Chapter IV

INTELLIGENCE, COGNITION, AND MEMORY

The branch of psychology most concerned with the topics in this section is called *cognitive psychology.* Cognitive psychologists study human mental processes. Our intelligence, our ability to think and reason, and our ability to store and retrieve symbolic representations of our experiences all combine to help make humans different from other animals. And, of course, these mental processes greatly affect our behavior. However, studying these processes is often more difficult than studying outward, observable behaviors, so a great deal of research creativity and ingenuity have been necessary.

The studies included here have changed the way psychologists view our internal mental behavior. The first article discusses the famous "Pygmalion study," which demonstrated that not only performance in school, but actual intelligence scores of children, can be influenced by the expectations of others, such as teachers. The second reading discusses a body of work that has transformed how we define human intelligence. In the early 1980s Howard Gardner proposed that humans do not possess one general intelligence but rather at least seven distinct intelligences. His idea has become widely known as *Multiple Intelligence (MI) Theory.* Third, we encounter an early groundbreaking study in cognitive psychology that examined how animals and humans form *cognitive maps,* which are their mental images of the environment around them. Fourth, you will read about research that revealed how our memories are not nearly as accurate as we think they are, as well as the implications of this for eyewitness testimony in court and in psychotherapy.

Reading 13: WHAT YOU EXPECT IS WHAT YOU GET

Rosenthal, R., & Jacobson, L. (1966). Teachers' expectancies: Determinates of pupils' IQ gains. *Psychological Reports, 19,* 115–118.

We are all familiar with the idea of the self-fulfilling prophecy. One way of describing this concept is that if we *expect* something to happen in a certain way,

our expectation will tend to make it so. Whether self-fulfilling prophecies really do occur in a predictable way in everyday life is open to scientific study, but psychological research has demonstrated that in some areas they are a reality.

The question of the self-fulfilling prophecy in scientific research was first brought to the attention of psychologists in 1911 in the famous case of "Clever Hans," a horse owned by Wilhelm von Osten (Pfungst, 1911). Clever Hans was famous for, ostensibly, being able to read, spell, and solve math problems by stomping out answers with his front hoof. Naturally, many people were skeptical, but when Hans's abilities were tested by a committee of experts at the time, they were found to be genuinely performed without prompting from von Osten. But how could any horse (except possibly Mr. Ed of 1960s TV comedy fame) possess such a degree of human intelligence? A psychologist in the early 1900s, Oskar Pfungst, performed a series of careful experiments and found that Hans was actually solving the problems but was receiving subtle, unintentional cues from his questioners. For example, after asking a question, people would look down at the horse's hoof for the answer. As the horse approached the correct number of hoofbeats, the questioners would raise their eyes or head very slightly in anticipation of the horse's completing its answer. The horse had been conditioned to use these subtle movements from the observers as signs to stop stomping, and this usually resulted in the correct answer to the question.

You might ask, how is a trick horse related to psychological research? The Clever Hans findings pointed out the possibility that observers often have specific expectations or biases that may cause them to telegraph unintentional signals to a participant being studied. These signals, then, may cause the participant to respond in ways that are consistent with the observers' bias and, consequently, confirm their expectations. What all this finally boils down to is that an experimenter may *think* a certain behavior results from his or her scientific treatment of one participant or one group of participants compared with another. Sometimes, though, the behavior may result from nothing more than the experimenter's own biased expectations. If this occurs, it renders the experiment invalid. This threat to the validity of a psychological experiment is called the *experimenter expectancy effect.*

Robert Rosenthal, a leading researcher on this methodological issue, demonstrated the experimenter expectancy effect in laboratory psychological experiments. In one study (Rosenthal & Fode, 1963), psychology students in a course about learning and conditioning unknowingly became participants themselves. Some of the students were told they would be working with rats that had been specially bred for high intelligence, as measured by their ability to learn mazes quickly. The rest of the students were told that they would be working with rats bred for dullness in learning mazes. The students then proceeded to condition their rats to perform various skills, including maze learning. The students who had been assigned the maze-bright rats recorded significantly faster learning times than those reported by the students with the maze-dull rats. In reality, the rats given to the students were standard lab rats and were randomly assigned. These students were not cheating or purpose-

fully slanting their results. The influences they exerted on their animals were apparently unintentional and unconscious.

As a result of this and other related research, the threat of experimenter expectancies to scientific research has been well established. Properly trained researchers, using careful procedures (such as the double-blind method, in which the experimenters who come in contact with the participants are unaware of the hypotheses of the study) are usually able to avoid most of these expectancy effects.

Beyond this, however, Rosenthal was concerned about how such biases and expectancies might occur outside the laboratory, such as in school classrooms. Because teachers in public schools may not have had the opportunity to learn about the dangers of expectancies, how great an influence might this tendency have on their students' potential performance? After all, in the past, teachers have been aware of students' IQ scores beginning in first grade. Could this information set up biased expectancies in the teachers' minds and cause them to unintentionally treat "bright" students (as judged by high intelligence scores) differently from those seen as less bright? And if so, is this fair? Those questions formed the basis of Rosenthal and Jacobson's study.

THEORETICAL PROPOSITIONS

Rosenthal labeled this expectancy effect, as it occurs in natural interpersonal settings outside the laboratory, the *Pygmalion effect.* In the Greek myth, a sculptor (Pygmalion) falls in love with his sculpted creation of a woman. Most people are more familiar with the modern George Bernard Shaw play *Pygmalion* (*My Fair Lady* is the musical version) about the blossoming of Eliza Doolittle because of the teaching, encouragement, and *expectations* of Henry Higgins. Rosenthal suspected that when an elementary school teacher is provided with information that creates certain expectancies about students' potential (such as intelligence scores), whether strong or weak, the teacher might unknowingly behave in ways that subtly encourage or facilitate the performance of the students seen as more likely to succeed. This, in turn, would create the self-fulfilling prophecy of actually causing those students to excel, perhaps at the expense of the students for whom lower expectations exist. To test these theoretical propositions, Rosenthal and his colleague Jacobson obtained the assistance of an elementary school (called Oak School) in a predominantly lower middle-class neighborhood in a large town.

METHOD

With the cooperation of the Oak School administration, all the students in Grades 1 through 6 were given an intelligence test (the Tests of General Ability, or TOGA) near the beginning of the academic year. This test was chosen because it was a nonverbal test for which a student's score did not depend primarily upon school-learned skills of reading, writing, and arithmetic. Also, it was a test with which the teachers in Oak School probably would not be familiar.

The teachers were told that the students were being given the "Harvard Test of Inflected Acquisition." This deception was important in this case to create expectancies in the minds of the teachers, a necessary ingredient for the experiment to be successful. It was further explained to the teachers that the Harvard Test was designed to serve as a predictor of academic *blooming* or *spurting*. In other words, teachers believed that students who scored high on the test were ready to enter a period of increased learning abilities within the next year. This predictive ability of the test was also, in fact, not true.

Oak School offered three classes each of Grades 1 through 6. All of the 18 teachers (16 women, 2 men) for these classes were given a list of names of students in their classes who had scored in the top 20% on the Harvard Test and were, therefore, identified as potential academic bloomers during the academic year. But here's the key to this study: the children on the teachers' top 10 lists had been assigned to this experimental condition purely at random. The only difference between these children and the others (the controls) was that they had been identified to their teachers as the ones who would show unusual intellectual gains.

Near the end of the school year, all children at the school were measured again with the same test (the TOGA), and the degree of change in IQ was calculated for each child. The differences in IQ changes between the experimental group and the controls could then be examined to see if the expectancy effect had been created in a real-world setting.

RESULTS

Figure 13-1 summarizes the results of the comparisons of the IQ increases for the experimental versus the control groups. For the entire school, the children for whom the teachers had expected greater intellectual growth averaged significantly greater improvement than did the control children (12.2 and

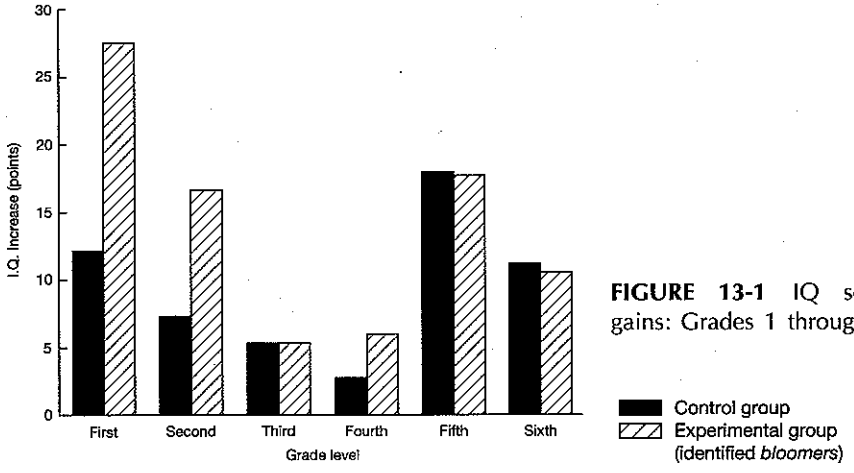

FIGURE 13-1 IQ score gains: Grades 1 through 6.

