely either adequate or helpful. Instead, each term should be defined *as it will be used in the researcher's project*. In defining a term, the researcher makes the term mean whatever he or she wishes it to mean within the contexts of the problem or question and any subproblems. Other people who read

the researcher's initial proposal or final report must know how the researcher defines the term. Those individuals won't necessarily agree with such a definition, but as long as they know what the researcher means when using the term, they can understand the research and appraise it appropriately.

The researcher must be careful to avoid *circular definitions*, in which the terms to be defined are used in the definitions themselves. For example, if a researcher were to define *self-confidence* as "degree of confidence one has in one's own abilities," readers would still be in the dark about what *confidence* actually means within the context of that particular study.

When talking about a variable that has no cut-and-dried, easy-to-pinpoint manifestation in the physical world—and especially when conducting quantitative research—it is often helpful to include an operational definition. That is, the researcher defines the variable in terms of how it will be identified and assessed in the research study. For instance, a researcher might define *self-confidence* as a high score on a self-report questionnaire that has items such as "I can usually achieve what I set out to do" and "I think of myself as a smart person." Likewise, a researcher might define *intelligence* as a score on a certain intelligence test or define a student's *popularity* as the number of classmates who identify the student as being a desirable social partner. As another example, let's return to the first scenario in the preceding Conceptual Analysis Exercise: examining the possible effects of regular physical exercise on the health and longevity of laboratory rats. Longevity is easily defined and measured: It's simply the length of a rat's lifespan in days or some other unit of time. Somewhere in the research proposal, however, the researcher will need to be more specific about how physical exercise and health will be assessed. For example, physical exercise might involve putting a treadmill in some rats' cages but not in others. Health might be measured in any number of ways—for instance, through measurement of hypertension or analyses of blood or hair samples.

Stating Assumptions

We have previously discussed assumptions in Chapter 1. Assumptions are so basic that without them, the research problem itself could not exist. For example, suppose a researcher is trying to determine, by means of a pretest and a posttest, whether one approach to in-service technical training in the workplace is superior to another approach. A basic assumption in such a situation is that the pretest and posttest measure knowledge of the subject matter in question.¹ The researcher must also assume that the instructor(s) in the study can effectively teach the desired new skills and that the employees are capable of learning the subject matter. Without these assumptions, the research project would be meaningless.

In research, we try to leave nothing to chance in order to prevent any misunderstandings. All assumptions that have a material bearing on the research problem or question should be openly and unreservedly set forth. If others know the assumptions a researcher is making, they are better prepared to evaluate the conclusions that result from such assumptions.

To discover your own assumptions, ask yourself: What am I taking for granted with respect to my problem or question? Ideally, your answer should bring your assumptions into clear view.

Identifying Delimitations and Limitations

A purpose statement describes what the researcher intends to do. But in some cases, it's also important to know what the researcher does *not* intend to do. Whatever things the researcher is not going to do in a research project are known as *delimitations*.

Research problems and questions typically emerge out of larger contexts and larger problem areas. The researcher can easily be beguiled and drawn off course by addressing questions and obtaining data that lie beyond the boundaries of the problem under investigation.

¹Alternatively, we might make no such assumption; instead, we might set out to determine the *validity* of the tests as measures in this situation. We discuss the nature of validity of assessment instruments in Chapter 4.

For example, in the Palestrina–Byrd problem, it's possible that because the two men were contemporaries, Byrd may have met Palestrina or at least come in contact with some of his motets. Such contact may have had a determinative influence on Byrd's compositions. But given how the problem has previously been expressed in the purpose statement, the researcher doesn't need to be concerned with *influences* on the motets of the two composers. The researcher should be primarily interested in the *characteristics* of the motets, including their musical style, musical individualism, and contrapuntal likenesses and differences. What the researcher does *not* need to do is to worry about collecting data extraneous to this goal, no matter how enticing or interesting such an exploratory safari might be.

Good researchers also acknowledge that their research projects have certain weaknesses, or *limitations*, that might cast shadows of doubt on results and conclusions. No research project can be perfect, and an honest researcher won't pretend that it is. For example, when studying a certain aspect or quality of human behavior, a researcher might consider such questions as the following:

Will my sample consist only of people of a certain age range, geographic location, or cultural background? If so, how generalizable are my results likely to be to other populations?

In what environment will I be conducting the study—in a laboratory, in a classroom, in a workplace setting, on the Internet, or elsewhere? How might this environmental context affect the results I obtain?

How will I be assessing specific variables in my study? How accurate are my assessments likely to be?

What personal biases might I be bringing to the study? Are they likely to influence the data I collect or my interpretations of the data?

What "shortcuts" will I be taking in order to make my study logistically feasible? Might these shortcuts weaken the strength of any conclusions I might draw?

