believe that "opposites attract." They don't (see Buss, 1985; Buss & Barnes, 1986). Some people believe that "familiarity breeds contempt." It doesn't (see Bornstein, 1989). Some people believe that blind people are blessed with supersensitive hearing. They're not (see Niemeyer & Starlinger, 1981; Stankov & Spilsbury, 1978). And the list goes on and on and on.

The many inadequacies in people's intuitive theories of behavior illustrate why we need the controlled experimentation of psychology: so that we can progress beyond our flat-earth conceptions of human behavior to a more accurate scientific conceptualization.

Summary

The heart of the experimental method involves manipulation and control. In contrast to a correlational study, where the investigator simply observes whether the natural fluctuation in two variables displays a relationship, in a true experiment, the investigator manipulates the variable hypothesized to be the cause and looks for an effect on the variable hypothesized to be the effect while holding all other variables constant by control and randomization. This method removes the third-variable problem present in correlational studies. The third-variable problem arises because, in the natural world, many different things are related. The experimental method may be viewed as a way of prying apart these naturally occurring relationships. It does so because it isolates one particular variable (the hypothesized cause) by manipulating it and holding everything else constant. However, in order to pry apart naturally occurring relationships, scientists often have to create special conditions that are unknown in the natural world.

7

"But It's Not Real Life!"

The "Artificiality" Criticism and Psychology

Having covered the basics of experimental logic in the previous two chapters, we are now in a position to consider some often heard criticisms of the field of psychology. In particular, we will discuss at length the criticism that scientific experiments are useless because they are artificial and not like "real life." Understanding why this is not a valid criticism will aid in thinking straight about psychology because the criticism is often aimed at psychological experimentation.

Why Natural Isn't Always Necessary

From the discussion in Chapter 6, it should already be fairly clear why this criticism is invalid. As was illustrated in that chapter, the artificiality of scientific experimentation is not a weakness but actually the very thing that gives the scientific method its unique power to yield explanations about the nature of the world. Contrary to common belief, the artificiality of scientific experiments is not an accidental oversight. It is intentionally sought. Scientists *deliberately* set up conditions that are unlike those that occur naturally because this is the only way to separate the many inherently correlated variables that determine events in the world.

Sometimes the necessary conditions already exist naturally, as in the example of Snow and cholera. More often, this is not the case. The scientist must manipulate events in new and sometimes strange ways, as in the example of Goldberger and pellagra. In many instances, these manipulations cannot be accomplished in natural environments, and the scientist finds it necessary to

bring the phenomenon into the laboratory, where more precise control is possible. Early studies of gravity and motion used specially constructed objects that were designed for no other reason than to create a set of special conditions for the observation of moving objects. It is often necessary to create increasingly *unreal* and extreme conditions in order to analyze a phenomenon.

Indeed, some phenomena would be completely impossible to discover if scientists were restricted totally to observing "natural" conditions. Physicists probing the most fundamental characteristics of matter build gigantic mile-long accelerators that induce collisions between elementary particles. Some of the by-products of these collisions are new particles that exist for less than a billionth of a second. The properties of these new particles, however, have implications for theories of atomic structure. Many of these new particles would not ordinarily exist on earth, and even if they did, there certainly would be no chance of observing them naturally. Yet few people doubt that this is how physicists should conduct their research; that probing nature in unusual and sometimes bizarre ways is a legitimate means of coming to a deeper understanding of the universe. Somehow, though, practices that seem reasonable for physicists are often viewed as invalid when used by psychologists.

Although the actions of all scientists are misunderstood when the public fails to realize the importance of creating special conditions in the laboratory, the work of psychologists is probably most subject to this type of misunderstanding. Many psychologists who have presented experimental evidence on behavior to an audience of laypersons have heard the lament, "But it's not real life!" Further discussion of this criticism usually exposes the audience's belief that knowledge cannot be obtained unless natural conditions are studied and that the laboratory studies of psychology are strange and probably indicate that it is an inadequate science.

It is not commonly recognized that many of the techniques used by the psychologist that are viewed as strange by the public are in no way unique to psychology; instead, they are manifestations of the scientific method as applied to behavior. Actually, similar bizarre ways of acquiring knowledge about the world can be observed in the investigations conducted by every science. Psychology ends up with the worst of both worlds. The same ignorance of the scientific method that supports the belief that psychology just can't be a science leads to the denigration of psychologists when they, like all other scientists, create the special conditions necessary to uncover more powerful and precise explanations of their phenomena.