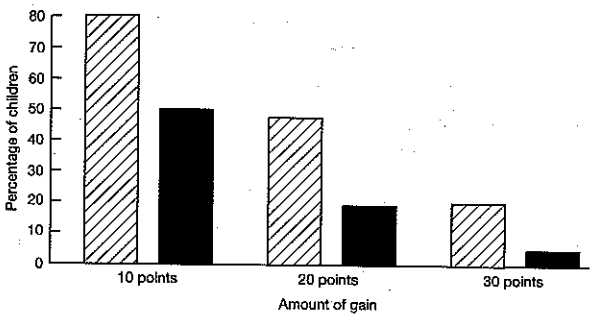

FIGURE 13-2 Percentage of 1st- and 2nd-grade students with major gains in IQ scores.

8.2 points, respectively). However, if you examine Figure 13-1, it is clear that this difference was accounted for by the huge differences in Grades 1 and 2. Possible reasons for this are discussed shortly. Rosenthal and Jacobson offered another useful and revealing way to organize the data for these 1st- and 2nd-grade students. Figure 13-2 illustrates the percentage of the children in each group who obtained increases in IQ of at least 10, 20, or 30 points.

Two major findings emerged from this study. First, the expectancy effect previously demonstrated in laboratory settings also appeared to function in less experimental, real-world situations. Second, the effect was very strong in the early grades, yet almost nonexistent for the older children. What does all this mean?

DISCUSSION

As Rosenthal suspected from his past research, the teachers' expectations of their students' behavior became a self-fulfilling prophecy. "When teachers expected that certain children would show greater intellectual development, those children did show greater intellectual development" (Rosenthal & Jacobson, 1968, p. 85). Remember, the data are averages of three classes and three teachers for each grade level. It is difficult to think of explanations for the differences in IQ gains other than the teachers' expectations.

However, Rosenthal felt it was important to try to explain why the self-fulfilling prophecy was not demonstrated in the higher grade levels. Both in this article and in later writings, Rosenthal and Jacobson offered several possible reasons for their findings:

1. Younger children are generally thought of as more malleable or "transformable." If this is true, then the younger children in the study may have experienced greater change simply because they were easier than the older children to change. Related to this is the possibility that even if younger children are not more malleable, teachers may have *believed* that they were. This belief alone may have been enough to create differential treatment and produce the results.
2. Younger students in an elementary school tend to have less well-established reputations. In other words, if the teachers had not yet had a chance to

form an opinion of a child's abilities, the expectancies created by the researchers could have carried more weight.

3. Younger children may be more easily influenced by and more susceptible to the subtle and unintentional processes that teachers use to communicate performance expectations to them:

> Under this interpretation, it is possible that teachers react to children of all grade levels in the same way if they believe them to be capable of intellectual gain. But perhaps it is only the younger children whose performance is affected by the special things the teacher says to them; the special ways in which she says them; the way she looks, postures, and touches the children from whom she expects greater intellectual growth. (p. 83)

4. Teachers in lower grades may differ from upper-grade teachers in ways that produce greater communication of their expectations to the children. Rosenthal and Jacobson did not speculate as to exactly what these differences might be if indeed they exist.

SIGNIFICANCE OF FINDINGS AND SUBSEQUENT RESEARCH

The real importance of Rosenthal and Jacobson's findings at Oak School relates to the potential long-lasting effects of teachers' expectations on the scholastic performance of students. This, in turn, feeds directly into one of the most controversial topics in psychology's recent history: the question of the fairness of intelligence testing. Let's explore some later research that examined the specific ways in which teachers may unconsciously communicate their higher expectations to those students whom they believe possess greater potential.

A study conducted by Chaiken, Sigler, and Derlega (1974) involved videotaping teacher–student interactions in a classroom situation in which the teachers had been informed that certain children were extremely bright (these "bright" students had actually been chosen at random from all the students in the class). Careful examination of the videos indicated that teachers favored the identified "brighter" students in many subtle ways. They smiled at these students more often, made more eye contact, and had more favorable reactions to these students' comments in class. These researchers go on to report that students for whom these high expectations exist are more likely to enjoy school, receive more constructive comments from teachers on their mistakes, and work harder to try to improve. What this and other studies indicate is that teacher expectancies can affect more than just intelligence scores.

Imagine for a moment that you are an elementary school teacher with a class of 20 students. On the first day of class, you receive a class roster on which is printed the IQ scores for all your students. You notice that five of your pupils have IQ scores over 145, well into the genius range. Do you think that your treatment and expectations of those children during the school year would be the same as of your other students? What about your expectations of those students compared with another five students with IQ scores in the low-to-normal range? If you answered that your treatment and expectations would

be the same, Rosenthal would probably be willing to bet that you'd be wrong. As a matter of fact, they probably *shouldn't* be the same! The point is, if your expectations became self-fulfilling prophecies, then that could be unfair to some of the students. Now consider another, more crucial point. Suppose the intelligence scores you received on your class roster were *wrong*. If these erroneous scores created expectations that benefited some students over others, it would clearly be unfair and probably unethical. This is one of the major issues fueling the intelligence testing controversy.

In recent decades, researchers have charged that many standard tests used to assess the intelligence of children contain a racial or cultural bias. The argument is that because the tests were originally designed primarily by white, upper-middle-class males, they contain ideas and information to which other ethnic groups are less exposed. Children from some ethnic minority groups in the United States have traditionally scored lower on these tests than white children. It would be ridiculous to assume that these nonwhite children possess less overall basic intelligence than white children, so the reason for these differences in scores must lie in the tests themselves. Traditionally, however, teachers in Grades K through 12 were given this intelligence information on all their students. If you stop and think about this fact in relation to the research by Rosenthal and Jacobson, you'll see what a potentially precarious situation may have been created. In addition to the fact that children have been categorized and stratified in schools according to their test scores, teachers' unintended expectations, based on this possibly biased information, may have been creating systemic, unfair self-fulfilling prophecies. The arguments supporting this idea are convincing enough that many school districts have instituted a moratorium on routine intelligence testing and the use of intelligence test scores until new tests are developed (or old ones updated) to be valid and bias free. At the core of these arguments is the research addressed in this chapter.

RECENT APPLICATIONS

Due in large part to Rosenthal and Jacobson's research, the power of teachers' expectations on students' performance has become an integral part of our understanding of the educational process. Furthermore, Rosenthal's theory of interpersonal expectancies has exerted its influence in numerous areas other than education. In 2002, Rosenthal himself reviewed the literature on expectancy effects using meta-analysis techniques (explained in the reading on Smith and Glass in Chapter IX). He demonstrated how "the expectations of psychological researchers, classroom teachers, judges in the courtroom, business executives, and health care providers can unintentionally affect the responses of their research participants, pupils, jurors, employees, and patients" (Rosenthal, 2002, p. 839).

An uncomfortably revealing article incorporating Rosenthal's expectancy research examined the criteria school teachers use to refer their students to school psychologists for assessment and counseling (Andrews, et al,

1997). The researchers found that teachers referred African American children for developmental handicap assessment at rates significantly higher than the rates of Caucasian students in their classrooms. In addition, boys were referred in equally disproportionate numbers over girls for problems of classroom and playground behavior problems. The researchers suggested that the differences among the various student groups may have revealed more about teachers' expectancies than real individual differences.

It should be noted that researchers in the fields of psychology and education are actively studying new ways of conceptualizing and measuring children's intellectual abilities. Several leading researchers have proposed methods of testing that focus on current theories of how the human brain works, and that go far beyond the old, limited idea of a single, general intelligence score expressed as IQ (see Benson, 2003). One of these modern approaches is Robert Sternberg's Triarchic Abilities Test (1993), which is designed to measure three distinct aspects of intellectual ability: analytic intelligence, practical intelligence, and creative intelligence. Another leading researcher in the field of intelligence is Howard Gardner, who, in the early 1980s, developed his theory of multiple intelligences, which continues today to exert a powerful influence over the study and measurement of intelligence. As you will discover in the next reading, Gardner's theory contends that we have not one, or three, but eight (and, perhaps nine or more!) *separate* intelligences, and each of us has differing amounts of each one (Gardner, 2006).

Andrews, T., Wisniewski, J., & Mulick, J. (1997). Variables influencing teachers' decisions to refer children for school psychological assessment services. *Psychology in Schools, 34*(3), 239–244.

