SECOND EDITION

The RESEARCH EXPERIENCE

PLANNING, CONDUCTING, AND REPORTING RESEARCH

ANN SLOAN DEVLIN

The Research Experience

Second Edition

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The Research Experience

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Second Edition

Ann Sloan Devlin
Connecticut College

SAGE

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Preface

Instructors of research methods courses face a major challenge: how to cover the necessary theoretical foundations adequately and provide enough practical help to guide students through a research project. This book is designed to accomplish both goals. The foundations of research design and methods are covered (e.g., how the nature of the research question determines the research design that is used; correlational, experimental, and qualitative designs), but there is a good deal of attention to the practical issues involved in research: finding measures, writing questionnaire items, and using online survey software such as Qualtrics®; obtaining participants and ethical review; statistical analysis; and ultimately writing a report of the research based on the format of the American Psychological Association (i.e., in APA style). Research is increasingly influenced by the availability of the Internet to conduct studies, and this book covers not only online survey software but also crowdsourcing platforms like Amazon Mechanical Turk as a source of participants. Many research methods books overlook the practical aspects of doing research. The information in this book will enable students to conduct a research methods project in a single semester.

This book can be used in a variety of social and behavioral science departments, from Psychology and Behavioral Neuroscience to Human Development, Education, and Social Work; Sociology, Criminology, and Political Science; Environmental Studies; and Communication. In addition, because research is increasingly a part of the practice of architecture, the book could be used in architecture studio courses where research is discussed. The book could be used in research methods courses taught in one or two semesters. Although statistics are covered in the book, the text is better suited for courses taught after an introductory statistics course.

The practical emphasis in the book is a major feature, and several appendices provide easily understandable summaries of fundamental issues: (a) research approaches, scale types, and associated statistical analyses; (b) a decision tree for statistical analyses (i.e., which test for which research situation); (c) commonly used "analyze" functions in IBM® SPSS® Statistics; and (d) sample informed consent and debriefing documents.

Each chapter contains several pedagogical aids to promote understanding and retention of information. For example, three kinds of questions are included in each chapter: **Revisit and Respond**; **Try This Now**; and **Build Your Skills**. The **Revisit and Respond** questions are considered review questions; the **Try This Now** questions push you to expand your understanding of the information just presented in the chapter or to challenge yourself to anticipate upcoming content; and the **Build Your Skills** questions at the end of the chapter are typically more activity-based and invite you to practice some skill introduced in the chapter (e.g., write your own survey questions). The book also contains glossary definitions in the chapter margins when a term is introduced in the text.

Updates to the New Edition

The second edition of the book preserves the qualities of the first edition but is updated in a number of significant ways. First, to recognize its importance, there is a separate chapter devoted to qualitative research. Next, recognizing that the federal policies governing research with human subjects have been significantly revised, the chapter on Ethics (Chapter 4) has been thoroughly updated to incorporate this material (i.e., the revised Common Rule went into effect in January 2019). In addition, the seventh edition of the *APA Publication Manual* appeared in 2020, and the text incorporates coverage of the distinctive features of that manual, including material on Bias-Free Language, as well as the new citation and reference styles (especially Chapter 13). Chapter 13 also discusses the procedure for determining authorship and ways to acknowledge specific author contributions. Further, the second edition covers the Journal Article Reporting Standards (JARS) discussed in the *APA Publication Manual* and how those standards change what should be reported in manuscripts submitted for publication. To provide a clearer focus, the chapter on measures has been split into two chapters; one deals with conceptual aspects of measurement and the criteria for selecting existing measures (Chapter 5); the new chapter contains the material on developing your own measures and items (Chapter 6). In the second edition, the two chapters on Experimental Research (Chapters 9 and 10) have been rewritten to emphasize both conceptual and practical considerations. Correlational and Nonexperimental Specialized Designs appear in a reorganized chapter (Chapter 7) and the experimental chapter on Within-Subjects, Mixed, and Pre–Post Designs (Chapter 10) also includes new material on ABBA and randomized block design. The second edition also includes updated information on SurveyMonkey®, Qualtrics, and a number of statistics software packages (e.g., STATA, SAS) (Chapter 6). Finally, Practice Quizzes have been added to the end of each chapter to give students more ways to test their understanding of the chapter. The answers to these quizzes appear in Appendix H.

Instructor Teaching Site

SAGE Edge for instructors supports teaching by making it easy to integrate quality content and create a rich learning environment for students.

These resources include an extensive test bank, chapter-specific PowerPoint presentations, discussion questions, SAGE journal articles with accompanying review questions, video links, and Web resources.

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I would also like to thank my research methods students at Connecticut College. The material in this book is the foundation of my research methods class, and the students' sense of accomplishment when they present their research projects at the end of the semester motivated me to share this material with others. Repeatedly students tell me how much they learned in the class and how often they refer to the material provided in the book. After the research methods course, the book continues to be a resource for upper-level individual study, an honors thesis, and graduate-level study.

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Introduction

Research. Many professors view research as the foundation of their discipline, the most important part of what they do. I agree. This book is written with the goal of exciting you about the research process. Many of us believe research methods is the most important course in the social and behavioral sciences, outweighing statistics, which might be viewed as a support system. Statistics are important, but their real value lies in their use to answer research questions.

Despite whether you plan to conduct research as part of a career, knowing the core values of the research process is important for you. Knowing the fundamentals of research design and analysis will not only help you in your education, but it will also make you a more sophisticated consumer of information in your personal and professional life.

Before taking a course in research methods, students provide interesting answers to the question, "What is research?" Some students think doing a Web search constitutes "research" (i.e., looking for articles by a given author); others think writing a literature review is "doing research" (i.e., presenting the existing research). In this book, we take the position that doing research involves (a) the formation of a hypothesis (or statement of purpose in exploratory investigations); (b) the acquisition of data to test that hypothesis or explore relationships (there are many approaches to such data acquisition); (c) evaluation of data or information, typically using inferential statistics; and (d) presentation of a conclusion or summary of findings based on the evidence.

One major hurdle in conducting sound research is avoiding the biases and faulty assumptions that are characteristic of human thought. That is why this book begins with an examination of such biases in thinking. Throughout the book, we will return to this theme of how the way we think influences the choices we make about the research process.

By working through the chapters in this book, you will learn how to do the following:

1. Recognize how biases in thinking are active during the research process
2. Select an area of interest and search the literature to see the published research on that topic
3. Formulate one or more hypotheses based on this literature
4. Design a study based on recommended approaches
5. Select valid and reliable scales to measure your variables of interest
6. Prepare a survey or other instrument to collect your data (using online survey software or a paper-based document)
7. Write a proposal to be evaluated by an ethics board (typically called the Human Subjects Institutional Review Board [IRB])

8. Collect data (using a campus subject pool, a source off campus, or an online source)
9. Create a data file or download your data from survey software
10. Analyze your data using a statistical package such as SPSS Statistics®
11. Understand what your data mean and how to report your results
12. Discuss your findings in the context of your hypotheses and the broader literature
13. Identify the limitations of your research, and propose directions for future research

Finally, you will learn how to write up this research following the guidelines of the *Publication Manual of the American Psychological Association* (APA, 2020) and avoid common mistakes in writing and style. In addition, you will learn how to prepare your article for publication and decide where to submit it if that is a goal. At the end of this book, you should have the skills to produce a well-executed project and a well-written research report or manuscript.

The skills you have acquired in the process of conducting research will enable you to compete successfully for internships and jobs. Students who have mastered the research process know how to locate measures, how to use survey software such as Qualtrics, how to analyze data using IBM SPSS, and perhaps even how to collect data using a crowdsourcing online tool such as AmazonMTurk®. With these skills, you are well positioned to compete effectively for a variety of jobs.