Restriction to real-life situations would prevent us from discovering many things. For example, biofeedback techniques are now used in a variety of areas such as migraine and tension headache control, hypertension treatment, and relaxation training (deCharms et al., 2005; Maizels, 2005; Miller, 1985a). These techniques developed out of research indicating that humans could learn partial control of their internal physiological processes if they could monitor the ongoing processes via visual or auditory feedback. Of course, because humans are not equipped to monitor their physiological functions via external feedback, the ability to control such processes does not become apparent except under special laboratory conditions. Observations under natural conditions would never uncover it.

The "Random Sample" Confusion

Sometimes, however, the "it's not real life" complaint arises from a different type of confusion about the purposes of psychological experimentation, one that is actually quite understandable. Through media exposure, many people are familiar with survey research, particularly in the form of election and public-opinion polling. There is now a growing awareness of some of the important characteristics of election polling. In particular, the media have given more attention to the importance of a random, or representative, sample for the accuracy of public opinion polls. This attention has led many people to believe, mistakenly, that random samples and representative conditions are an essential requirement of all psychological investigations. Because psychological research seldom uses random samples of subjects, the application of the random sample criterion by the layperson seems to undermine most psychological investigations and to reinforce the criticism that the research is invalid because it doesn't reflect real life.

Again, a moment's thought about the nature of other sciences should go a long way toward exposing the fallaciousness of this belief. Chemists make no attempt to draw random samples of compounds. Biologists do not experiment on random samples of cells or organisms. The rats and monkeys in a medical research facility are not at all representative of their species. The organisms in such laboratories are often studied under conditions that are vastly different from their natural environments. Indeed, these conditions are often utterly unique. Yet they yield insights that help shed great light on human biology. The same is true of most psychological investigations. This is because it is actually *not* necessary for every psychological investigation to employ a random sample. And this is a good time to stress and important point: that random sampling and random assignment (discussed in Chapter 6) are not the same thing.

The Random Assignment Versus Random Sample Distinction

Because they both have the term *random* in them, many people come to think that random assignment and random sampling refer to the same thing. Actually they are very different concepts—similar only in that they make use of the properties of random number generation. But they are used for very different purposes.

Random sampling refers to how subjects are chosen to be part of a study. As noted previously, random sampling is not a requirement for all research, but when it does become necessary (in survey research, consumer research, or election polling, for example) it refers to drawing a sample from the population in a manner that ensures that each member of the population has an equal chance of being chosen for the sample. The sample that is drawn then becomes the subject of the investigation. And it is important to understand that that investigation could be either a correlational study or a true experiment. It is not a true experiment unless random assignment is *also* used.

Random assignment is a requirement of a true experiment where an experimental and control group are formed by the experimenter. Random assignment is achieved when each subject is just as likely to be assigned to the control group as to the experimental group. This is why a randomizing device such as a coin flip (more often, a specially prepared table of random numbers) is employed—because it displays no bias in assigning the subjects to groups.

The best way to keep in mind that random assignment and random sampling are not the same thing is always to be clear that any of the four combinations can occur: nonrandom sampling without random assignment, nonrandom sampling with random assignment, random sampling without random assignment, and random sampling with random assignment. Most psychological research does not employ random sampling because it is not necessary. The research involves theory testing, as we will see in the next section, and a convenience sample is all that is necessary. If random assignment is employed in the study, then it becomes a true experiment. If random assignment is not employed, then the study is a correlational investigation. Many studies that do use random sampling do not employ random assignment because they are surveys and are only looking for associations—that is, they are correlational investigations. However, some studies using random samples do employ random assignment and they, of course, are true experiments.

Theory-Driven Research Versus Direct Applications

Douglas Mook (1983, 1989, 2001), a psychologist at the University of Virginia, discusses the different types of prediction that characterize different types of investigation. In many kinds of applied research the goal is to relate the results of the study directly to a particular situation. In applied research, the prediction is what Mook termed "analogue"—from the study to the field—and the findings are applied directly. Election polling is an example of applied research that makes use of analogue prediction. The goal is to predict a specific behavior in a very specific setting, in this case, voting on election day. Here, where the nature of the prediction is direct, questions of the randomness of the sample and the representativeness of the conditions are important because the findings of the study are going to be applied directly.