Benson, E. (2003). Intelligent intelligence testing: Psychologists are broadening the concept of intelligence and how to test it [Electronic version]. *Monitor on Psychology, 34*(2), 48.

Chaiken, A., Sigler, E., & Derlega, V. (1974). Nonverbal mediators of teacher expectancy effects. *Journal of Personality and Social Psychology, 30,* 144–149.

Gardner, H. (2006). *Multiple intelligences: New horizons.* Jackson, TN: Perseus Books Group.

Pfungst, O. (1911). *Clever Hans (the horse of Mr. von Osten): A contribution to experimental, animal, and human psychology.* New York: Holt, Rinehart and Winston.

Rosenthal, R. (2002). Covert communication in classrooms, clinics, courtrooms, and cubicles. *American Psychologist, 57,* 839–849.

Rosenthal, R., & Fode, K. (1963). The effect of experimenter bias on the performance of the albino rat. *Behavioral Science, 8,* 183–189.

Rosenthal, R., & Jacobson, L. (1968). *Pygmalion in the classroom: Teacher expectations and pupils' intellectual development.* New York: Holt, Rinehart and Winston.

Sternberg, R. J. (1993). *Sternberg Triarchic Abilities Test.* Unpublished test, Yale University.

Reading 14: JUST *HOW* ARE YOU INTELLIGENT?

Gardner, H. (1983) *Frames of mind: The theory of multiple intelligences.* New York: Basic Books.

The heading for this chapter is an intentional play on words. The usual form of the question "Just how intelligent *are* you?" implies that you have a certain amount of intelligence. The question here, "Just *how* are you intelligent?" is unrelated to *amount* of overall intelligence and asks instead about the nature

of your particular *type* of intelligence. This implies, of course that people are not simply more or less intelligent but that each of us possesses a unique combination of various forms of intellectual abilities.

Many, if not most, of you probably have taken at least one intelligence test in your life (even if you don't remember it), and some of you may have taken several. For the most part, intelligence tests developed over the past hundred years have been designed to produce a single score. That score was called your *Intelligence Quotient* (IQ). If tests of intelligence are designed to produce a single score, a person's intelligence must also be conceptualized as a single, *general* mental ability. That is exactly how intelligence was interpreted throughout most of the 20th century. In fact, intelligence was often referred to as *g* for this general mental ability. People's IQ score, their *g*, was used widely to place, judge, categorize, and describe people in various life settings, including school, the workplace, and the military.

In the 1970s and 1980s, researchers began to question the validity of the unitary, g-theory approach to human intelligence. Many of the IQ tests themselves were shown to be biased toward certain economic classes and cultural groups. Moreover, children's educational opportunities were often dictated by their scores on these biased and potentially invalid scores (see the work of Robert Rosenthal in Reading 13 for an example of the dangers of this bias).

As criticisms of the early conceptualization of intelligence grew in number and influence, IQ tests began fade. At the same time, a new, and at the time radically different, view of intelligence was making its way into scientific and popular thinking about how our minds work. In stark contrast to the notion of a single, generalized intelligence, this emerging approach expanded the notion of intelligence into many *different* mental abilities, each possessing in itself the characteristics of a complete, "free-standing" intelligence. Howard Gardner, at Harvard University, introduced to the world this new view of *multiple intelligences* in his 1983 book *Frames of Mind,* which forms the basis of this chapter.

THEORETICAL PROPOSITIONS

Gardner's theory of multiple intelligences (*MI Theory*) was based on much more than simply observing the various, diverse mental skills people can demonstrate. His ideas stem from his research on the structure of the brain itself. Prior to launching his work on intelligence per se, Gardner had spent most of his career studying the biology and functioning of the brain. Gardner expanded on previous research that demonstrated that the human brain is not only diverse in its abilities but also extremely specialized in its functioning. In other words, different regions of your brain have evolved to carry out specific tasks related to thinking and knowing. This brain specialization may be demonstrated by observing, as Gardner has done, exactly what abilities are lost or diminished when a person experiences damage to a particular region of the brain. For example, language abilities reside in most people primarily in one section of the brain's left hemisphere, vision is centered in the occipital cortex at the rear of the brain, and one specific brain structure located at

the base of the visual cortex is responsible for your ability to recognize and discriminate among human faces (see Reading 1 on Michael Gazzaniga's split-brain research for more about brain specialization).

Carrying the theory of brain specialization a step further, Gardner contends that different parts of the human brain are responsible for different aspects of intelligence or, more correctly, different intelligences altogether. To defend scientifically his theory of multiple intelligences, Gardner drew upon evidence from many sources and developed criteria for defining a certain set of abilities as a unique intelligence. Gardner described his sources of data as follows:

> In formulating my brief on multiple intelligences, I have reviewed evidence from a large and hitherto unrelated group of sources: studies of prodigies, gifted individuals, brain-damaged patients, *idiot-savants* [a rare form of mental retardation or autism accompanied by extraordinary talent or ability in one or two mental areas], normal children, normal adults, experts in different lines of work, and individuals from diverse cultures. (p. 9)

METHOD

Incorporating information from all these sources, Gardner then developed a set of eight indicators or "signs" that define an intelligence. Any intellectual ability, or set of abilities, must map onto most of these criteria, if it is to be considered a separate, autonomous intelligence:

1. *Potential isolation of the intelligence by brain damage.* Gardner contended that if a specific mental ability can be destroyed through brain damage (such as injury or stroke), or if it remains relatively intact when other abilities have been destroyed, this provides convincing evidence that the ability may be a separate intelligence unto itself.
2. *The existence of savants, prodigies, and other exceptional individuals relating to the intelligence.* You may be aware that certain individuals possess an extreme level of intellectual skill in one particular ability. Some mentally retarded and autistic people demonstrate "strokes of genius," and some people with normal intelligence are *prodigies,* with abilities far beyond others of their age or experience. Gardner believes that the exceptional skills of these individuals lend significant support for considering an ability as a separate intelligence.
3. *A clear set of information-processing (thinking) operations linked to the intelligence.* This refers to mental abilities that are specific to the ability under consideration. To qualify as an intelligence, an ability must involve a specific set of mental processes, which Gardner calls *core operations,* that exist in specific areas of the brain and are triggered by certain kinds of information. Table 14-1 lists the core operations for the various intelligences proposed by Gardner.
4. *A distinctive developmental history of the intelligence and the potential to reach high levels of expertise.* Gardner believes that an intelligence must include

TABLE 14-1 Core Operations and Well-Known Individual Examples of Gardner's Eight Intelligences

INTELLIGENCE	CORE OPERATIONS	FAMOUS EXAMPLES
Linguistic	Syntax (word phrasing), phonology (the sounds of speech), semantics (the meaning of words), pragmatics (word usage)	Shakespeare, J. K. Rowling, Dr. Seuss, Woody Allen
Musical	Pitch (frequency of sounds), rhythm, timbre (quality of sounds)	Mozart, Gwen Stefani, Andrea Boccelli, Paul Simon
Logical-mathematical	Numbers, quantities, categorization, causal relations	Albert Einstein, Carl Sagan, Marie Curie, B. F. Skinner
Spatial	Accurate visualization, mental rotation and transformation of images	Picasso, Frank Lloyd Wright, Leonardo da Vinci, Vincent van Gogh
Bodily-kinesthetic	Control of one's own body, control in handling objects	Charlie Chaplin, LeBron James, Serena Williams and Venus Williams
Interpersonal	Awareness of others' feelings, emotions, goals, motivations	Mohandas Gandhi, Abraham Maslow, Oprah Winfrey
Intrapersonal	Awareness of one's own feelings, emotions, goals, motivations	Plato, Hermann Rorschach, Helen Keller
Naturalist	Recognition and classification of objects in the environment; sensitivity to the natural world	Charles Darwin, Jane Goodall, Rachel Carson
Existential*	Ability to engage in transcendental concerns, such as the fundamentals of human existence, the significance of life, and the meaning of death	Elie Wiesel, Martin Luther King, Jr., Carl Rogers, Elizabeth Kübler-Ross

*proposed

a developmental path that starts with simple and basic steps and progresses through incremental milestones of increased skill levels.