Each chapter contains three kinds of questions to promote learning: **Revisit and Respond**; **Try This Now**; and **Build Your Skills**. **Revisit and Respond** items generally ask directly about the information in the chapter (e.g., explain why or list two examples of . . .) and would be considered review questions. **Try This Now** questions ask you to pause and stretch a bit to go beyond the information given at the moment (e.g., after reading the list, come up with three additional settings where you think ethnographic research could be conducted; see Chapter 6). **Build Your Skills** items at the end of the chapter are either questions or activities that ask you to apply what you have learned to some of the major issues in the chapter. For example, you might be asked to make a case for having institutional review board (IRB) review (see Chapter 4) even for projects with no more than minimal risk or to create an account to try out a free version of an online survey software (see Chapter 5).

CHAPTER 1

Research, Biases in Thinking, and the Role of Theories

Chapter highlights

- Why research matters
- Humans as limited information processors
- Heuristics (representativeness and availability)
- Shermer's (1997) categories of how thinking goes wrong:
    - Problems in scientific thinking
    - Problems in pseudoscientific thinking
    - Logical problems in thinking
    - Psychological problems in thinking
- The role of common sense in posing research questions
- Laws, theories, and hypotheses: Importance and qualities
- What makes something a good research question?

Why Research Matters

In the movie *The Big Short*, which depicted the implosion of the housing market and the collapse of the financial system in the United States, hedge-fund manager Mark Baum (the character played by actor Steve Carell) and his team go out in the field to collect data on the "health" of the housing market. Rather than accepting someone else's conclusion that the housing market was a "bubble" about to burst, they collect their own data by consulting a real estate agent, several mortgage brokers, and even an exotic dancer (who has adjustable rate mortgages on five houses, as it turns out). Social scientists might not consider this credible research, but at least Baum and his team were willing to look at some evidence. As you will learn later in this book, there were some problems with their approach, although their conclusion was correct (it wouldn't have made a good story, otherwise). As you will see in Chapter 11, their sampling strategy was flawed because they looked at only one housing market in the United States (Miami); they needed a random sample of housing markets across the United States to be more certain about the housing bubble.

Every day you see behavior that triggers questions ranging from the mundane—"What do people think of students who wear pajamas to class?"—to the more important—"Do people disclose less information to their health care providers when a 'medical scribe' (i.e., someone taking notes for the physician) is in the room?" How do we evaluate the research in terms of its credibility? That is, what makes research believable or convincing? What criteria should we use in evaluating the findings of a research study? Courses in research methods provide the tools to conduct and evaluate research. Students may take a research methods course because it is required, but the information will serve them far beyond the course. Learning how to evaluate research may help students make more informed and potentially life-altering decisions in the future (e.g., whether to take a particular medication to treat a condition or how much to pay for a particular home).

Research can help you answer a variety of questions, some of them very important. Being able to evaluate research gives you a powerful set of tools to solve problems, especially because the body of knowledge is expanding exponentially. To ask and answer good questions, it is helpful to understand how humans think because humans have cognitive capacities that both help (category formation; common sense; flexibility; creativity) and hurt (stereotypes; heuristics, that is shortcuts in thinking) the research process. In fact, the same cognitive capacity can be adaptive in some situations and maladaptive in others. For example, using speed to make a decision under duress might save your life, but it might make you an unreliable eyewitness. Recognizing these cognitive characteristics in yourself will help you maximize the positive aspects and minimize the negative aspects in the research process. In this chapter, you will learn about the kinds of heuristics or shortcuts humans use in thinking and how these may shape our approach to research. Armed with this information, you will be better prepared to both evaluate the research that others conduct and carry out your own research.

Heuristics: Mental shortcuts (e.g., estimations and common sense) that often guide thinking and problem solving.

In this chapter, four categories of how thinking "goes wrong" from a list generated by Michael Shermer (1997) will be highlighted. The chapter will also present some adaptive characteristics humans have, most notably, common sense. The chapter also introduces you to the distinctions between law, theory, and hypothesis (a proposed explanation for the relationship between variables that must be tested) and explores why theory is important and how a good research question is connected to theory.

Hypothesis: "A testable proposition based on theory, stating an expected empirical outcome resulting from specific observable conditions" (Corsini, 2002, p. 463).

The Research Process: Humans Make Predictions

Humans are limited information processors; what this characteristic means is that people cannot process all incoming information at once. As a consequence, individuals learn to focus on the most important features of an object (or situation). An important consequence of this limitation is that humans are forced to make predictions. Predictions are the essence of research: as humans we make hypotheses (proposed explanations about the relationships of variables we want to test). If you see traffic lined up along an artery where traffic usually flows smoothly, you likely conclude there is some kind of traffic tie-up.

This limited ability to process information has some important effects on how humans organize material (and think about research). To manage the overload of information around us, humans evolved to chunk or categorize information into groupings or clusters. This kind of organization leads us to form overarching categories; there are words that designate those categories, like vegetable or sports or furniture. A term that is often used to describe such mental representations of knowledge is a **schema**. If you have a schema for something, you understand its gist or essence; a schema serves as a generalized description of the core characteristics of a given role, object, or event. You might have a schema for a role (e.g., father), for an object (e.g., a chair), or for an event (e.g., going to a restaurant). The benefit of having a schema is that it provides a condensed version of the information that is available about an entity in the world and it helps you make predictions.

Schema: Mental representation of a category that can be a role, an object, or an event (e.g., parent, table, or going to the dentist, respectively).

The ability to compartmentalize by categories minimizes the cognitive load and leaves the brain available to respond to incoming information that may have implications for survival (a car speeding toward a pedestrian; a loud noise). That's the upside. The downside is that such compartmentalization leads to stereotypes and overgeneralizations, which can interfere with thinking objectively about research. Redheads are tempestuous, people who live in Detroit drive American-made cars, New Yorkers like to wear black, and so on. The propensity for categorization may lead humans to minimize the differences across dimensions and to categorize stimuli as similar when, in fact, there may be important differences.

Heuristics and the Work of Kahneman and Tversky

This chapter has presented some advantages and disadvantages to the formation of schemas. Let's talk about some other cognitive characteristics of humans and how they interact with the research process. In particular, the focus will be on what are known as cognitive heuristics or mental shortcuts and how they both shape research questions and the answers participants provide.

The researchers Daniel Kahneman and Amos Tversky (see, for example, Kahneman & Tversky, 1972, 1973, 1979; Tversky & Kahneman, 1971, 1973, 1974) studied these predictive tendencies (heuristics) or shortcuts in thinking. Kahneman received the Nobel Prize in Economics (psychologists like to claim him as one of their own) for the work he and Tversky did on these cognitive biases. (Nobel prizes are awarded only to living recipients, and Tversky had died by the time the work was honored.)

There is evolutionary value in being an animal that operates on incomplete information and the ability to use schemas for prediction. The work of Kahneman and Tversky focuses on these heuristics or shortcuts and illustrates how these shortcuts may lead humans to incorrect decisions. Before you become discouraged about human capabilities, it's useful to remember that the work of Kahneman and Tversky applies to particular kinds of decision-making problems, not to all problems. A good deal of their work focuses on the idea of representativeness (e.g., Kahneman & Tversky, 1972) and **availability** (e.g., Tversky & Kahneman, 1973), *both of which have applications to the research process.* Here the idea of representativeness is its frequency of occurrence in a population. It can also mean the

Availability: One of the heuristics talked about by Kahneman and Tversky (1972) in which humans use examples that easily come to mind.

extent to which an array of events or objects or people reflects the characteristics of its parent population (discussed in terms of sampling). Availability involves using examples that come easily to mind (e.g., because you just read an article on that topic).