Weaknesses related to these and other issues must be clearly stated in a discussion of limitations, both in the research proposal and in the final research report.

Importance of the Study

In most dissertations and other research reports, researchers set forth their reasons for undertaking the study. Such a discussion may be especially important in a research proposal. Some proposed studies seem to go far beyond any relationship to the practical world. Of such research efforts readers might silently ask, "Of what *use* is it? Will it significantly enhance our understanding of a puzzling phenomenon? How might it contribute to existing theoretical and empirical knowledge about the topic? And what *practical value* does the study have? Will it make an appreciable difference in the health of the planet or in the well-being of one or more species living on it?" Such questions need to be answered.

MyLab Education **Self-Check 2.3**

MyLab Education **Application Exercise 2.3:** Selecting Variables to Study

WRITING THE FIRST CHAPTER OR SECTION OF A RESEARCH PROPOSAL

In any research proposal or final research report, the first order of business is to present the general research problem or question, typically within its larger context. For example, as a doctoral student at the University of Maryland, Baltimore County, Christy Leung conducted a mixed-methods study concerning the experiences of Chinese women who had immigrated

to the United States. Following is what she wrote on the first page of her final dissertation, but her strategy would have been similar in her dissertation proposal:

America has long been recognized as a nation of immigrants . . . many immigrants believe that having freedom and equal opportunity for success and prosperity is possible. Immigrants come to the U.S. with a belief that through hard work, motivation, and persistence, they will be able to earn a better living and provide a better life for their children (Clark, 2003). Many groups, including the Chinese, have chosen to leave their home country because of this belief. The Chinese people have a long history of migration to and settlement in the U.S. to pursue the American dream. Chinese immigrants were once predominantly men who migrated as contract labor workers (e.g., Yung, Chang, & Lai, 2006). However, a series of political incidents and subsequent legislations led to a different wave of Chinese immigration to the U.S. after World War II (Yung et al., 2006; Zhao, 2002). Changes in the pattern of international migration are important for understanding the adaptation and well-being of immigrants (Massey, Arango, Hugo, Koussou, Pellegrino, & Taylor, 1993). (Leung, 2012, p. 1)

In the three paragraphs that followed, Leung expanded on the diverse characteristics and motives of Chinese immigrants, described some of the unique challenges that women were apt to face in moving to the United States, and identified certain key concepts related to the issues her study was addressing (e.g., *socialization, availability of social supports, and acculturation*). At that point, Leung had provided sufficient information for readers to understand her purpose and goals in conducting the study:

(T)he overall goal of this research project was to examine Chinese immigrant mothers' reasons for migration, experiences of migrating to the U.S., . . . acculturation strategies, adjustment, and parenting. . . . (Leung, 2012, p. 3)

After presenting the main research problem or question—often within the context of a purpose statement—a research proposal should identify more specific subproblems to be addressed, along with any *a priori* hypotheses the researcher may have posed related to these subproblems. Somewhere in the introductory section or chapter, a theoretical or conceptual framework should be identified, key concepts or variables should be identified and defined, basic assumptions should be elucidated, and, if appropriate, delimitations and limitations should be put forth. A discussion of the importance of the study might have its own section or, alternatively, might be integrated into early paragraphs that introduce the research problem.

In a dissertation or other lengthy research report, such topics often comprise the first chapter or section. The document then generally continues with an in-depth discussion of investigations that others have done, usually titled “Review of the Related Literature” or something of that nature. We discuss this review in the next chapter.

PRACTICAL APPLICATION Writing the First Section of a Proposal

In a checklist earlier in this chapter, you developed a purpose statement that presumably encompassed a general research problem or question. In doing so, you took the first step in creating a research proposal. Now you can add the subproblems and identify the setting of the problem by completing the following exercise.

1. **State the subproblems.** On a blank sheet of paper or new computer document, write the purpose statement you developed earlier. Now inspect your statement carefully and do these things:

- a. Within the statement, box off or highlight those areas that need in-depth treatment in order for the problem to be fully explored. Consecutively number these distinct areas.
 - b. Underline the words that indicate your intention to interpret the data (e.g., *analyze, compare*).
 - c. Below the problem, which has been thus treated, write the several subproblems of your study in complete declarative sentences or in questions. Make sure each subproblem includes a word that reflects data interpretation.
2. *Identify or create a theoretical or conceptual framework that can guide your study.* Will you be drawing from an existing theory as you plan and conduct your investigation? If so, briefly describe the theory and its relevance to your research problem and to one or more of its subproblems. If, instead, you are unaware of a useful theoretical perspective, identify major concepts that will provide a foundation for your study. Possibly you might also create a graphic that illustrates the theoretical or conceptual framework on which you will base your study, with lines that show logical interconnections (e.g., cause-and-effect relationships, category and subcategories) among the concepts depicted.
 3. *State any a priori hypotheses you might have.* Are you expecting to find certain kinds of results related to one or more of your subproblems? If so, write your research hypotheses, along with a brief rationale for each one. Your rationales should be either theoretically or logically defensible. The sections on deductive logic, inductive reasoning, and theory building in Chapter 1 can help you complete this step.
 4. *Identify and define key concepts and (possibly) specific variables that will be the focus of your study.* Specify the particular characteristics, conditions, and/or behaviors that are either stated or implied in your research problem or question or in one or more of your subproblems. Give a short but precise explanation of what each concept or variable means *in your particular study*—for instance, how you intend to study it and in some way determine its existence and, if applicable, its specific values.
 5. *Write your assumptions.* Make a list of the specific assumptions you will be making as you design and carry out your research project—perhaps assumptions related to the people or other entities you will be studying, the relevance (or nonrelevance) of the environmental context in which you will be conducting your study, and your assessment techniques.
 6. *Identify and describe delimitations of your study—that is, specific boundaries beyond which you will not go.* Review the earlier discussion of delimitations. Now write several topics and questions related to your research problem or question that your research project will *not* address.
 7. *Identify and describe possible limitations of your study.* Identify potential weaknesses of your study related to your proposed sample, data-collection environment, assessment techniques, and personal biases, as well as any planned “shortcut” strategies that may adversely affect the quality of your results and the credibility of your conclusions.
 8. *Explain the importance and significance of your study.* In a short paragraph or two, explain why your study is worthy of being conducted. Eventually, you may want to move this discussion to an earlier point in your proposal where you introduce your topic and provide an overall context for it. For now, however, keeping it in a separate section with its own label can help you remember that *explaining* your study’s potential contribution to your field of inquiry is important in its own right.

9. *Type your proposal.* Use word-processing software so that you will easily be able to make future edits (there will be many!). Set margins at least an inch wide, and double-space the entire document; double-spacing makes proofreading easier and allows room for handwritten edits.

Now that you have written the first sections of a proposal, reflect on your proposed project using the following checklist.

CHECKLIST

Evaluating Your Proposed Research Project

- _____ 1. Have you read enough literature relevant to your topic to know that your research project is worth your time and effort?
 - If so, have you ascertained that the project will advance the frontiers of human knowledge in an important way?

 - If not, have you asked one or more experts in your field to advise you on the value of your research effort?

- _____ 2. Have you looked at your research problem from all angles to minimize unwanted surprises?
 - What are the potential strengths of your proposed project?

 - What are the potential pitfalls of attempting this research effort?

- _____ 3. What procedures will you follow going forward?
 - Do you have a tentative plan for reviewing the literature?

 - Do you have a tentative plan for data collection?

 - Do you have a tentative plan for data analysis?

 - Do you have a tentative plan for how you will interpret the data you collect?

- _____ 4. What research tools are available for you to use? Make a list and check their availability. Determine how you will use them.

- _____ 5. Ask two or three of your peers to read your proposal. Do they understand what you are proposing to do? What questions do they have? What concerns do they express?

- I have discussed this plan with _____, _____, and _____.
- They have the following questions and concerns:

PRACTICAL APPLICATION Reappraising a Proposed Research Problem

In this chapter we've given you many suggestions for identifying an appropriate problem or question to drive your research. We can't overemphasize this fact: If you don't precisely pin down both (a) your research problem or question and (b) your goals for conducting your study, you may put considerable time, energy, and resources into an endeavor that is much less than what it could be.

GUIDELINES Fine-Tuning Your Research Problem or Question

Earlier in the chapter we offered guidelines for identifying and stating an appropriate research problem or question. We now give you a few general suggestions for fine-tuning the problem or question you've identified.

1. *Conduct a thorough literature review.* You have presumably already looked at some of the literature related to your overall research problem or question. A next critical step is to make sure you know enough about your topic that you can ask yourself important methodological and procedural questions and then make solid decisions about how you might address them in your research endeavor. You may find that you need to revise your research plan significantly once you have delved more deeply into the scholarly literature related to your topic.

2. *Think concretely about how you will conduct the subsequent steps you must take in your project.* Once you have brought your research problem into clear focus, imagine walking through the whole research procedure, from literature review through data collection, data analysis, and interpretation. You can gain valuable insights as you mentally walk through the project. Pay close attention to potential bottlenecks and pitfalls that might cause problems later on.

3. *Discuss your research problem or question with others.* Beginning researchers frequently need to revise their research problems, questions, and goals in order to clarify them and make them more manageable. One good way to do this is to show your purpose statement to other people. If they don't understand what you intend to do, further explanation and clarity are needed. One can learn a great deal from trying to explain something to someone else.