5. *Evidence that the intelligence has developed through evolutionary time.* Human intelligence has evolved over millions of years as one of many adaptive mechanisms that have allowed us to survive as a species. If a particular set of abilities is to be defined as an intelligence, Gardner believes the skills involved should show evidence of evolutionary development, based on cross-cultural research and observations of similar types of abilities in nonhuman animals (such as the "mental maps" in the rats in Tolman's research discussed in Reading 15.).
6. *Ability to study the intelligence with psychological experiments.* Gardner maintains that any ability proposed as an intelligence be confirmed using solid experimental techniques to be considered an intelligence. An example of this might be an experiment to determine a person's speed and accuracy

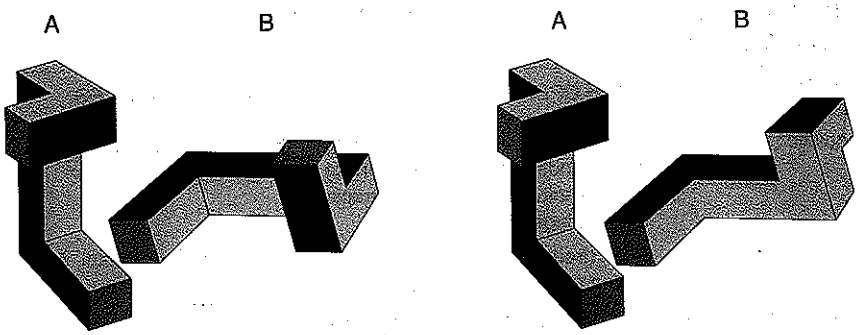

FIGURE 14-1 Example of Mental Rotation Task to Assess Spatial Intelligence. Are the two figures in each set the same or different?

in a *mental rotation task* as a sign of spatial relationships skills. Figure 14-1 contains a demonstration of this task. How fast can you figure it out?

7. *Ability to measure the intelligence with existing standardized tests.* Here, Gardner acknowledges the potential value of IQ and other intelligence tests of the past. However, the value he sees is not in the tests' ability to produce a single intelligence score but in the fact that some of the tests contain various subscales that may, in fact, measure different intelligences.
8. *Aspects of the intelligence may be represented by a system of symbols.* Gardner proposes that any human intelligence should incorporate a system of symbols. The most obvious of these, of course, are human language and math. Other examples of symbol systems include notation for musical ability and pictures for spatial skills.

In the next section we look at a summary of the intelligences Gardner proposed as part of his original theory in his 1983 book. Each intelligence included was analyzed using his eight criteria. If an intellectual ability failed to meet most of the criteria, it was rejected. Through this process of elimination, Gardner originally suggested seven distinct human intelligences, later added an eighth, and has recently proposed a ninth.

RESULTS

Gardner discussed each of his original seven intelligences in detail in his 1983 book. Here, you will find brief descriptions of each intelligence, along with a quote from Gardner, to give you the "flavor" of the abilities described. In addition, Table 14-1 summarizes the core operations of each intelligence and provides examples of several well-known individuals who would be likely to scoring high on the abilities that comprise each intelligence. Although Gardner does not endorse any single test for measuring multiple intelligences, many have been developed. You can try some of these online simply by searching for "tests of multiple intelligence," but keep in mind that a great deal of material on the Internet is of questionable validity.

Linguistic Intelligence. If you are strong in linguistic intelligence, you are able to use words in ways that are more skillful, useful, and creative than the average person. You are able to use language to convince others of your position; you can memorize and recall detailed or complex information; you are better than most at explaining and teaching concepts and ideas to others; and you enjoy using language to talk about language itself. Gardner suggested that talented poets are good examples of individuals possessing strong linguistic intelligence:

> In the poet's struggles over the wording of a line or stanza, one sees at work some central aspects of linguistic intelligence. The poet must be superlatively sensitive to the shades of meanings of words and must try to preserve as many of the sought-after meanings as possible. . . . A sensitivity to the order among words, the capacity to follow the rules of grammar, and, on carefully selected occasions, to violate them. At a somewhat more sensory level—a sensitivity to the sounds, rhythms, inflections, and meters of words—that ability to make poetry even in a foreign tongue beautiful to hear. (pp. 77–78)

Musical Intelligence. You are probably already guessing some of the components of musical intelligence: gifted abilities involving sound, especially pitch, timbre, and rhythm. Gardner claimed that this is the earliest of all intelligences to emerge. Musical child prodigies serve as examples of individuals who are "musical geniuses." Gardner points to the musical composer to illustrate musical intelligence:

> [A] composer can be readily identified by the facts that he constantly has "tones in his head"—that is, he is always, somewhere near the surface of consciousness, hearing tones, rhythms, and larger musical patterns. (p. 101)

Logical-Mathematical Intelligence. This intelligence enables you to think about, analyze, and compute various relationships among abstract objects, concepts, and ideas. High levels of this intelligence may be found among mathematicians, scientists, and philosophers, but they may also be present in those individuals who are obsessed with sports statistics, design computer code, or develop algorithms as a hobby:

> What characterizes [this] individual is a love of dealing with abstraction. . . . The mathematician must be absolutely rigorous and perennially skeptical: no fact can be accepted unless it has been proved rigorously by steps that are derived from universally accepted first principles. . . . One obvious source of delight attends the solution of a problem that has long been considered insoluble. (pp. 138–141)

Spatial Intelligence. You would score well in spatial intelligence if you are skilled in creating, visualizing, and manipulating mental images. These are abilities that come naturally and easily to those in various visually oriented professions or avocations, such as artists, sculptors, interior decorators, engineers, and architects. To be more specific, Gardner explained that spatial intelligence entails:

> The ability to recognize instances of the same element; the ability to transform or to recognize a transformation of one element into another; the capacity to

> conjure up mental imagery and then to transform that imagery; the capacity to produce a graphic likeness of spatial information; and the like. (p. 176)

The object rotation task in Figure 14-1 is an example of a skill with which someone strong in spatial intelligence would have very little difficulty.

Bodily Kinesthetic Intelligence. These abilities also might be called "physical intelligence." If you possess strong bodily kinesthetic intelligence, you are very aware of your own body and bodily movements and are skilled in using and controlling your body to achieve various goals or effects. As you might imagine, dancers, athletes, surgeons, potters, and many actors possess a high degree of bodily intelligence. Gardner goes on to explain:

> Characteristic of such an intelligence is the ability to use one's body in highly differentiated and skilled ways, for expressive as well as goal-directed purposes. . . . Characteristic as well is the capacity to work skillfully with objects, both those that involve fine motor movements of one's fingers and hands and those that exploit gross motor movements of the body. (pp. 206–207)

The next two intelligences Gardner proposes, although separate, fall into a single category that Gardner called the *personal intelligences.* One type of personal intelligence is focused inward, while the other is focused outward. He referred to these as *intrapersonal intelligence* and *interpersonal intelligence,* respectively.

Intrapersonal Intelligence. How well do you "know *yourself*"? Gardner proposed that the ability to be aware of and understand who you are, your emotions, your motivations, and the sources of your actions exist in varying degrees among humans. Gardner describes intrapersonal intelligence as follows:

> The core capacity here is *access to one's own feeling life*—one's range of emotions: the capacity instantly to effect discriminations among these feelings and, eventually, to label them, to enmesh them in symbolic codes, to draw upon them as a means of understanding and guiding one's behavior. (p. 239)

Interpersonal Intelligence. This intelligence is contrasted with intrapersonal intelligence by asking "How well do you know *others*?" Interpersonal intelligence involves skills similar to those of intrapersonal intelligence, but they are outward directed—focused on the feelings, motivations, desires, and behaviors of other people:

> The core capacity here is the ability to notice and make distinctions among other individuals and, in particular, among their moods, temperaments, motivations, and intentions. In an advanced form, interpersonal knowledge permits a skilled adult to read the intentions and desires—even when these have been hidden—of many other individuals and, potentially to act upon this knowledge. (p. 239)

These, then, are the seven sets of abilities that comprised Gardner's original conceptualization of multiple intelligences. He states very clearly in *Frames of Mind* that these formed a working, and somewhat preliminary, list and that through further study and research other intelligences might be

added or a convincing argument might be made to remove one or more of the original seven. What has happened over the years is that these seven intelligences have maintained their positions in the theory, and, as discussed shortly, Gardner has added an eighth (and perhaps a ninth) intelligence.

SUBSEQUENT RESEARCH AND CRITICISMS

Gardner's MI Theory was immediately seized upon by educators, parents, and society in general as proof of a belief they had always held: *people are smart in different ways.* Finally, here was an explanation for those children (and adults, too) who performed poorly on tests and in some subjects in school but were clearly exceptionally bright in other ways.

MI Theory mapped well onto growing concerns and research about learning disabilities and was largely responsible for the reformulation in education of "learning disabilities" into "learning differences." Indeed, MI Theory has exercised its greatest influence in the area of education, and Gardner's research following the publication of *Frames of Mind* focused on applying his ideas to enhancing the educational process for children and adults.