However, it would be a mistake to view this class of research as typical. The vast majority of research studies in psychology (or any other science, for that matter) are conducted with a very different purpose in mind. The nature of prediction in most research is from a theory to a research situation. The findings of most research are applied only indirectly through modifications in a theory that, in conjunction with other scientific laws, is then applied to some practical problem (Nickerson, 1999). In short, most theory-driven research seeks to test theories of psychological processes rather than to generalize the findings to a particular real-world situation.

Research that focuses primarily on theory testing is often termed *basic research*. Whereas in applied research the purpose of the investigation is to go from data directly to a real-world application, basic research focuses on theory testing. However, it is probably a mistake to view the basic-versus-applied distinction solely in terms of whether a study has practical applications, because this difference often simply boils down to a matter of time. Applied findings are of use immediately. However, there is nothing so practical as a general and accurate theory. The history of science is filled with examples of theories or findings that eventually solved a host of real-world problems even though the scientists who developed the theories and/or findings did not intend to solve a specific practical problem.

Several examples of basic research that had practical implications are described in an article by Robert Crease and Nicholas Samios (1991), who work at the Brookhaven National Laboratory, a leading physics research center. They cited the case of Wilhelm Roentgen, who "explored the curious fact that a fluorescent screen near his apparatus was glowing, contrary to all expectations; he ended up discovering a whole new phenomenon of nature, which he called X-rays. Within three months they had been used to examine bone fractures" (p. 82). Or consider Howard Florey, who, with a colleague, began a survey of antibacterial mechanisms: "On their list of microbes to study was penicillin, which had been discovered accidentally only a few years before but whose antibacterial properties had been neglected. Much of modern medicine is based on substances whose discovery and development were matters of . . . disinterested academic research" (p. 82).

Seymour Kety (1974) described how a seemingly unrelated set of scientific findings led up to the discovery of chlorpromazine, a drug of immense usefulness in treating schizophrenia. Kety made the point that virtually *none* of the precursor discoveries of this treatment for schizophrenia would have been recognized as having anything to do with schizophrenia! Time and time again, attempts to control the direction of science (by trying to tell scientists to solve a particular practical problem) turn out to impede rather than facilitate progress. Ironically, the urge to have scientists solve only practical

problems and not bother with the "other stuff" (basic research) turns out to be wildly impractical and shortsighted.

The road to many practical applications is remarkably tortuous and unpredictable. A group of researchers at the University of Texas Southwestern Medical Center was seeking to genetically engineer a population of rats with arthritis in order to study that inflammatory disease. Unexpectedly, their rats also developed inflammation of the intestines (Fackelman, 1996). The research team "had serendipitously created rats with ulcerative colitis, thus giving scientists an animal model in which to study the human disease" (Fackelman, 1996, p. 302). Whether these scientists make any progress on arthritis (their original problem), it now looks as if they have made a substantial contribution to the eventual treatment of ulcerative colitis and Crohn's disease.

In short, we must recognize that, although some research is designed to predict events directly in a specific environmental situation, much scientific research is basic research designed to test theory. Researchers who conduct applied and basic research have completely different answers to the question, How do these findings apply to real life? The former answers, "Directly, provided that there is a reasonably close relationship between the experimental situation and the one to which the findings are to be applied." Thus, questions of the random sampling of subjects and the representativeness of the experimental situation are relevant to the applicability of the results. However, the investigator in a theory-testing study answers that his or her findings do not apply directly to real life, and that the reason for conducting the study is not to produce findings that would be applicable to some specific environmental situation. Therefore, this scientist is not concerned with questions of how similar the subjects of the study are to some other group or whether the experimental situation mirrors some real-life environment. Does this mean, then, that these findings have no implications for the real world? No. These findings apply directly not to a particular situation but to a theory. The theory may, at some later date, in conjunction with other scientific laws, be applied to a particular problem.