As you proceed with your project, continue to ask others for feedback. Don't be overly discouraged by one or two individuals who are nonconstructively critical or dismissive. Many great discoveries have been made by people who were repeatedly told that they couldn't do what they set out to do.

4. *Remember that your project will take time—lots of time.* All too often, we authors have had students tell us that they anticipate completing a major research project, such as a thesis or dissertation, in a semester or less. In the vast majority of cases, such a belief is unrealistic. Consider all the steps involved in research: formulating a research problem or question, conducting the necessary literature review, collecting and interpreting data, describing what you have done in writing, and improving on your research report through multiple drafts. If you think you can accomplish all of these things within 2 or 3 months, you're almost certainly setting yourself up for failure and disappointment. We would much rather you think of any research project—and especially your first project—as something that is a valuable learning experience in its own right. As such, it's worth however much of your time and effort it takes to do the job well.

5. *Also remember that the first drafts of whatever you write will almost certainly NOT be your last ones.* Good researchers continually revise their thinking and, as a result, their writing. Furthermore, as mentioned in Chapter 1, writing about one's project often helps to clarify and enhance one's thinking. So get used to writing . . . and rewriting . . . and rewriting once again.

Nevertheless, by putting your problem statement on paper early in your research project, you have begun to focus your research efforts.

FOR FURTHER READING

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ANSWERS TO THE CONCEPTUAL ANALYSIS EXERCISE “Identifying Independent, Dependent, Mediating, and Moderating Variables”:

1. The phrase “effects of . . . on” tells us the direction of a hypothesized cause-and-effect relationship. Amount of physical exercise is the independent variable. Health and longevity are two dependent variables.
2. Placement of recycling bins is the independent variable; for example, the researcher might vary the number of recycling bins available and/or their proximity to

classrooms and high-student-traffic areas. Recycling behavior is the dependent variable; for example, the researcher might count the number of recyclable objects (aluminum cans, sheets of paper, etc.) found in recycling bins each day or week.

3. The problem statement uses the term *relationship* without necessarily implying that this is a cause-and-effect relationship; for instance, the statement does not include a term such as *influence* or *affect*. However, we can reasonably guess that the researcher is hypothesizing that cell-phone usage *increases the risk of* an accident, in which case amount of cell-phone use is the independent variable, and accident rate is the dependent variable. (To some degree, car accidents lead to cell-phone use as well—someone in an accident is likely to call a family member or 911—but that cause-and-effect relationship hardly seems worthy of a research study.)
4. Don't let the sequence of variables mentioned in the problem statement lead you astray here. Test anxiety is the independent variable; test performance is the dependent variable. The third variable mentioned—distracting thoughts—is hypothesized to be the mediating variable: Level of anxiety (independent variable) affects the degree to which one has distracting thoughts (mediating variable), which in turn affects test performance (dependent variable).
5. The word *impact* implies a possible causal connection between bullying (independent variable) and emotional well-being (dependent variable). The nature of a student's relationship with his or her teacher can influence the impact of bullying; thus, the student-teacher relationship is a moderating variable.
6. The problem statement includes no words to suggest the direction of a relationship. Certainly, however, career choices *cannot* affect one's gender, so any possible causal relationship must go in the other direction: from gender (independent variable) to career choice (dependent variable). The comparative aspect of the problem statement suggests that gender might have more of an influence on career choice in some countries (presumably those that adhere to traditional ideas about occupations appropriate for men and women) than in others. Country of residence, then, would be a moderating variable affecting the strength of the gender-career choice relationship.
7. The cause-and-effect relationship between frequent exposure to sunlight (independent variable) and melanoma (dependent variable) is well established in the medical literature. The presence or absence of a particular gene is hypothesized to be a moderating variable: The chances of sunlight leading to melanoma may be reduced—that is, the cause-and-effect relationship may be considerably weaker or possibly nonexistent—if a person has the tumor-suppressing gene.
8. Once again, the problem statement talks only about a *relationship*, without using verbs such as *cause*, *affect*, or *influence* to imply causation. However, the mention of two psychological factors that *underlie* the relationship suggests that the researcher is assuming that either body mass index affects psychological stress or vice versa. Although the problem statement doesn't clarify which of these two variables is the independent variable and which is the dependent variable, two other variables—levels of depression and anxiety—are apparently hypothesized to be *mediating variables*. Perhaps a higher body mass index (independent variable) increases depression and anxiety (mediating variables) that, in turn, increase psychological stress (dependent variable). Or perhaps, instead, greater psychological stress (independent variable) increases depression and anxiety (mediating variables) that, in turn, lead to more food consumption and/or less physical exercise (two more, unstated and apparently unmeasured mediating variables), which in turn increase body mass index (dependent variable).