As Gardner was revisiting his original theory 10 years after its original publication, he considered the possibility of other sets of abilities that might qualify as intelligences. Several candidates had been suggested to him by colleagues in various fields, such as a "spiritual intelligence," a "sexual intelligence," and a "digital intelligence" (Gardner, 2003). Although Gardner concedes that selecting a certain set of skills that qualify as an intelligence is open to subjective interpretations, he believed that these and many other suggestions did not meet his eight criteria adequately to qualify as new intelligences. Gardner did, however, find an additional set of abilities that he felt clearly met the criteria for an intelligence. Gardner was asked by a colleague to describe the abilities of history's most influential biologists, and when he attempted to do so he realized that none of the other seven intelligences fit those individuals very well. This sparked the addition of an eighth ability that he called, *naturalist intelligence.* Gardner explains:

> The naturalist intelligence refers to the ability to recognize and classify plants, minerals, and animals, including rocks and grass and all variety of flora and fauna. Darwin is probably the most famous example of a naturalist because he saw so deeply into the nature of living things. (quoted in Checkley, 1997)

Currently, the eight intelligences discussed here comprise Gardner's MI Theory. But Gardner is not yet finished with his theory. He sees the notion of multiple intelligences as fluid: always open to new, clearly defined sets of abilities. One skill he has suggested that might fit his criteria for an intelligence fairly well is *existential intelligence.* Because existential intelligence appears to be nearing the threshold for inclusion in MI Theory, it has been included here in Table 14-1. Gardner describes existential intelligence as follows:

> This candidate for intelligence is based on the human proclivity to ponder the most fundamental questions of existence. Why do we live? Why do we die? Where do we come from? What is going to happen to us? What is love? Why do

> we make war? I sometime say that these are questions that transcend perception; they concern issues that are too big or too small to be perceived by our five principle sensory systems. (Gardner, 2006, p. 20)

Since the 1983 release of *Frames of Mind,* Gardner has published numerous books and articles refining his theory and applying it in relevant settings. It is safe to say that MI Theory has been applied in educational settings, especially K–12, perhaps more than in any other learning or thinking environment. For example, only one year after the publication of *Frames of Mind,* a school district in Indianapolis began redesigning its curriculum completely around MI theory. Today virtually all schools in the United States and many other countries incorporate the theory to varying degrees.

Although MI Theory is an extremely popular approach to human intelligence and has found widespread support in various research and educational domains, it has certainly not gone uncriticized. New, influential theories that challenge long-standing views in any science are typically targets for intense controversy within the field. MI Theory has been no different. One common objection to MI Theory suggests that Gardner's eight intelligences are not really separate intelligences but rather merely describe different "thinking styles," all of which may be seen as existing within earlier unified intelligence (g) views discussed at the beginning of this reading (Morgan, 1996). Another criticism contends that the theory contains embedded contradictions that make it too ambiguous to be valid (Klein, 1998). Moreover, some contend, because of its ambiguity, that MI Theory can be molded "conveniently" to explain virtually any cognitive activity, rendering it impossible to prove or disprove. Moreover, some researchers have argued that not enough rigorous scientific research has been undertaken to demonstrate the validity of the intelligences and the effectiveness of applying MI Theory in real-world settings. These critics suggest—if future research finds that MI Theory is not a valid or effective tool—that a great deal of time and effort will have been wasted and that learning thought to have been taking place, in reality, was not (Collins, 1998). These and other criticisms notwithstanding, MI Theory continues to influence strongly the field of human intelligence.

RECENT APPLICATIONS

Hundreds of scientific articles and books that rest on Howard Gardner's Theory of Multiple Intelligences, and that cite his 1983 book, appear every year. Dr. Gardner's work in this area continues to have a powerful and widespread impact on research and thinking about learning and intelligence. To give you an idea of the diverse applications of MI Theory, following is a brief description of just two of these recent applications.

A cross-cultural study of Gardner's seven intelligences compared British and Iranian students' self-ratings and their ratings of their parents' levels of each of Gardner's intelligences (Furnham et al., 2002). Some of the most interesting findings were that (a) Iranian students rated themselves lower in

logical-mathematical intelligence but higher in spatial, musical, and intrapersonal intelligence than did the British students; (b) Iranians perceived their fathers' mathematical and spatial intelligence to be lower but their fathers' interpersonal and intrapersonal intelligence to be higher than did the British students; (c) the Iranian students rated their mothers' level of intelligence lower than did the British students on all but one (intrapersonal) of the seven intelligences; and (d) the Iranians rated their brothers higher than did the British students on all but one scale (mathematical).

Another fascinating study related Gardner's theory to Sandra Bem's research on androgyny (Bem's study is discussed in Reading 26). The authors found that people's estimates of their own intelligence was linked to their gender-identity (Rammstedt & Rammsayer, 2002). Researchers asked participants to estimate their own level on various intelligences and also to complete the *Bem Sex Role Inventory* to measure their level of masculinity, femininity, and androgyny. Not only were gender differences found for the logical-mathematical intelligence (masculine) versus musical intelligence (feminine), but also the males' degree of self-perceived masculinity, femininity, or androgyny significantly influenced their estimates of their own levels of various intelligences.

CONCLUSION

Gardner's MI Theory has survived over two decades and shows no signs of fading from view. Whether the ideas of the theory continue to grow in importance and influence or become overshadowed by new conceptualizations of intelligence remains to be seen. Whatever its future, however, one point is certain: MI Theory has changed forever how the world looks at learning, teaching, and intelligence. However, Gardner himself cautions that MI Theory is a means to an end and should not be seen as an end in itself:

> Educational goals should reflect one's own values, and these can never come simply or directly from a scientific theory. Once one reflects on one's educational values and states one's goals, however, then the putative existence of our multiple intelligences can prove very helpful. And, in particular, if one's educational goals encompass disciplinary understanding, then it is possible to mobilize our several intelligences to help achieve that lofty goal. . . . I have come to realize that once one releases an idea into the world, one cannot completely control its behavior—anymore than one can control those products of our genes called children. Put succinctly, MI has and will have a life of its own, over and above what I might wish for it, my most widely known intellectual offspring. (Gardner, 2002)

Checkley, K. (1997). The first seven . . . and the eighth. *Educational Leadership, 55,* 8–13.
Collins, J. (1998). Seven kinds of smart. *Time, 152,* 94–96.
Furnham, A., Shahidi, S., & Baluch, B. (2002). Sex and cultural differences in perceptions of estimated multiple intelligence for self and family: A British-Iranian comparison. *Journal of Cross Cultural Psychology, 33,* 270–285.
Gardner, H. (2003). Multiple intelligences after twenty years. Paper presented at the American Educational Research Association, Chicago, IL, April 21, 2003.

Gardner, H. (2006). *Multiple intelligences: New horizons.* Jackson, TN: Perseus Books Group.
Klein, P. (1998). A response to Howard Gardner: Falsifiability, empirical evidence, and pedagogical usefulness in educational psychologies. *Canadian Journal of Education, 23,* 103–112.
Morgan, H. (1996). An analysis of Gardner's theory of multiple intelligence. *Roeper Review, 18,* 263–269.
Rammstedt, B., & Rammsayer, T. (2002). Gender differences in self-estimated intelligence and their relation to gender-role orientation. *European Journal of Personality, 16,* 369–382.

Reading 15: MAPS IN YOUR MIND

Tolman, E. C. (1948). Cognitive maps in rats and men. *Psychological Review, 55,* 189–208.

Many of the studies in this book are included because the theoretical propositions underlying them and their findings contradicted the prevailing view and conventional wisdom of their time. Bouchard's revelations concerning genetic influences on personality (Reading 3), Hobson and McCarley's conceptualization of dreams (Reading 7),Watson's study of Little Albert (Reading 10), and Harlow's theory of infant attachment (Reading 17), among other research studies, all challenged the status quo of psychological thinking and thereby opened up new and often revolutionary interpretations of human behavior. Edward C. Tolman's theories and studies of learning and cognition made just such a contribution. During the years when psychology was consumed with strict stimulus-response learning theories that dismissed unobservable, internal mental activity as "unknowable," Tolman, at the University of California at Berkeley, was doing experiments demonstrating that complex internal cognitive activity could be studied in rats, not only in people, and that these mental processes could be studied without the necessity of observing them directly. Due to the significance of his work, Tolman is considered to be the founder of a school of thought within the field of learning psychology that is called *cognitive-behaviorism.*

To experience some of what Tolman proposed, imagine for a moment that you want to make your way from your present location to the nearest post office or video store. You probably already have an image in your mind of where these are located. Now think about the route you would take to get there. You know you have to take certain streets, make specific turns at the right intersections, and eventually enter the building. This picture in your mind of your present location relative to the post office or video store and the route you would follow to travel between them is called a *mental representation.* Tolman called these representations *cognitive maps.* Tolman maintained that not only do humans use cognitive maps, but other animals, including rats, think about their world in similar ways. Why does anyone care how a rat thinks? Well, if you were a learning theorist in the 1930s and 1940s, the main research method being used was rats in mazes; people were very interested in how they *learned.*

THEORETICAL PROPOSITIONS

In the first half of the 20th century, learning theorists were on the front lines of psychology. In addition to trying to explain the mechanisms involved in learning, they were invested in demonstrating the "respectability" of psychology as a true science. Because psychology had been emerging as a science, from its roots in philosophy, for only a few decades, many researchers felt that the best way to prove psychology's scientific potential was to emulate the so-called *hard* sciences, such as physics and chemistry. This notion led the learning theorists to propose that the only proper subjects for study were, as in physics and chemistry, observable, measurable events. In that light, a stimulus applied to an organism could be measured, and the organism's behavior in response to that stimulus could be measured. But they contended that what went on *inside* the organism between these two events was not observable or measurable, so it could not be studied and, moreover, it was not considered important. According to this view, when a rat learned to run through a maze faster and faster and with fewer and fewer errors, the learning process consisted of a succession of stimuli to which a succession of correct responses led to the reward of food at the end of the maze. This focused, stimulus-response, connectionist view of all behavior formed the core of behaviorism and dominated the first 50 years or so of behavioral psychology's history.