This type of indirect application through theory has become quite common in some areas of psychology. For example, years ago when cell phones were first introduced, many cognitive psychologists immediately began to worry about the implications for safety when people began to use them while driving automobiles. The psychologists immediately expected that cell phone use would cause additional accidents—and not just because the phone would take a hand off the wheel. Instead, what they were worried about was the attentional requirements of talking on the cell phone. What is important to realize was that the psychologists became worried about cell phone use in cars long before there was a single experimental study of actual cell phone use and its relation to accidents (see Strayer & Johnston, 2001). The psychologists made their prediction of accident problems with cell phones through

theory, in this case theories of limited-capacity attention that were decades old (e.g., Broadbent, 1958; Kahneman, 1973). Cell phone use in a car clearly falls within the domain of those theories, which had been established through voluminous experimentation (literally hundreds of laboratory studies). When in fact the actual studies of real cell phone use were done, they confirmed the prediction from the psychological theories of attention: Cell phone use is indeed a cause of motor vehicle accidents (Insurance Institute for Highway Safety, 2005; McEvoy et al., 2005; Redelmeier & Tibshirani, 1997, 2001).

Douglas Mook (1983) discussed an example that illustrates the ideas of theory-testing experimentation and the nature of indirect application in psychology. In the 1930s, Selig Hecht published a series of studies of visual sensitivity in the *Handbook of General Experimental Psychology* (Murchison, 1934). These studies concerned the phenomenon of dark adaptation. You have probably experienced the temporary blindness that occurs when you walk into a darkened movie theater. As you wait in your seat, however, you probably notice that chairs, people, and other objects begin to become visible. If you keep concentrating on this phenomenon, you will observe that the visibility of objects in the theater continues to increase for several minutes.

This phenomenon is called *dark adaptation*, and it occurs in two phases: a rather quick but fairly small increase in visual sensitivity on entering a darkened room, followed by a delayed but much larger increase in sensitivity. Hecht linked this two-part adaptation curve to the two different types of receptor cells in the retina of the eye. The cones are receptor cells that are densely packed in the center of the fovea (the part of the retina where incoming light is focused) and are very sensitive to red light. The rods are located outside the foveal area, are much less densely packed, and are not very sensitive to red light. Hecht used these facts to establish that the initial phase of dark adaptation (a small, rapid increase in visual sensitivity) is due to the adaptation of the cones and that the second phase (a larger increase in sensitivity taking place over a longer period of time) is due to rod adaptation.

Mook (1983) urged us to consider the complete unnaturalness of Hecht's experimental situation. Subjects (who were not randomly chosen) were in a dark room responding, "Yes, I see it" or "No, I don't," depending on whether or not they detected a tiny red light that was flashed at them. We normally do not respond to little red lights in this way in everyday life. Hecht, however, was not concerned about generalizing his findings to individuals in dark rooms responding "yes" or "no" to tiny red lights, so whether such a situation ever actually occurs is irrelevant. Hecht was interested in establishing facts and testing theories about the basic processes that characterize the visual system, such as dark adaptation. He was not concerned about whether his experimental situation was realistic but about whether it adequately isolated the specific visual process he was interested in studying.

Hecht's findings gain generalizability not through the nature of the setting in which they occurred, but by their ability to establish a theory of basic

visual processes that are implicated in many tasks. His research uncovered the basic functional relationships that characterize the human visual system, precisely because his situation was controlled and artificial. If the theoretical model for the relationships is correct, then it should have wide applicability and should account for performance in a variety of situations much different from the one in which it was derived. In other words, Hecht's findings have indirect applications through their influence on theory. For example, the basic understanding of the visual system promoted by Hecht's findings has helped in the treatment of night blindness and in the problem of reading X-rays (Leibowitz, 1996; Mook, 1982). And more dramatically, while awaiting the night raids of Hitler's bombers during the blitz in World War II, the British fighter pilots who were to engage the German planes wore red goggles (because the rods—not being sensitive to red light—would stay dark-adapted; see Mook, 1982). The leap from subjects judging little red dots in a laboratory to the dangerous sky over London was made through theory, not through a redesign of Hecht's lab to resemble a Spitfire airplane.