The Representativeness Heuristic in Research

In one of Kahneman and Tversky's classic examples, participants were presented with the following: "All families of six children in a city were surveyed. In 72 families the exact order of births of boys and girls was GBGBBG. What is your estimate of the number of families surveyed in which the exact order of births was BGBBBB?" (Kahneman & Tversky, 1972, p. 432). Not surprisingly, a significant number of the respondents (75 of 92) said the second option was less likely to occur because, as Kahneman and Tversky argued, it seems less representative of the population. When the question is posed in terms of the frequency with which two birth sequences occur (BBBGGG vs. GBBGBG), the same participants pick the second sequence. The first looks "fixed" or nonrandom to us (and them). How representative something looks is one heuristic or bias that may influence the research process. A researcher might select a stimulus (e.g., photograph) as representative of a population of interest (e.g., urban parks) without knowing the full range of existing sites (compare Figure 1.1 and Figure 1.2). In this instance, both of these photos come from the same park (Brooklyn Bridge Park in Brooklyn, New York) but would communicate very different aspects of the park

Figure 1.1 Pier 2 at Brooklyn Bridge Park

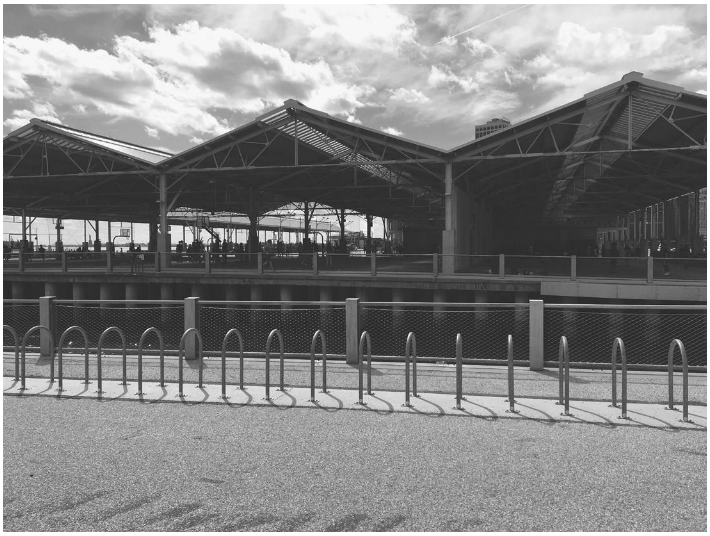

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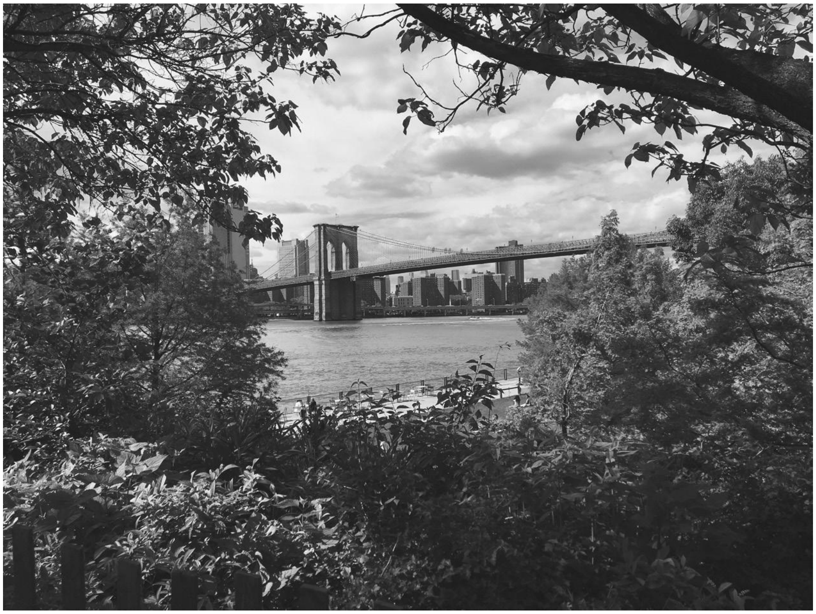
Figure 1.2 View of the Brooklyn Bridge From the Brooklyn Bridge Park Greenway



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depending on which photograph was used. If you try to generalize from a single picture or even a limited range of pictures to say something definitive about people's evaluations of such settings, the results might be overstated.

Although the work of Kahneman and Tversky focuses on cognitive decision-making processes (e.g., the decisions we make about stimuli), the idea of representativeness emerges in other ways in research. You may be familiar with such phrases as "a representative sample" or "a randomly selected sample" (the example from *The Big Short* earlier in this chapter raised the issue of sampling; see Chapter 11 for a fuller discussion of sampling).

One central question in every research project is who the participants are and to what extent the results of the study are therefore "representative" of the population of interest. If research uses a participant pool that consists of students enrolled in an introductory psychology course, there are several questions to ask about who participates, starting with the degree to which people who take an introductory course in psychology are representative of that student body as a whole (by gender, race, income, and many other qualities). Every decision about securing participants (e.g., the time of day the study is offered) is likely to influence the representativeness of the sample and, in turn, of the results.

The Availability Heuristic in Research

Let's now turn to the availability heuristic, the second heuristic from Kahneman and Tversky to be discussed. The availability heuristic suggests that humans make decisions to some extent based on how easy it is to think of examples from that domain. One well-known example of Kahneman and Tversky's work on availability involves the judgment of word frequency (Tversky & Kahneman, 1973). Take the letter K. Question: In words with three or more letters in English text, does the letter K appear more frequently in the first or third position?

When we hear this question about the letter K, what happens? We start to generate words that *begin* with the letter K because it is *available* to us. That seems easier to do than to think of words with K in the third position. But, after you've run out of key, knife, knight, and knit, you begin to realize that, well, bake, cake, fake, lake, make, rake, take, bike, hike, like, mike, … (k in the third position) generates far more possibilities; in fact, two times as many in a typical text (Tversky & Kahneman, 1973).

The availability heuristic emerges in research in many ways. For example, if we develop a questionnaire that first asks people to rate a list of items describing their university in terms of preference (e.g., food, school spirit, academics, career counseling, cost, and residence halls), and then we ask them an open-ended question about advantages and disadvantages of attending that university, the items from that initial list will be *available* in memory and will likely influence what people say in the open-ended question. If we had asked the open-ended question first, we might get a different set of responses. Thus, the order in which information is presented to participants may influence their responses and is related to the availability heuristic. Chapter 10 discusses one way to address this problem of availability by doing what is known as counterbalancing the order of presentation of materials. In complete counterbalancing, all possible orders of presenting the materials are included in the research approach.

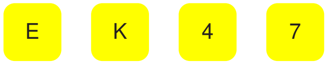
Counterbalancing: Presenting orders of the treatment to control for the influence of confounding variables in an experiment.

Wason Selection Task: Logic problem in which you have to determine which of four two-sided cards need to be turned over to evaluate the stated hypothesis (e.g., if there is a vowel on one side there is an even number on the other).

Humans Want to Confirm Hypotheses

What we have available in memory influences us in other important ways, specifically when we think about ways to confirm our hypotheses rather than when we think of ways to disconfirm them. Figure 1.3 shows a well-known example of our preference for thinking about information in terms of the way it is presented: the Wason Selection Task (Wason, 1966, 1968). This task involves making decisions about two-sided cards. This task has many variations, but in one version (Figure 1.3), people are told the following: These cards have two sides: a letter of the alphabet on one side and a number on the other. Then people are told a "rule," and their job is to make sure the rule is being followed. Here is the rule: If there's a vowel on one side, there's an even number on the other.