Led by Tolman during the 1930s and 1940s, a small band of "renegades" appeared who maintained that much more was going on inside the learning organism than mere responses to stimuli. In fact, Tolman proposed two main modifications to the prevailing view. One was that the true nature and complexity of learning could not be fully understood without an examination of the internal mental processes that accompany the observable stimuli and responses. As Tolman stated in the famous 1948 article that is the subject of this discussion:

> We believe that in the course of learning something like a field map of the environment gets established in the rat's brain. We agree with the other [stimulus-response] school that the rat running a maze is exposed to stimuli and is finally led as a result of these stimuli to the responses which actually occur. We feel, however, that the intervening brain processes are more complicated, more patterned, and often . . . more autonomous than do the stimulus-response psychologists. (p. 192)

The second proposal made by Tolman was that even though internal cognitive processes could not be directly observed, they could be objectively and scientifically inferred from observable behavior.

METHOD AND RESULTS

Tolman presented numerous studies in his 1948 article to support his views, all of which involved maze learning by rats. Two of the studies that clearly and concisely demonstrated his theoretical position are included here.

The first was called the *latent learning* experiment. For this study, rats were divided into three groups. Group C (the control group) was exposed to

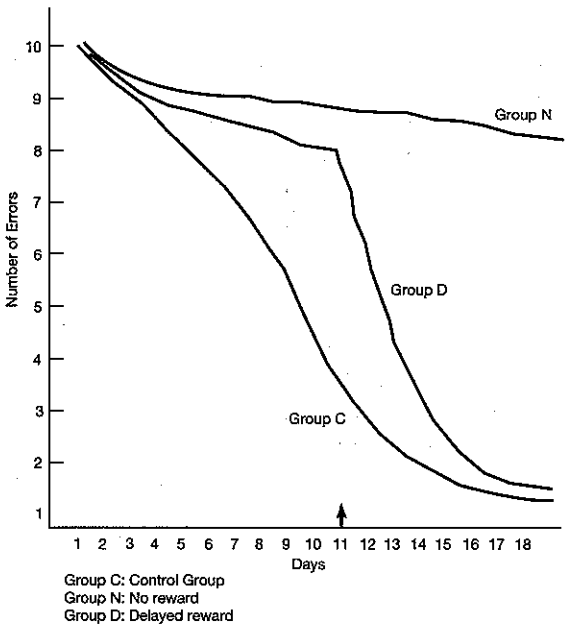

FIGURE 15-1 Latent learning experiment error rates in maze learning. (Adapted from p. 195.)

a complex maze using the standard procedure of one run through the maze each day with a food reward at the end of the maze. Group N (no reward) was exposed to the maze for the same amount of time each day but found no food and received no reward for any behavior in the maze. Group D (delayed reward) was treated exactly like group N for the first 10 days of the study, but then on day 11 found food at the end of the maze and continued to find it each day thereafter.

Figure 15-1 summarizes the results for the three groups based on the average number of errors (running down blind alleys) made by each group of rats. As you can easily see in the graph, the rats in Groups N and D did not learn much of anything about the maze when they were not receiving any reward for running through the maze. The control rats learned the maze to near perfection in about 2 weeks. However, when the rats in Group D discovered a reason to run the maze (food!), they learned it to near perfection in only about 3 days (day 11 to day 13). The only possible explanation for these findings was that during those 10 days when the rats were wandering around in the maze, they were learning much more about the maze than they were showing. As Tolman explained, "Once . . . they knew they were to get food, they demonstrated that during the preceding nonreward trials, they had learned where many of the blinds were. They had been building up a 'map' and could utilize [it] as soon as they were motivated to do so" (p. 195).

The second study to be discussed here is called the "spatial orientation" experiment. Stimulus-response (S-R) theorists had maintained that a rat only "knows" where the food reward is by running the maze (and experiencing all the S-R connections) to get to it. This is very much like saying that you only

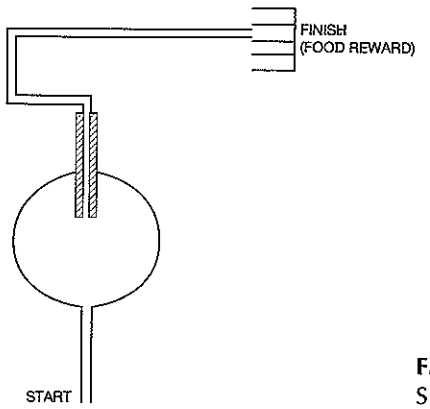

FIGURE 15-2 Spatial orientation experiment: Simple maze. (Adapted from p. 202.)

know where your bedroom is by walking out of the kitchen, across the living room, down the hall, past the bathroom, and into your room. In reality, you have a mental representation of where your bedroom is in the house without having to "run the maze." Tolman's spatial orientation technique was designed to show that rats trained in a maze actually know the location in space of the food reward relative to their starting position even if the elements of the maze are radically changed, or even removed.

First, rats learned to run the simple maze shown in Figure 15-2. They would enter the maze at the start, then run across a round table and into the path leading, in a somewhat circuitous route, to a food reward at the end. This was a relatively simple maze and no problem for the rats that learned it to near perfection in 12 trials.

Then the maze was changed to a sunburst pattern, similar to that shown in Figure 15-3. Now when the trained rats tried to run their usual route, they found it blocked and had to return to the round table. There they had a

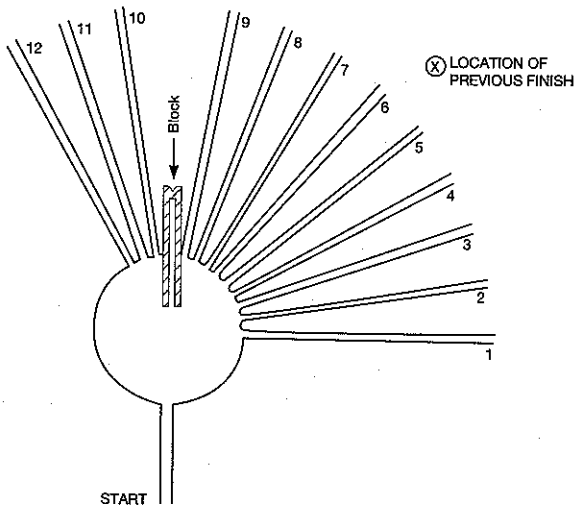

FIGURE 15-3 Spatial orientation experiment: Sunburst maze. (Adapted from p. 203)

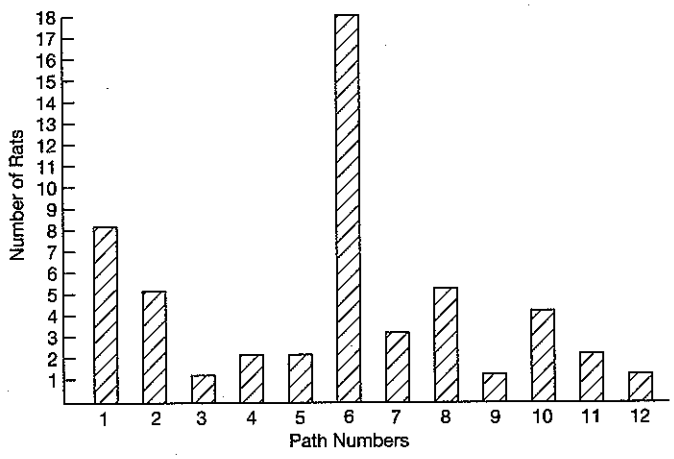

FIGURE 15-4 Spatial orientation experiment: Number of rats choosing each path. (Adapted from p. 204)

choice of 12 possible alternate paths to try to get to where the food had been in the previous maze. Figure 15-4 shows the number of rats choosing each of the 12 possible paths.