Applications of Psychological Theory

Once we understand that the purpose of most research is to develop theory rather than to predict events in a specific environment and that the findings of most research are applied indirectly, through theory, rather than directly in a specific environmental situation, we can legitimately ask how much application through theory has been accomplished in psychology. That is, have psychology's theories been put to the test of generality?

On this point, we must admit that the record is mixed. But it is wise to keep psychology's diversity in mind here. It is true that some areas of research have made only modest progress along these lines. However, other areas have quite impressive records of experimentally derived principles of considerable explanatory and predictive power (see Buss, 2003; Byrnes, 2001; Davidson & Sternberg, 2003; Gazzaniga, 2004; Hilton, 2003; Sunstein, 2002; Wilson & Keil, 1999; Zimbardo, 2004). For example, even applied areas like counseling psychology, school psychology, clinical psychology, and psychotherapy have benefited from theory-driven basic research (Davidow & Levinson, 1993; Garb & Schramke, 1996; Lilienfeld, Lynn, & Lohr, 2003; Lilienfeld, Wood, & Garb, 2000; Mahrer, 2000; Siegert & Ward, 2002).

Consider the basic behavioral principles of classical and operant conditioning. These principles and their elaborating laws were developed almost entirely from experimentation on nonhuman subjects, such as pigeons and rats, in highly artificial laboratory settings. Yet these principles have been successfully applied to a wide variety of human problems, including the treatment of autistic children, the teaching of large amounts of factual material,

the treatment of alcoholism and obesity, the management of residents in psychiatric hospitals, and the treatment of phobias, to name just a few.

The principles from which these applications were derived were identified precisely because the laboratory experimentation allowed researchers to specify the relationships between environmental stimuli and behavior with an accuracy not possible in a natural situation, in which many behavioral relationships may operate simultaneously. As for the use of nonhuman subjects, in many cases theories and laws derived from their performance have provided good first approximations to human behavior (Vazire & Gosling, 2003). When humans were examined, their behavior often followed laws that were very similar to those derived from other animals. Findings such as these should hardly surprise anyone today, when just about every medical advance in the treatment of human illness has involved data from animal studies. For example, research with animals has contributed to developments in behavioral medicine, stress reduction, psychotherapy, the rehabilitation of injured and handicapped individuals, the effects of aging on memory, methods to help people overcome neuromuscular disorders, drug effects on fetal development, substance abuse, memory loss, traffic safety, and the treatment of chronic pain (Domjan & Purdy, 1995; Gosling, 2001; Kalat, 1995; Miller, 1985b; Zimbardo, 2004). Recent research with dogs is on the threshold of leading to some real advances in understanding the underlying basis of human anxiety disorders (Groopman, 1999).

In fact, the it's-not-real-life argument has been used misleadingly to denigrate the results of animal research—often for political reasons. For example, lobbyists for polluting companies often put forth the argument that the evaluation of the human risk of cancer-causing agents is invalid if based on animal studies. However, in a 1988 study of 23 carcinogenic agents (benzene, asbestos, etc.) by a team of scientists, it was found that estimated death rates from animal studies were quite close to estimates from epidemiological studies of humans (Finkel, 1996).

Psychologists studying perceptual processes have made impressive theoretical progress, and the laws and theories they have derived have been applied to problems as diverse as radar monitoring, street lighting, and airplane cockpit design (Nickerson, 1992; Swets, Dawes, & Monahan, 2000; Wickens, 1992). Much is now known about the cognitive effects of aging (Salthouse, 2004), and this new knowledge has direct implications for efforts to design systems that will help people to compensate for cognitive loss (Dixon & Backman, 1995).

Psychological studies of judgment and decision making have had implications for medical decision making, educational decision making, and economic decision making (Gigerenzer, 2002; Gilovich, Griffin, & Kahneman, 2002; Hilton, 2003; Kahneman, 2003; Kahneman & Tversky, 2000; Swets, Dawes, & Monahan, 2000; Tetlock, 2005; Zweig, 2001). An exciting new