Figure 1.3 Example of Wason Selection Task



Then they are asked:

Which card or cards do you have to turn over to make sure the rule is being followed?

Try This Now 1.1

Before you read further, what card(s) did you select?

People usually select E and frequently E in combination with K and 4; they hardly ever select 7.

Why? One reason is that people heard the statement, "If there's a vowel . . .," and so what do they see? They see a vowel (E). They have a vowel available (think availability heuristic), and it seems logical to investigate the other side of that card. And they are correct, at least to that point; they should turn over the E. But they must also turn over the 7 to make sure that there is no vowel on the other side of that card. People don't do that; they don't think to disconfirm the rule.

The Wason Selection Task demonstrates an important part of thinking related to research. Humans have a much easier time thinking of ways to confirm information (think hypothesis) than to disconfirm it. What comes far less easily is taking a disconfirmational strategy to the hypothesis or the theory by seeking to disconfirm it. In research, we seem far more willing to seek to confirm rather than to disconfirm. Humans tend to exhibit what is known as **confirmation bias** in that we look for information that confirms our hypotheses. We also need to ask ourselves the question, what situation(s) would be a good test to show that the hypothesis is *incorrect*?

Confirmation bias: Tendency to look for information that confirms our hypotheses.

In the research findings of Kahneman and Tversky, you have seen that our cognitive processes are susceptible to a wide range of influences and biases. Even such respected researchers as Kahneman and Tversky may have been susceptible to the biases they studied. In the article "Voodoo Correlations Are Everywhere—Not Only in Neuroscience," Klaus Fiedler (2011) showed that the use of the letter K (discussed earlier in this chapter) for Tversky and Kahneman's (1973) demonstration of the availability heuristic may have used an unrepresentative letter (K). Because this finding has not been replicated with many other letters of the alphabet (as Fiedler reported, citing the work of Sedlmeier et al. [1998]), using K may not have been a good test of Tversky and Kahneman's hypothesis. In selecting their stimulus (K) intuitively, Fiedler explained, Tversky and Kahneman were fallible human beings: "Such an intuitive selection process will typically favor those stimuli that happen to bring about the expected phenomenon, making mental simulation an omnipresent source of bias in behavioral research" (Fiedler, 2011, p. 165).

In other words, Fiedler (2011) argued that the authors (consciously or otherwise) selected a stimulus that was likely to prove their point. The larger message of this research example provides a cautionary tale: Researchers and cognitive animals want to validate their hypotheses; by reinforcing what the Wason Selection Task shows, they seek to prove, not to disprove, and are likely to select stimuli that support their hypotheses rather than stimuli that challenge or refute them.

How can humans guard against this common “affirming” behavior? Being aware that such errors are likely is the first step. Asking how one might disprove or refute the hypothesis is another step. Imagining the conditions under which a prediction would not hold is as important as identifying the conditions under which the prediction is likely to hold. In other words, ask yourself what evidence would counter the hypothesis.

Revisit and Respond 1.1

Explain what it means to say humans are limited information processors.

Describe the concept of a schema and its adaptive and maladaptive implications for research.

Define heuristics and give examples of representativeness and availability.

Explain the Wason Selection Task and what it shows about the difference between confirming and disconfirming hypotheses.

Other Problems in Thinking

Several problems in thinking have been covered; let’s discuss a few more and in the process reinforce some of the information already presented. In Shermer’s (1997) *Why People Believe Weird Things*, Chapter 3 is titled “How Thinking Goes Wrong: Twenty-Five Fallacies That Lead Us to Believe Weird Things.” In that chapter, Shermer discussed four major categories of difficulties in how we think about evidence and data (Table 1.1). To illustrate the categories and the problems they present for our research, the chapter will focus on examples (see shading) in each category.

Problems in Scientific Thinking: Theory Influences Observations

As part of the category “Problems in Scientific Thinking,” Shermer listed “Theory influences observations” (1997, p. 46). What this statement means is that theory in some sense directs, shapes, or may even limit the kinds of observations humans make. Again, it is clear that we might limit ourselves because we look for

Table 1.1 Twenty-Five Fallacies That Derail Thinking

“Problems in scientific thinking” (pp. 46–48)

Theory influences observations

The observer changes the observed

Equipment constructs results

“Problems in pseudoscientific thinking” (pp. 48–55)

Anecdotes do not make a science (stories recounted in support of a claim)

Scientific language does not make a science (watch out for jargon)

Bold statements do not make claims true

Heresy does not equal correctness (belief/opinion contrary to religious doctrine)

Burden of proof—convince others of validity of evidence (not of mere existence of evidence)

Rumors do not equal reality

Unexplained is not inexplicable

Failures are rationalized (**pay attention to negative findings**)

After-the-fact reasoning (correlations do not mean causation)

Coincidence (gambler’s fallacy)

Representativeness (base rate)

“Logical Problems in Thinking” (pp. 55–58)

Emotive words and false analogies (not proof; merely tools of rhetoric)

Ad ignorantiam—an appeal to ignorance; belief should come from positive evidence in support of a claim, not from lack of evidence for or against a claim

Ad hominen (to the man) and *tu quoque* (you also)—watch that you focus on the content, not on the character of the person making the argument or on the consistency of the behavior of the person relative to the argument the person is making

Hasty generalization—prejudice/improper induction; conclusions before facts warrant it

Overreliance on authorities (false positive: accept results just because supported by someone admired; false negative: reject results just because supported by someone you disrespect)

Either-or—fallacy of negation or the false dilemma (creation vs. evolution); dichotomizing the world, such that if you reject one position, you are forced to accept the other

Circular reasoning—begging the question; tautology

Reductio ad absurdum and the slippery slope—refutation of an argument by carrying the argument to its logical end and so reducing it to an absurd conclusion

(*Continued*)

Table 1.1 (Continued)

"Psychological Problems in Thinking" (pp. 58–61)
Effort inadequacies and the need for certainty, control, and simplicity (have to practice thinking logically and clearly; thinking is skilled work)
Problem-solving inadequacies—we don't seek evidence to disprove
Ideological immunity, or the Planck problem—we all resist paradigm change; opponents have to die out gradually; we build up immunity against new ideas; the higher the IQ, the greater the potential for ideological immunity

Source: Adapted from Shermer, 1997, pp. 44–61.

a particular kind of behavior rather than being open to any kind of activity in the environment. Most people have never heard a peacock's scream and would never guess that the sound they hear when visiting a suburb outside Los Angeles comes from that bird. Why? Because most of us think peacocks are birds that reside in captivity. But peacocks have roamed wild in some places (like Rolling Hills on the Palos Verdes Peninsula in California) for more than 100 years. We limit our choices to the most likely suspects. As Shermer stated, "[O]ur perceptions of reality are influenced by the theories framing our examination of it" (p. 46). As Sidman (1960) noted, "To the neutral observer it will be obvious that science is far from free of human bias, even in its evaluation of factual evidence" (p. 70); researchers need to maintain a healthy skepticism about research evidence and seek to replicate their work.

Problems in Pseudoscientific Thinking: Scientific Language Does Not Make a Science

Pseudoscientific thinking: Involves reference to a theory or method that is without scientific support.

Pseudoscientific thinking involves reference to a theory or method that is without scientific support. What we are thinking about may be called science, but it may have no scientific basis, and it is not based on the scientific method. Shermer notes, "Scientific language does not make a science" (p. 49). It is tempting to use words that sound impressive and appear in a discipline, even when no convincing explanation of their meaning or importance is provided. What's better than coming up with a new term, especially with your name linked to it? Social science is replete with such terms. The use of scientific terms is not necessarily incorrect, but what is a problem is the use of terms without an explanation of their meaning in everyday language.