As you can see, Path 6, which ran to about 4 inches from where the food reward box had been placed in the previous maze, was chosen by significantly more rats than any other possible route. S-R theory might have predicted that the rats would choose the path most closely in the direction of the first turn in the original maze (Path 11), but this was not the case. "The rats had, it would seem, acquired not merely a strip-map to the effect that the original specifically trained-on path led to food, but rather a wider, comprehensive map to the effect that food was located in such and such a direction in the room" (p. 204). Here, Tolman was expanding his theory beyond the notion that rats, and potentially other organisms including humans, produce cognitive maps of the route from point A to point Z. He was demonstrating that the maps that are produced are not mere *strip maps* represented as A to B to C and so on, to Z, but are much broader, comprehensive or conceptual maps that give organisms a cognitive "lay of the land."

DISCUSSION

Tolman's concluding remarks in his 1948 article focused on this distinction between narrow strip maps and broader comprehensive maps. In applying his findings to humans, Tolman theorized that comprehensive maps of our social environment are advantageous to humans, although narrow, striplike maps can lead to negative human conditions, such as mental illness or prejudice and discrimination. His reasoning was based on findings related to the studies

described previously indicating that when rats were overmotivated (e.g., too hungry) or overfrustrated (e.g., too many blind alleys), they tended to develop very narrow maps and were less likely to acquire the comprehensive cognitive mapping skills of the rats described in his studies. Acknowledging that he was not a clinical or social psychologist, Tolman offered this as a possible explanation for some of society's social problems. In Tolman's words:

> Over and over again men are blinded by too violent motivations and too intense frustrations into blind . . . haters of outsiders. And the expression of their hates ranges all the way from discrimination against minorities to world conflagrations.
>
> What in the name of Heaven or Psychology can we do about it? My only answer is to preach again the virtue of reason—of, that is, broad cognitive maps. . . . We dare not let ourselves or others become so over-emotional, so hungry, so ill-clad, so over-motivated that only narrow strip-maps will be developed. All of us . . . must be made calm enough and well-fed enough to be able to develop truly comprehensive maps. . . . We must, in short, subject our children and ourselves (as the kindly experimenter would his rats) to the optimal conditions of moderate motivation and an absence of unnecessary frustrations, whenever we put them and ourselves before that great God-given maze which is our human world. (p. 208)

SUBSEQUENT RESEARCH AND RECENT APPLICATIONS

Over the decades since Tolman's early studies, a great deal of research has supported his theories of cognitive learning. Perhaps the most notable outgrowth of Tolman's ideas and reasoning is the fact that one of the most active and influential subfields of the behavioral sciences today is *cognitive psychology.* This branch of psychology is in the business of studying internal, unobservable cognitive processes. Since the time only a few decades ago when the entire concept of "mind" was rejected as subject matter for scientific investigation, psychology has made a nearly complete reversal. Now it is generally accepted that the way a stimulus is processed mentally through perceiving, attending, thinking, expecting, remembering, and analyzing is at least as important in determining a behavioral response as the stimulus itself, if not more so.

Tolman's theory of cognitive mapping has influenced another area of psychology known as *environmental psychology.* This field is concerned with the relationship between human behavior and the environment in which it occurs. A key area of research in environmental psychology is concerned with how you experience and think about your life's various surroundings, such as your city, your neighborhood, your school campus, or the building in which you work. The study of your conceptualizations of these places is called *environmental cognition,* and your precise mental representations of them have been given Tolman's term, *cognitive maps.* Using Tolman's basic concepts, environmental psychologists have been influential not only in our understanding of how people understand their environments but also in how environments should be designed or adapted to create the optimal *fit* with our cognitive mapping processes.

One of the environmental psychologists who led in applying Tolman's ideas to humans was Lynch (1960). Lynch proposed five categories of environmental features that we make use of in forming our cognitive maps. *Paths* are perceived arteries that carry traffic, whether it be in cars, on foot, on bicycles, or in boats. *Edges* are boundaries we use in our cognitive mapping to divide one area from another, but they do not function as paths, such as a canyon, a wall, or the shore of a lake. *Nodes* are focal points, such as city parks, traffic circles, or a fountain, where paths or edges meet. *Districts* take up large spaces on our mental representations and are defined by some common characteristic, such as the theater district or restaurant row. *Landmarks* are structures that are used as points of reference within a map and are usually visible from a distance, such as a clock tower, a church steeple, or a tall or especially unusual building.

This early article by Tolman articulating his theory of cognitive mapping has been cited throughout the 50 years since its publication consistently and frequently in a wide array of diverse studies. For example, a recent study applied Tolman's model of cognitive maps to understanding how birds rely on the location of the sun to find landmarks and create cognitive maps for their remarkable migratory treks over hundreds or even thousands of miles each year (Bingman & Able, 2002). On a different track, a study from the field of tourism cited Tolman's ideas in an examination of how travelers in wilderness areas (*nature-based tourists*) develop their knowledge of the terrain they are exploring (Young, 1999). The author found that several factors influenced the quality of the participants' mental maps, including mode of transportation, whether they had visited the region before, number of days spent in the area, where they were from, their age, and their gender.

Today, much of our "traveling" does not require going anywhere at all, at least in a physical sense. We can now find our way to anywhere in the world on the Internet. Tolman's conceptualization of cognitive maps has even influenced research on the psychology of the World Wide Web. Imagine for a moment what you do when you are on the Internet: you explore; you jump from place to place; you surf; you navigate, you google. You don't really go anywhere geographically, yet you often feel as if you have been on a journey. And chances are, most of you could probably go there again using approximately the same route, right? If so, you have formed a mental map of a small part of the Web. A study in a journal devoted to research on human–computer relationships examined Internet search behavior and the strategies people use to navigate the Web (Hodkinson et al., 2000). The researchers were able to translate Web search behavior into graphic form, identify individual search strategies, and suggest possible methods for improving Internet search effectiveness.

Tolman's research was incorporated into a study that may have shed some light on that age-old gender stereotype: "Men never ask for directions." Research by Bell and Saucier (2004) explored the connection between people's gender and sex hormone levels with their ability to navigate along a specified

route. Imagine for a moment that you are moving along a path from point A to point B. Along the way, you will pick up some mental images of your surroundings, such as notable landmarks in the distance and specific points of interest along your route, and you will probably have a general sense of the direction from which you began your journey. If asked to point to some of these mental representations, you would likely indicate the correct direction for some, but not for others. In other words, you would have developed a cognitive map of your route, but it would seldom be perfect. Bell and Saucier asked participants to do just this and found that greater levels of testosterone, the primary male sex hormone, was significantly related to increased accuracy in these pointing tasks, indicating a clearer understanding of the cognitive maps the participants formed during their environmental experiences. So, does this mean that men ask for directions less than women do because men already know where they are? No. As intriguing as these findings are, a great deal more research will be needed to answer *that* one!

Bell, S., & Saucier, D (2004). Relationship among environmental pointing accuracy, mental rotation, sex, and hormones. *Environment and Behavior, 36*(2), 251–275.

Bingman, V., & Able, K. (2002). Maps in birds: Representational mechanisms and neural bases. *Current Opinion in Neurobiology, 12,* 745–750.

Hodkinson, C., Kiel, G., & McColl-Kennedy, J. (2000). Consumer Web search behavior: Diagrammatic illustration of wayfinding on the Web. *International Journal of Human-Computer Studies, 52*(5), 805–830.

Lynch, K. (1960). *The image of the city.* Cambridge, MA: MIT Press.

Young, M. (1999). Cognitive maps of nature-based tourists. *Annals of Tourism Research, 26*(4), 817–839.

Reading 16: THANKS FOR THE MEMORIES!

Loftus, E. F. (1975). Leading questions and the eyewitness report. *Cognitive Psychology, 7,* 560–572.

PERRY MASON: Hamilton, I believe that my client is telling the truth when she says she was nowhere near the scene of the crime.

HAMILTON BURGER: Perry, why don't we let the jury decide?

PERRY MASON: Because, Hamilton, I don't believe there is going to be a trial. You haven't got a case. All you have is circumstantial evidence.

HAMILTON BURGER: Well, Perry, I suppose this is as good a time as any to tell you. We have someone who saw the whole thing, Perry. We have an *eyewitness!*

And, as the mysterious music rises in a crescendo, we know that this is going to be another difficult case for the most victorious TV lawyer of all time, Perry Mason. Even though we are reasonably certain Mason will prevail in the end, the presence of a single eyewitness to the crime has seemingly changed a weak

case into a nearly airtight one for the district attorney. Why do people believe that eyewitness reports provide such strong evidence in criminal cases? The reason is that we tend to believe that the way in which a person remembers an event must be the way it actually happened. In other words, memory is typically thought of as the *replaying* of an event, exactly as we saw it, like playing a video or DVD. However, psychologists who study memory have drawn that notion into question, along with many other common beliefs about the reliability of human memory.