development is the increasing involvement of cognitive psychologists in the legal system, where problems of memory in information collection, evidence evaluation, and decision making present opportunities to test the applicability of cognitive theories (Kassin, Tubb, Hosch, & Memon, 2001; Koehler, 1993; Kuhn, Weinstock, & Flaton, 1994; Redding, 1998; Wrightsman, 1999; Zimbardo, 2004). Also, since the mid-1980s, theory and practice in the teaching of reading have begun to be affected by research in cognitive psychology (Rayner, Foorman, Perfetti, Pesetsky, & Seidenberg, 2001, 2002; Snowling & Hulme, 2005; Stanovich, 2000; Vellutino, Fletcher, Snowling, & Scanlon, 2004). Finally, psychologists have played an important role in providing scientific evidence to inform the public debate about the status of children's testimony in legal proceedings (Ceci & Hembrooke, 1998) and about the validity of "recovered" memories of child abuse (Brainerd & Reyna, 2005; Bremner, Shobe, & Kihlstrom, 2000; Clancy, Schacter, McNally, & Pitman, 2000; Gardner, 2006; Loftus, 1997; Lynn, Loftus, Lilienfeld, & Lock, 2003; McNally, 2003; Pezdek & Banks, 1996; Spanos, 1996). The American Psychological Association maintains a Web site where you can read about many more of the practical applications of psychological knowledge: http://www.psychologymatters.org/.

The "College Sophomore" Problem

The concerns of many people who question the "representativeness" of psychological findings focus on the subjects of the research rather than on the intricacies of the experimental design. However, in many areas of psychology such as the study of basic perceptual and cognitive processes, conflicting results are more often due to the latter than to the former. The basic information-processing operations, the functional organization of the brain, and the nature of the visual systems of people in Montana tend to be very similar to those of people in Florida (or Argentina, for that matter). In addition, these characteristics of humans also depend very little on whether one's parents are tinkers, tailors, or professors.

All sciences assume that certain factors are so tangential that they will make no difference in the final results. Biologists do not generally worry that the slightly different thickness of petri dishes will significantly affect the bacteria in them. These differences, of course, may have an effect—every assumption in science is tentative—but biologists must expend their effort investigating possibilities with a higher probability. Similarly, Hecht assumed that dark adaptation did not depend on a person's religious affiliation, so he did not ask his subjects whether they were Lutherans or Roman Catholics.

We are confronting here what is sometimes called the *college sophomore problem;* that is, the worry that, because college sophomores are the subjects in an extremely large number of psychological investigations, the generality of the results is in question. Psychologists are concerned about the college sophomore issue because it is a real problem in certain areas of research.

Nevertheless, it is important to consider the problem in perspective and to understand that psychologists have several legitimate responses to this criticism. Here are three:

1. The college sophomore criticism does not invalidate results but simply calls for more findings that will allow assessment of the theory's generality. Adjustments in theory necessitated by contrary data from other groups can be made accurately only because we have the college sophomore data. The worst case, a failure to replicate, will mean that theories developed on the basis of college sophomore data are not necessarily wrong but merely incomplete.
2. In many areas of psychology, the college sophomore issue is simply not a problem because the processes investigated are so basic (the visual system, for example) that virtually no one would believe that their fundamental organization depends on the demographics of the subject sample.
3. Replication of findings ensures a large degree of geographic generality and, to a lesser extent, generality across socioeconomic factors, family variables, and early educational experience. As opposed to studies conducted 50 years ago, when the sample of university subjects participating would have come from an extremely elite group, research now goes on in universities that serve populations from a great variety of backgrounds.

It would be remiss, however, not to admit that the college sophomore issue is a real problem in certain areas of research in psychology (Peterson, 2001). Nevertheless, psychologists are now making greater efforts to correct the problem. For example, developmental psychologists are almost inherently concerned about this issue. Each year hundreds of researchers in this area test dozens of findings and theories that were developed from studies of college subjects by performing the same research on subjects of different ages.

The results from subject groups of different ages do not always replicate those from college students. Developmental psychology would be starkly boring if they did. But this sizable group of psychologists is busy building an age component into psychological theories, demonstrating the importance of this factor, and ensuring that the discipline will not end up with a large theoretical superstructure founded on a thin database derived from college students.