Furthermore, using such words without supporting evidence and confirmation is an example of pseudoscientific thinking. In the area of health care research, for example, many architects now use the term *evidence-based design* to describe their work. Without a clear understanding of what that terms means, and what qualifies as credible evidence (e.g., subjective measures such as patients' self-reports? Objective measures such as vital signs, levels of pain medication, and recovery time?), simply using that phrase makes designers sound more authoritative than they actually are. The use of a term in a discipline without an explanation of its meaning or clear indication of how the term is operationalized (i.e., how it is being measured) creates misunderstanding.

Coincidence (Gambler's Fallacy) and Representativeness (Base Rate)

Two other important aspects of this category "Problems in Pseudoscientific Thinking" according to Shermer (1997) are coincidence (gambler's fallacy) (pp. 53–54) and representativeness (base rate) (pp. 54–55). These two aspects frequently appear when we make assumptions in the research process. In the gambler's fallacy, we commit a logical fallacy and lose sight of the facts of probability; we think an event is less likely to occur if it has just occurred or that it is likely to occur if it hasn't for a while. When we toss a coin, we have a 50–50 chance of heads. Each toss of the coin is an independent event. Yet if we have seen three heads in a row, we may be very likely to predict that the next toss will yield tails when, in fact, the odds of a tail (or head) appearing on the next coin toss is still 50–50.

A related idea is the mistaken belief that correlation (for example, of two co-occurring events) is causation. Superstitions are an example of this erroneous thought process. Athletes are notorious for superstitions (Vyse, 1997). For example, if you win two games in a row in which you tie your left shoelace first as you prepared for the game, you may believe that tying that left shoe first influenced the victories. These two events (left shoe tying and game victory) are correlated, that is, when one event happened the other also happened, but shoe tying did not achieve the victory. Humans are pattern seekers because they are limited information processors. Humans look for causal relationships that may not exist; they see patterns (a series of coins coming up heads) and predict that the next coin toss will produce a tail. Humans make this prediction because such an outcome would be more representative of the occurrence of events as they know them. This is an aspect of representativeness (which was discussed earlier in the chapter).

In representativeness, we are on the lookout for events in the world that match or resemble the frequency of occurrence of those events in our experience. When we encounter a situation that does not look representative, we are likely to ignore, disregard, or mistrust it. As we have already discussed in this chapter, Kahneman and Tversky's work is full of examples of problems in thinking related to representativeness. The base rate is the frequency with which an event (e.g., twins, a hole in one, or perfect SATs) occurs in a population. We may have little knowledge of the actual base rate of events in a population, and we often overestimate the occurrence of events (e.g., likelihood of a plane crash or likelihood of winning the lottery). Our overestimation of the base rate may be influenced by the availability

Coincidence (gambler's fallacy): Thinking that an event is less likely to occur if it has just occurred or that it is likely to occur if it hasn't occurred for some time (e.g., assuming a slot machine will pay off because it hasn't for the past few hours).

Representativeness (base rate): One of the heuristics talked about by Kahneman and Tversky (1972) in which we make decisions based on how representative or characteristic of a particular pattern of events data are (e.g., people think the birth order BGBBGG is more representative of a sequence of births than is BBBGGG).

heuristic (discussed earlier in the chapter). If we have read or heard about a recent plane crash, for example, we are more likely to overestimate the occurrence of a plane crash for our upcoming trip.

The odds of dying from a motor vehicle accident are far greater than the odds of dying from a commercial airline accident. Likewise, we are far, far more likely to die from heart disease than we are from homicide (Kluger, 2006). In other words, we are not logic machines, and we don't carry around statistics in our heads; instead we carry estimates of events based on the frequency with which we have encountered them, and exposure to media typically elevates our estimates of the base rate, or the frequency with which events actually occur.

These errors in understanding the base rate underscore the importance in research of assessing the degree to which participants in your study may have familiarity with the topics under investigation. For example, if you were evaluating patients' reactions to hospitalization, you would certainly want to ask a question about the number of prior hospitalizations. You want to ask yourself what aspects of a participant's background might have relevance and possibly influence your research. As another example, if you were investigating students' satisfaction with their educational institution, it might be helpful to know if the college they attend was their first choice.

Try This Now 1.2

What kinds of background variables and experiences might influence students' satisfaction with their educational institution, aside from qualities of the institution itself?

Logical Problems in Thinking: Hasty Generalization and Overreliance on Authorities

Hasty generalization: Reaching decisions before evidence warrants, or faulty induction.

Faulty induction: Reasoning from the premises to a conclusion that is not warranted.

Among the logical problems in thinking that Shermer lists, he gives us "**hasty generalization**" (p. 56)—reaching conclusions before the evidence warrants—or **faulty induction**. Induction is reasoning from premises to a probable conclusion. In faulty induction, the conclusion is not warranted. People also describe this kind of thinking as stereotyping. As but one example, when we take a limited range of evidence about an individual and ascribe those qualities to the group of which the person is a member, we are stereotyping. A popular television show,[1] *The Big Bang Theory*, had characters that embody stereotypes, whether Sheldon Cooper, the brilliant but interpersonally less skilled theoretical physicist, or Amy

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[1] Ranked seventh in prime broadcast network television shows in the United States the week of June 1, 2015, according to Nielsen (http://www.nielsen.com/us/en/top10s.html). The show ended in 2019 after 12 seasons.

Farrah Fowler, who for some time was his "girlfriend" before becoming his wife. Those who faithfully watched the show will recall that initially Sheldon described Amy as a "girl" and his "friend" but not his "girlfriend" in the traditional meaning of the term. For long-term watchers of the show, the staying power of the series came through the evolution of these characters over time as they became less true to the stereotype they represented. But many individuals argue that the portrayal of these characters reinforced unfortunate and hurtful stereotypes about scientists and gender (Egan, 2015).

Hasty generalizations are a problem in many steps of the research process. We can consider the problem of hasty generalization when we talk about how much data are needed before conclusions are warranted. We can also include hasty generalization when we talk about sampling (see Chapter 11). Because humans are limited information processers and pattern seekers, we are eager to take information and package or categorize it; this process makes the information more manageable for us, but it may lead to errors in thinking.

A second kind of logical problem in thinking that Shermer lists is "**overreliance on authorities**" (pp. 56–57). In many cases, we accept the word or evidence provided by someone we admire without carefully examining the data. In the domain of research, we may have an overreliance on the published word; that is, we assume that when we read a published article, we should unquestioningly accept its data. Unfortunately, as we increasingly observe in academia, we should be far more skeptical about what has been published. Instances of fraud are numerous. Consider the case of fraud involving a graduate student, Michael LaCour (and Donald Green, the apparently unknowing faculty mentor), who published work in *Science* (LaCour & Green, 2014) showing that people's opinions about same-sex marriage could be changed by brief conversations (http://retractionwatch.com/2015/05/20/author-retracts-study-of-changing-minds-on-same-sex-marriage-after-colleague-admits-data-were-faked/). LaCour apparently fabricated the data that were the basis of his article, and the story of how this came to light reinforces the idea that findings must be reproducible. Two then–graduate students at the University of California–Berkeley, David Broockman and Josh Kalla, are responsible for identifying the anomalies in LaCour's data, which were revealed when these students from Berkeley tried to replicate the study. This revelation quickly led to the identification of other inconsistencies (e.g., the survey research firm that was supposed to have collected the data had not; no **Qualtrics** file of the data was ever created).

Overreliance on authorities: Trusting authorities without examining the evidence.