Developmental psychologists also conduct cross-cultural research in order to assess the generality of the developmental processes uncovered by researchers working only with North American children. For example, Stevenson et al. (1985) gave a large battery of cognitive tasks to Chinese, Japanese, and American children and concluded, "The organization of cognitive abilities tapped in these tasks was very similar among the children in

the three cultures" (p. 727). Other comparisons of cognitive abilities across racial and cultural groups have shown the same thing (Demetriou et al., 2005; McBride-Chang & Kail, 2002). With regard to other psychological characteristics, there are many other instances in which cross-cultural comparisons have shown similar trends across cultures (e.g., Day & Rounds, 1998; Rozin, Lowery, Imada, & Haidt, 1999), but others where cross-cultural research does not replicate the trends displayed by American college sophomores (e.g., Nisbett, 2003). However, when these discrepancies occur, they provide important information about the contextual dependence of theories and outcomes (Chang, 1996; Henrich et al., 2004; Medin & Atran, 2004; Nisbett, 2003; Yates, Lee, & Shinotsuka, 1996).

As previously mentioned, findings in cognitive psychology have met the basic test of replicability. Many of the fundamental laws of information processing have been observed in dozens of laboratories all over the world. It is not often realized that if a psychologist at the University of Michigan obtains a finding of true importance, similar experiments will soon be attempted at Stanford, Minnesota, Ohio State, Cambridge, Yale, Toronto, and elsewhere. Through this testing, we will soon know whether the finding is due to the peculiarities of the Michigan subjects or the study's experimental setting.

Educational psychologists have also addressed the college sophomore problem. For example, in conjunction with developmental psychologists and other educational researchers, educational psychologists have constructed measures of basic cognitive skills that predict future educational achievements, such as the rate of reading acquisition, with a moderate degree of accuracy. The predictive accuracy of these measures has been shown to be very similar for children of different socioeconomic status and race and from different geographic regions and school districts.

The college sophomore problem and criticisms of representativeness are most often aimed at social psychology, which makes frequent use of college subjects in laboratory paradigms in an attempt to develop theories of social interaction, group behavior, and information processing in social situations (Kunda, 1999). However, even in this area of psychology, evidence has indicated that the laboratory-derived relationships and theories do in fact predict behavior in a variety of other situations involving different types of individuals.

For example, several years ago, Leonard Berkowitz, a psychologist at the University of Wisconsin, demonstrated the so-called weapons effect—the fact that the mere presence of a weapon in a person's environment increases the probability of an aggressive response. This finding originated in the laboratory and is a perfect example of an unrepresentative situation. The results were strongly criticized as misleading because they were products of a contrived situation. Yet the fact remains that the finding has been replicated in experiments using different measures of aggression, has been obtained in Europe as well as the United States, has been found to hold for children as well as adults, and has been found outside the laboratory in field studies in which the subjects did not know they were part of an experiment (Berkowitz & Donnerstein, 1982; Turner, Simons, Berkowitz, & Frodi, 1977). Researchers have even isolated the cognitive mechanism behind the weapons effect. It is a process of automatic priming in semantic memory (see Anderson, Benjamin, & Bartholow, 1998). The effect is so encompassing that it led Anderson et al. (1998) to title their article "Does the Gun Pull the Trigger?"

Cognitive, social, and clinical psychologists have also studied various human decision-making strategies. Most of the original studies in this research area were done in laboratories, used college students as subjects, and employed extremely artificial tasks. However, the principles of decision-making behavior derived from these studies have been observed in a variety of nonlaboratory situations, including the prediction of closing stock prices by bankers, actual casino betting, the prediction of patient behavior by psychiatrists, economic markets, military intelligence analysis, betting on NFL football games, the estimation of repair time by engineers, the estimation of house prices by realtors, business decision making, and diagnoses by physicians—and these principles are also now being applied in the very practical domain of personal financial counseling (Bazerman, 1999, 2001; Belsky & Gilovich, 1999; Goldstein & Hogarth, 1997; Hammond, 1996; Tassoni, 1996; Zweig, 2001, 2002).

Birnbaum (1999) has demonstrated that the Internet provides a way for psychology to deal with the college sophomore problem. He ran a series of decision-making experiments in the laboratory and by recruiting participants over the Internet. The laboratory findings all replicated on the Internet sample even though the latter was vastly more diverse—including 1,224 participants from 44 different countries (see also Jaffe, 2005; McGraw, Tew, & Williams, 2000). Gosling et al. (2004) studied a large Internet sample of participants (361,703 people) and compared them with the participants in 510 traditional samples in published studies. They found that the Internet sample was more diverse with respect to gender, socioeconomic status, geographic region, and age. Importantly, they found that findings in many areas of psychology, such as personality theory, were similar on the Internet when compared to traditional methods.