Qualtrics: Online platform for survey research.

The broader issue of reproducibility has been in the news recently with what is known as the **Reproducibility Project** (https://osf.io/ezcuj/), in which scientists are trying to reproduce the findings of 100 experimental and correlational articles in psychology published in three journals. The results (Open Science Collaboration, 2015) have been less than encouraging as many replications produced weaker findings than the original studies did. The authors emphasize that science needs both tradition (here, reproducibility) as well as innovation to advance and "verify whether we know what we think we know."

Reproducibility Project: Project in which researchers are trying to reproduce the findings of 100 experimental and correlational articles in psychology.

Simply because an article has been published does not make it good science. Even well-known researchers publish articles that contribute little to the literature. In Chapter 2, you will see the need to take into account the standards of particular journals (e.g., their acceptance rates, scope of research they publish, and rigor of methodology) rather than treating the work in all journals as equal. Relying on authority without questioning the evidence leads to mistakes in repeating what might have been weak methodology, for example. As Julian Meltzoff (1998) stated in his useful book about critical thinking in reading research, we should approach the written (here, published) word with skepticism and always ask, "show me." Meltzoff went on to say, "Critical reading requires a mental set of a particular kind," and he believed this mental set can be "taught, encouraged, and nurtured" (p. 8). The value of a particular argument has to be demonstrated with evidence that stands up to rigorous questioning. In regard to the research process, being willing to challenge authority by asking questions is an essential skill.

Psychological Problems in Thinking: Problem-Solving Inadequacy

Problem-solving inadequacy: When we do not seek to disprove hypotheses, only to confirm them.

The last category Shermer offered is "Psychological Problems in Thinking." Among the problems identified is the idea that we exhibit "**problem-solving inadequacy**" (1997, p. 59) when we don't seek evidence to disprove, only to prove. We discussed this issue earlier in the context of the Wason Selection Task, where people rarely thought that turning over the 7 was necessary. We invariably turn over the E (that is, look for evidence to confirm the hypothesis).

Consider the sobering evidence that "most doctors quickly come up with two or three possible diagnoses from the outset of meeting a patient. . . . All develop their hypotheses from a very incomplete body of information. To do this, doctors use shortcuts. These are called heuristics" (Groopman, 2007, p. 35). The word *heuristics* is familiar from material covered earlier in this chapter and, unfortunately, in the current context! Once we develop our hypotheses, we tend to stick with them; relinquishing them is difficult.

Doing Science as Tradition and Innovation

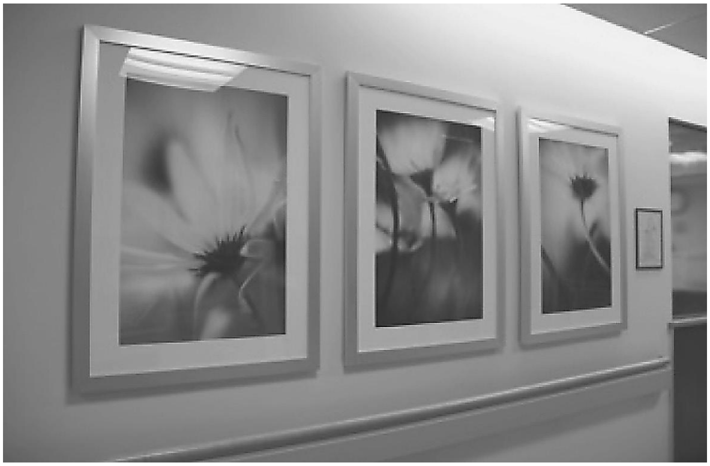
When we think about how science advances, we can talk about the social and behavioral sciences broadly as a combination of tradition and innovation. As the work of Kahneman and Tversky (and others cited here) has shown, tradition is easier than innovation. It is much easier to operate within an existing framework and harder to figure out how to head in new directions. Most of the time we hope to master the tradition through a review of the literature, and then we take a small step toward innovation by figuring out how we can advance the discipline with this small step. We have to write a literature review or summary of the work in the field that shows our knowledge of past work; at the same time, we have to propose research that goes beyond the existing literature in some way. We should be able to answer the question, "What's new here?" If views to everyday nature enhance recovery for surgical patients (Ulrich, 1984), why not see whether substitutes for nature such as representational paintings of nature have beneficial effects such as pain reduction. That use of "manufactured nature" would be a step forward. Researchers have done this work, and such representational paintings of nature do in fact reduce stress (Hathorn & Nanda, 2008; see Figure 1.4).

Paradigm: In science, an overarching approach to a field of inquiry that frames the questions to be asked and how research is conducted.

In your work, the problem of being governed by a **paradigm** or way of thinking about a research topic directly affects the kinds of research questions you are willing to ask. In an influential book written in 1962 titled *The Structure of Scientific Revolutions*, Thomas Kuhn describes how normal science proceeds. While he concentrates on scientific revolutions in physics, astronomy, and chemistry (e.g., Aristotle and Galileo, Ptolemy and Copernicus, Lavoisier and Priestley), the basic messages he provides in this book about how knowledge accumulates can be applied to the social and behavioral sciences. He states that scientists "whose research is based on shared paradigms are committed to the same rules and standards for scientific practice" (p. 11). Kuhn uses the term paradigm in an overarching way to describe scientific practice; components include "law, theory, application and instrumentation together" (p. 10). As he notes "normal-scientific research is directed to the articulation of those phenomena and theories that the paradigm *already supplies*" (p. 24) (italics added).

In one sense, a theory provides a necessary roadmap for normal science to proceed; on the other hand, we should remember Shermer's first problem in scientific thinking that theory influences observations and his second that the observer

Figure 1.4 Examples of Representational Images of Nature



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changes the observed. Kuhn references a well-known early study by psychologists Bruner and Postman (1949) in which anomalous (e.g., a red six of spades) as well as normal playing cards are used. A few participants in the study fail to identify the anomalies, even with extended exposure to the these mis-fit cards. In these cases, their experience appears to limit their ability to perceive. Kuhn comments, "In science, as in the playing card experiment, novelty emerges only with difficulty, manifested by resistance against a background provided by expectation" (p. 64).

A major point of Kuhn's book is that researchers who operate within a paradigm or scientific tradition have a difficult time accepting anomalous data that do not fit within the theories and laws of that framework. When old frameworks or paradigms are overthrown, it is often young researchers who may be outside of that tradition who forge the new framework: these researchers are "so young or so new to the crisis-ridden field that practice has committed them less deeply than most of their contemporaries to the world view and rules determined by the old paradigm" (p. 143). Similarly, as Murray Sidman (1960) states in his volume *Tactics of Scientific Research*, "sometimes it is the younger scientists, who enter the field unencumbered by the prejudices of past controversies, who pick out the threads of continuity from the tangle of theory, data and pseudo-problems that form a part of every stage of scientific progress" (p. 41).

Though not always resulting in the overthrow of a paradigm, some of the major changes in science have come from young researchers who perhaps were not fully wedded to a single theory or methodology (that hypothesis itself might be testable). Consider the experimental study of memory, where questions of capacity and duration have been studied since at least the time of Ebbinghaus in the late 19th century. As but one example of breaking out of a procedural paradigm, George Sperling's (1960) doctoral thesis at Harvard University transformed the way scientists think about the storage capacity of very short-term visual memory (immediate memory) by introducing the partial report technique. Prior to that time, using the whole report technique, participants in research on immediate visual memory storage had to call out or recall everything that they had just seen in a brief exposure (~ 50-msec.) to visual stimuli. Sperling's breakthrough was to have participants call out information presented on only *one row* in the visual array of three rows (Figure 1.5).