These few examples illustrate that the degree of consistency and generality of the findings of psychological research is often underestimated (Cheng, 2001; Gage, 1996; Rosenthal, 1990). Anderson, Lindsay, and Bushman (1999) have reported the most systematic examination of the relation between experimental effects found in laboratory and field studies. Across a variety of studies examining diverse topics such as aggression, leadership, and depression, Anderson et al. (1999) found a high level of convergence—almost always the different research settings led to similar conclusions.

Of course, not all psychological findings replicate (see Carroll & Nelson, 1993). On the contrary, replication failures do happen, and they are often more

instructive than confirmations. However, in cognitive psychology, replication failures are rarely due to the peculiarities of the subjects. Instead, most are due to subtle differences in experimental stimuli and methods. By closely examining exactly what experimental conditions are necessary for the demonstration of a phenomenon, scientists come to a more precise understanding of the phenomenon and lay the foundation for a more precise theory about its occurrence.

But how can any psychological findings be applied if replication failures sometimes occur? How can applications be justified if knowledge and theories are not established with certainty, when there is not complete agreement among scientists on all the details? This particular worry about the application of psychological findings is common because people do not realize that findings and theories in other sciences are regularly applied before they are firmly established. Of course, Chapter 2 should have made it clear that all scientific theories are subject to revision. If we must have absolutely certain knowledge before we can apply the results of scientific investigations, then no applications will ever take place. Applied scientists in all fields do their best to use the most accurate information available, realizing at the same time that the information is fallible.

The Real-Life and College Sophomore Problems in Perspective

Several issues have been raised in this chapter, and it is important to be clear about what has, and what has not, been said. We have illustrated that the frequent complaint about the artificiality of psychological research arises from a basic misunderstanding not only of psychology but also of basic principles that govern all sciences. We have seen why people are concerned that psychologists do not use random samples in all their research and also why this worry is often unfounded. Finally, we have seen that a legitimate concern, the college sophomore problem, is sometimes overstated, particularly by those who are unfamiliar with the full range of activities and the diverse types of research that go on in psychology (see Chapter 1).

Nevertheless, psychologists should always be concerned that their experimental conclusions not rely too heavily on any one method or particular subject population. The next chapter deals with this very point. Indeed, some areas of psychology *are* plagued by a college sophomore problem (Jaffe, 2005; Peterson, 2001; Wintre, North, & Sugar, 2001). Cross-cultural psychology, an antidote to the college sophomore problem, is a very underdeveloped field. However, there is reason for optimism because self-criticism is valued highly by research psychologists (see Chapter 12; Anderson & Gunderson, 1991; Henriques, 2003, 2004, 2005; Jaffe, 2005; Kimble, 1999; Machado, Lourenço, & Silva, 2000; Proctor & Capaldi, 2001). In fact, there are many psychologists who are well known because they have made a career of criticizing the field

(Leary, 2001; Robinson, 2001). Not a year goes by without many articles in scientific journals warning psychologists of flaws in their methods and pointing out the college sophomore problem. The latter has been an issue of great concern within psychology, and no psychologist is unaware of it. So, although we should not ignore the issue, we must also keep it in perspective.

Summary

Some psychological research is applied work in which the goal is to relate the results of the study directly to a particular situation. In such applied research, in which the results are intended to be extrapolated directly to a naturalistic situation, questions of the randomness of the sample and the representativeness of the conditions are important because the findings of the study are going to be applied directly. However, most psychological research is not of this type. It is basic research designed to test theories of the underlying mechanisms that influence behavior. In most basic research, the findings are applied only indirectly through modifications in a theory that will at some later point be applied to some practical problem. In basic research of this type, random sampling of subjects and representative situations are not an issue because the emphasis is on testing the universal prediction of a theory. In fact, artificial situations are deliberately constructed in theory-testing basic research because (as described in the previous chapter) they help to isolate the critical variable for study and to control extraneous variables. Thus, the fact that psychology experiments are "not like real life" is a strength rather than a weakness.