Sperling (1960) argued that to recall the information successfully from this *one row*, participants must have had *ALL of the rows available* at the time the particular row in question was cued. The cue was presented through an auditory tone (high, medium, or low) to correspond to the position of the rows of information on the page (top, middle, bottom). This approach is a masterful example of tradition (continuing the study of memory through visual exposure) and innovation (changing what was asked of the participant, which in turn dramatically transformed our thinking about the capacity of immediate visual memory).

Figure 1.5 Example of Sperling's (1960) Partial Report Technique

"7 1 V F
X L 5 3
B 4 W 7"

Source: Adapted from Sperling, 1960, p. 3.

Revisit and Respond 1.2

Give an example from each one of Shermer's (1997) categories:

- Problems in scientific thinking
- Problems in pseudoscientific thinking
- Logical problems in thinking
- Psychological problems in thinking

Of these four categories, which do you think has the most potential to undermine the research process and why?

Explain why science is a combination of tradition and innovation.

Research and the Value of Common Sense

You might be a bit discouraged about how limitations in thinking affect the research process. There is reason for concern; on the other hand, humans have some remarkable cognitive assets.

In 1995, Marvin Minsky gave an address at Connecticut College at the dedication of its new interdisciplinary science center, funded by the Olin Foundation. His address was as wide ranging and stimulating as his research. Minsky is considered a founder of artificial intelligence, and one of his corporate affiliations was as a fellow of Walt Disney Imagineering (http://web.media.mit.edu/~minsky/minskybiog.html). Minsky died in 2016. Imagineers, as the name suggests, were part of a research and development think tank and worked on imagining ideas that might result in possibilities for entertainment (Remnick, 1997). In David Remnick's article describing the Disney Corporation's view of amusement in the future, Minsky was reported to have accepted the offer to be an Imagineer because it "reminded him of the early days at the Artificial Intelligence Lab" (Remnick, 1997, p. 222). In describing his view of the future, Minsky said: "I'm telling you: all the money and the energy in this country will eventually be devoted to doing things with your mind and your time" (p. 222). Speaking about what he thought future amusements might have in store, he said, "you'll put on a suit and a special pair of glasses, and you'll become involved in an experiential form of entertainment" (p. 222). Virtual reality and Google Glass? This article was published over 20 years ago.

Minsky was obsessed (not too strong of a word) with the workings of the mind. Among Minsky's many contributions, his book *The Society of Mind* (1985), written for a general audience, stands out because it provides a perspective on what makes the human mind amazing and distinctive. The book is presented as a series of short topics and reflects Minsky's wide-ranging approach to discourse. Researchers often focus exclusively on the errors we make (Kahneman, 1991); in this book, Minsky also points out some of the cognitive assets of humans, in particular, common sense.

Discussing all of the processes that must be involved when making something with children's blocks, Minsky stated, "In science, one can learn the most by studying what seems the least" (1985, p. 20). Furthermore, "What people vaguely call common sense is actually more intricate than most of the technical expertise we admire" (1985, p. 72). Minsky argued it is easier to represent expertise than common sense because with expertise you are dealing with a limited domain of knowledge; humans, on the other hand, bring to bear many different kinds of expert systems in solving the simplest of everyday problems. Hence, common sense is anything but common, according to Minsky.

Hindsight bias: After an event has occurred, we have the tendency to claim that it could have been easily predicted.

Much of what Minsky said can be applied to the research process. Research does not have to be sophisticated to be powerful; in fact, you could argue that the most powerful research is simple and elegant (think of Sperling's [1960] partial report technique described earlier in this chapter). Small studies such as those one might do in a research methods class provide the opportunity to fill in the gap between what is known at the local level and shared wisdom, according to Rachel Kaplan in a very nice piece titled "The Small Experiment: Achieving More With Less" (R. Kaplan, 1996). People often complain that results in the social sciences are obvious, that is, we just demonstrate what everyone already knows—the we-knew-it-all-along effect, which is also called **hindsight bias**. But many such findings are not obvious until after you conduct the research. Common sense may lead us to ask questions that have been overlooked. Don't be afraid to ask questions that others would view as "obvious," that is, as commonsensical. After research emerged showing that patients have positive judgments of therapists whose offices are neat but also personalized (Nasar & Devlin, 2011), a therapist is reported to have commented, "Isn't that obvious?" If it were obvious, then why did so many therapists' offices used in this series of studies fail to conform to these criteria?

Flexibility in Thinking

Research is essentially about problem-solving, and humans are very good problem solvers. Relatedly, Kuhn (1962) describes normal science as puzzle-solving. What makes humans good at these kinds of activities? In addition to common sense, we can imagine objects used in a variety of ways. In essence, seeing potential or flexibility is a form of creativity. This kind of problem-solving creativity we have as humans was described by Hubert Dreyfus (1972) when he said that humans don't necessarily see the function of an object as fixed. Consider using a turkey baster to fill a sports car running low on transmission fluid or a door as a desk surface. The artist Marcel Duchamp used found objects, called *readymades*, as art; his bicycle wheel mounted upside down on a stool from 1913 is a well-known example. Nevertheless, we shouldn't take this flexibility for granted, for either objects or processes. For example, we may apply the same process (procedure) when it is no longer appropriate to solve a problem. This is essentially a problem-solving set effect, meaning that we approach a problem using an established (repeated) procedure. In other words, we don't recognize that there might be a more efficient way of solving the problem. This repeated procedural approach is a problem for researchers because we might settle in on a particular approach to evaluate a hypothesis because that is what other researchers have done (the tradition). Until Sperling introduced the partial report technique, scientists' estimate of the capacity of immediate visual memory was limited by the procedure used (the whole report) to measure it. We need to stop and ask ourselves *how else* we might go about investigating that particular issue. Can we improve on the tradition?

In the case of work on bias and discrimination, for example, researchers have been limited by using scales that directly ask questions about beliefs and attitudes. For example, an item from the Modern Sexism Scale is "It is rare to see women treated in a sexist manner on television" (Swim et al., 1995). Participants who see such scale items are likely to self-monitor and answer with **social desirability**, presenting themselves in a good light (see Chapter 5 on measures).

Social desirability: Responding to experimental stimuli and/or scales in a way that presents the respondent in a positive (socially appropriate) light.

A procedural breakthrough in addressing these kinds of problems with self-report measures has come in the form of Implicit Association Tests (IATs; Greenwald et al., 2003), which use reaction time to measure people's associations to topics (e.g., race, sex, obesity, and age) where your explicit response might be different than your implicit response (see https://implicit.harvard.edu/implicit/takeatest.html if you want to try out an IAT for yourself). If the pairing of "fat people" with the adjective "good" takes longer to react to than the pairing of "thin people" with the adjective "good," then we, as well as the individual taking the IAT, have learned about whether the individual's biases are congruent with the explicit positions that person expresses about weight. In all likelihood, if we had only explicitly asked about people's attitudes toward people who are thin versus heavy, we would not see differences. Generally, people do not want to appear biased, in this case, against those in a particular weight category.

The challenge of research is to appreciate what previous studies have shown us (tradition) without becoming limited by them in the questions we can ask (innovation). But with experience, our thought processes become routinized, regularized, and less likely to see the new in the old, to think outside the box. All too soon we are unwilling to break out of the box. Are you up to the challenge?!

Theories: What They Are and Why They Matter

The chapter has devoted quite a bit of space to a description of how information can be packaged in manageable ways to support the research process. There are three important terms that reflect different kinds of "packaging": hypotheses, theories, and laws. In *The Dictionary of Psychology* (Corsini, 2002), a hypothesis is defined as "a testable proposition based on theory, stating an expected empirical outcome resulting from specific observable conditions" (p. 463). This dictionary defines a theory as "a body of interrelated principles and hypotheses that explain or predict a group of phenomena and have been largely verified by facts or data" (p. 994). A law is defined in this dictionary as "a theory accepted as correct, that has no significant rivals in accounting for the facts within its domain" (p. 536). Thus, a theory is the pivotal link between hypotheses, which are generated from theories at the least-verified end of the spectrum, and laws, on the other end of the spectrum, which emerge when a theory is viewed as having been consistently verified and operates without challenge (Figure 1.6).

Theory: "A body of interrelated principles and hypotheses that explain or predict a group of phenomena and have been largely verified by facts or data" (Corsini, 2002, p. 994).

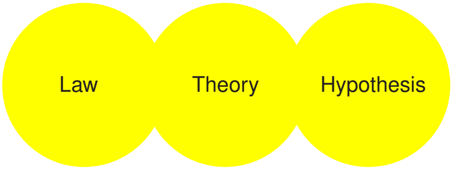
Law: "A theory accepted as correct, that has no significant rivals in accounting for the facts within its domain" (Corsini, 2002, p. 536).

A question you might ask is whether the social and behavioral sciences have any laws. Three-and-a-half pages of laws are listed in Corsini's (2002) dictionary, including the law of association, the law of belongingness, the law of common fate, the law of effect, the law of mass action, the law of proximity, and the law of vividness (pp. 537–540). These "laws" may conform to the idea of a theory being accepted as correct and lacking significant rivals, but many social scientists might have some difficulty easily coming up with an example of a "law" in their discipline. In contrast, we could all probably think of some of the laws of thermodynamics from high school; at the very least, we would know that there were laws of thermodynamics. Many of us think of laws as those referred to as natural laws, in terms of aspects of nature that predictably occur under specific conditions.

As is evident in that description, one challenge in the social and behavioral sciences is that human behavior doesn't conform to this idea of invariable occurrence. As a result, in research, we spend most of our time testing hypotheses; if we are fortunate, these hypotheses are generated within the context of a theory. Thus, hypotheses and theories and their interrelationships are important to understand.

Let's further consider the importance of theories. One of the fundamental goals of research is to provide information that allows us to predict what will happen in future situations without having to retest the assumptions. For example, it would be useful to know whether a given antibiotic, such as penicillin, works on a variety of bacteria, and not just one type. Perhaps you remember taking amoxicillin, a type of penicillin, for childhood ear infections. Amoxicillin, sometimes described as a broad-spectrum antibiotic, has been demonstrated to be effective in treating tonsillitis, bronchitis, and pneumonia, among other bacterial infections. Thus, scientists could claim the effectiveness of this drug over a range of situations; it has generality.

Figure 1.6 Venn Diagram of Link Between Law, Theory, and Hypothesis



One common definition of research is systematic investigation with the goal of generalizable knowledge. This definition comes from the federal regulations known as the revised Common Rule that most institutions follow to regulate how research is conducted (this rule is discussed in Chapter 4 of this book). Generalizable knowledge refers to the idea that the knowledge gained from research applies beyond the circumstances and characteristics of the particular investigation (i.e., we should be able to infer what will happen beyond the circumstances at hand).

How does this idea of generalizability relate to theory? At its core, a theory provides an interrelated set of principles demonstrated to explain not just the situation in question but a group of phenomena. Such principles have been tested and verified. Without theories, we would continually examine situations as if they were unique, without appreciating what they have in common with other presumably related situations. We would not be in a position to predict behavior; we would not appreciate how the variables under examination are related to each other; and we would have a difficult time developing a comprehensive understanding of human behavior.

In the social and behavioral sciences, theories use interrelated concepts to describe and predict behaviors (events) by making clear the relationships among variables. In Ulrich's (1991) Theory of Supportive Design, his explanatory framework, he offers three dimensions predicted to enhance patients' well-being in health care settings. These dimensions are (1) positive distraction, (2) social support, and (3) perceived control. Having (1) positive aspects of the environment (e.g., artwork, a view to nature, or music) to distract us from our worries; (2) the social contact of others, either in person (accommodated by seating) or by phone, e-mail, or Skype; and (3) the ability to control aspects of the environment around us, for example, by using the remote control or adjusting the temperature, is theorized to lead to greater well-being. These three constructs have in common their focus on the physical environment, on the one hand, and their predicted effect on human well-being, on the other. Could we imagine generating hypotheses within this theoretical framework? Before answering that question, let's revisit the concept of a hypothesis, which is based on a theory, is testable, and states an expected empirical outcome based on observable data.

Try This Now 1.3

Come up with two hypotheses based on Ulrich's (1991) Theory of Supportive Design.

Theories are important because they help to organize and structure information and provide a way to think about ideas. Theories provide a structured foundation that should support the generation of hypotheses. At the same time, in returning to one of the themes of this chapter, it is important to recognize that biases may be embedded in theories. Shermer (1997, p. 46) quoted the physicist and Nobel laureate Werner Heisenberg, who stated, "What we observe is not nature itself but nature exposed to our method of questioning." In the case of Ulrich's (1991) theory, for example, we may stop thinking of other dimensions of supportive design if we accept his three-factor model. You can see that research questions are shaped by theory, and it is always a good idea to question whether the theory is limiting how you might think about the topic. In the case of Ulrich's model, you might ask whether other aspects of design could be supportive beyond the three dimensions he identifies. For example, perhaps maintenance and upkeep need to be considered.

Ways in Which Theories May Differ: Scope and Parsimony

Theories differ in scope, that is in how much territory they cover, or the range of behaviors to which they apply. An example of one environmental theory broad in scope is Urie Bronfenbrenner's Ecological Systems Theory (Bronfenbrenner, 1977, 1979), which explains the various environmental contexts of child development. There are five contexts in this theory: microsystem (immediate environment), mesosystem (connections), exosystem (indirect environment), macrosystem (social and cultural values), and chronosystem (changes over time). Thus, this theory essentially covers the entire "landscape" of child development! In contrast, Ulrich's theory previously described is more limited in scope, applying more narrowly to health facility design.

Theories may also differ in their parsimony, that is the extent to which few rather than more explanations are needed to explain the phenomenon. Scope and parsimony are distinct concepts. One could, for example, have broad scope but need few explanations for the behavior(s). An example of a parsimonious theory with broad scope is Lewin's postulation (Lewin, 1933) that behavior is a function of the person and the person's environment (psychological life space) as experienced. This theory was initially represented as $B = f(P\ E)$ and sometimes later as $B = f(P \mathrm{x} E)$.

In the history of science, parsimony appears frequently as a valued characteristic of theories. What is known as Occam's Razor, named after 14th century English philosopher William of Occam, posits that, given competing explanations for a phenomenon, the simplest one is best. The concept of the razor comes from the idea of reducing (i.e., shaving) the explanations to the simplest. One advantage of such simplicity is that it makes the theory easier to support (or falsify). This emphasis on simple explanations does not originate (or end) with Occam, as Aristotle claimed superiority of using fewer postulates or hypotheses. One can also point to Newton, Einstein, Hawking, and others in support of this general concept (see, for example, Baker's entry on "Simplicity," 2016, in the *Stanford Encyclopedia of Philosophy*).

Another aspect of theories to appreciate is that they are powerful; in some instances, theories may become self-fulfilling (Ferraro et al., 2009). In their commentary about why theories matter, Fabrizio Ferraro et al. cited the work of Carol Dweck (2006), who showed that people's beliefs about intelligence (whether fixed vs. mutable/changeable) can shape their behavior. In particular, those who believed that intelligence was fixed behaved differently (e.g., avoided tasks where