One of the leading researchers in the area of memory is Elizabeth Loftus at the University of Washington. She has found that when an event is recalled, it is not accurately re-created. Instead, what is recalled is a *reconstruction* of the actual event. Loftus's research has demonstrated that reconstructive memory is a result of our use of new and existing information to fill in the gaps in our recall of an experience. She maintains that memories are not stable, as we commonly believe, but that they are malleable and changeable over time. If you tell someone a story from your vacation 5 years ago, you *think* you are re-creating the experience just as it happened, but you probably are not. Instead, you have reconstructed the memory using information from many sources, such as the previous times you've told it, other experiences from the same or later vacations, perhaps a movie you saw last year that was shot in a place similar to your vacation, and so on. You know this is true if you and a person who was with you at the time have ever recounted your shared experience. You are often surprised by how your stories can totally disagree about an event you both experienced simultaneously!

Usually, these alterations in memory are nothing more than interesting and harmless. However, in legal proceedings, when a defendant's fate may rest on the testimony of an eyewitness, memory reconstructions can be critical. For this reason, much of Loftus's research in the area of memory has been connected to legal eyewitness testimony. In her early research, she found that very subtle influences in how a question is worded can alter a person's memory for an event. For example, if witnesses to an automobile accident are asked "Did you see a broken headlight?" or "Did you see the broken headlight?" the question using the word *the* produced more "yes" responses than the question using the word *a*, even when no headlight had been broken. The use of *the* presupposes (assumes) the presence of a broken headlight, and this, in turn, causes many witnesses to add one to their memories as they reconstruct the event.

The article by Loftus that is the focus of this discussion is one of the most often cited because it reports on four related studies that took her theory a major step forward. In these studies, she demonstrated that the mere wording of questions asked of eyewitnesses could alter their memories of events when they were later asked other questions about the events. This research influenced both memory theory and criminal law.

THEORETICAL PROPOSITIONS

These studies focus on the power of questions containing presuppositions to alter a person's memory of an event. Loftus defines a presupposition as a condition that must be true for the question to make sense. For example, suppose

you have witnessed an automobile accident and I ask you "How many people were in the car that was speeding?" The question *presupposes* that the car was speeding. But what if the car was not actually speeding? You might answer the question anyway because it was not a question about the speed of the car—it was about its passengers. Loftus proposed, however, that because of the way the question was worded, you might add the speeding information to your memory of the event. Consequently, if you are asked other questions later, you will be more likely to say the car was speeding. Loftus hypothesized that if eyewitnesses are asked questions that contain a false presupposition about the witnessed event, the new *false* information may be incorporated into the witness's memory of the event and appear subsequently in new testimony by the witness.

METHOD AND RESULTS

The methods and results for each of the four experiments reports are summarized in the following subsections.

Experiment 1

In the first study, 150 participants in small groups saw a film of a five-car chain-reaction accident that occurred when a driver ran through a stop sign into oncoming traffic. The accident took only 4 seconds and the entire film ran less than a minute. After the film, the participants were given a questionnaire containing 10 questions. For half of the participants, the first question was "How fast was Car A [the car that ran the stop sign] going when it ran the stop sign?" For the other half of the participants, the question was "How fast was Car A going when it turned right?" The remaining questions were of little interest to the researchers until the last one, which was the same for both groups: "Did you see a stop sign for Car A?"

In the group that had been asked about the stop sign, 40 participants (53%) said they saw a stop sign for Car A, while only 26 (35%) in the "turned-right" group claimed to have seen it. This difference was statistically significant.

Experiment 2

The second study Loftus reported was the first in this series to involve a delayed memory test and was the only one of the four not to use an automobile accident as the witnessed event. For this study, 40 participants were shown a 3-minute segment from the film *Diary of a Student Revolution.* The clip showed a class being disrupted by eight antiwar demonstrators. After they viewed the film, the participants were given questionnaires containing 20 questions relating to the film clip. Half of the participants were asked "Was the leader of the *four* demonstrators who entered the classroom a male?" The other half were asked "Was the leader of the *twelve* demonstrators who entered the classroom a male?" All remaining questions were identical for the two groups.

One week after this initial test, the participants from both groups returned and answered 20 new questions about the film (without seeing it

again). The one question that provided the results of the study was "How many demonstrators did you see entering the classroom?" Remember, both groups of participants saw the same film and answered the same questions, except for the reference to 12 versus 4 demonstrators.

The group that had received the question presupposing 12 demonstrators reported seeing an average of 8.85. Those who had received the question asking about 4 demonstrators averaged 6.40. This was also a significant difference. This experiment showed that, on average, the wording of one question altered the way participants remembered the basic characteristics of a witnessed event.

Experiment 3

This third experiment was designed to see if a false presupposition inherent in a question could cause witnesses to reconstruct their memory of an event to include objects that, in reality, were not there. The participants (150 university students) watched a short video of an accident involving a white sports car and then answered 10 questions about the content of the video. One question included for only half the participants was "How fast was the white sports car going *when it passed the barn* while traveling along the country road?" The other half of the participants were asked "How fast was the white sports car going while traveling along the country road?" As in the previous study, the participants returned a week later and answered 10 new questions about the accident. The question under study was "Did you see a barn?"

Of those participants who had previously answered a question in which a barn was mentioned, 13 (17.3%) of them answered "yes" to the test question, compared with only 2 (2.7%) in the no-barn group. Once again, this was a statistically significant difference.

Experiment 4

The final experiment reported in this article was somewhat more elaborately designed to meet two goals. First, Loftus wanted to further demonstrate the memory reconstruction effects found in Experiment 3. Second, she wondered if perhaps just the mention of an object, even if it was not included as part of a false presupposition, might be enough to cause the object to be added to memory. For example, imagine you are asked directly "Did you see a barn?" when no barn was depicted in the film. You will probably answer "no." But if you are asked again a week later, might that barn have crept into your memory of the event? This is what Loftus tested in the fourth experiment.

Three groups of 50 participants viewed a 3-minute film shot from the inside of a car that ends with the car colliding with a baby carriage pushed by a man. The three groups then received booklets containing questions about the film. These booklets differed as follows:

Group D: The direct question group received booklets containing 40 "filler" questions and 5 key questions directly asking about

TABLE 16-1 Appearance of Nonexistent Objects in Participants' Recall of Filmed Accident Following Direct Questions and False Presuppositions

DIRECT QUESTION	FALSE PRESUPPOSITION	PERCENT OF "YES" RESPONSES TO DIRECT QUESTION 1 WEEK LATER BY GROUP		
		D	C	F
Did you see a school bus in the film?	Did you see the children getting on the school bus?	12	6	26
Did you see a truck in the beginning of the film?	At the beginning of the film, was the truck parked beside the car?	8	0	22
Did you see a center line on the country road?	Did another car cross the center line on the country road?	14	8	26
Did you see a woman pushing the carriage?	Did the woman pushing the carriage cross into the road?	36	26	54
Did you see a barn in the film?	Did you see a station wagon parked in front of the barn?	8	2	18

C = control group
D = direct-question group
F = false-presupposition group
(From p. 568.)

nonexistent objects—for example, "Did you see a barn in the film?" (see Table 16-1).

Group F: The false presupposition group received the same 40 filler questions and 5 key questions that contained presuppositions about the same nonexistent objects, such as, "Did you see a station wagon parked in front of the barn?"

Group C: The control group received only the 40 filler questions.

One week later all the participants returned and answered 20 new questions about the film. Of the questions, 5 were the exact same key questions as were asked of the direct-question group a week before. So, group D saw those 5 questions twice. The dependent measure (the result) was the percentage of participants in each group who claimed to remember the nonexistent objects.

Table 16-1 summarizes the findings for all three groups. Remember, the film included no school bus, truck, center line on the road, woman pushing the carriage, or barn. Combining all the questions, the overall percentages of those participants answering "yes" to the direct questions 1 week later were 29.2% for the false-presupposition group, 15.6% for the direct-question group, and 8.4% for the control group. The differences between the direct-question group and the false-presupposition group for each item, as well as for all the items combined, were statistically significant.

DISCUSSION

Based on these and other studies, Loftus argued that an accurate theory of memory and recall must include a process of reconstruction when new information is integrated into the original memory of an event. The findings of these studies cannot be explained by assuming that recall simply involves a mental replaying of an event, even with varying degrees of accuracy. To illustrate, Figure 16-1 compares the traditional view of recall with the reformulated process proposed by Loftus. As you can see, the extra step of integrating new information into memory has been added. This new information, in turn, causes your representation of the original memory to be altered or *reconstructed.* Later, if you are asked a question about the event, your recall will not be of the actual original event but, rather, your reconstruction of it. Loftus contended that this reconstruction process was the reason that barns, school busses, trucks, women pushing baby carriages, and center lines in roads were all conjured up in participants' memories when they were not part of the original experience. The false presupposition in the questions provided new in-

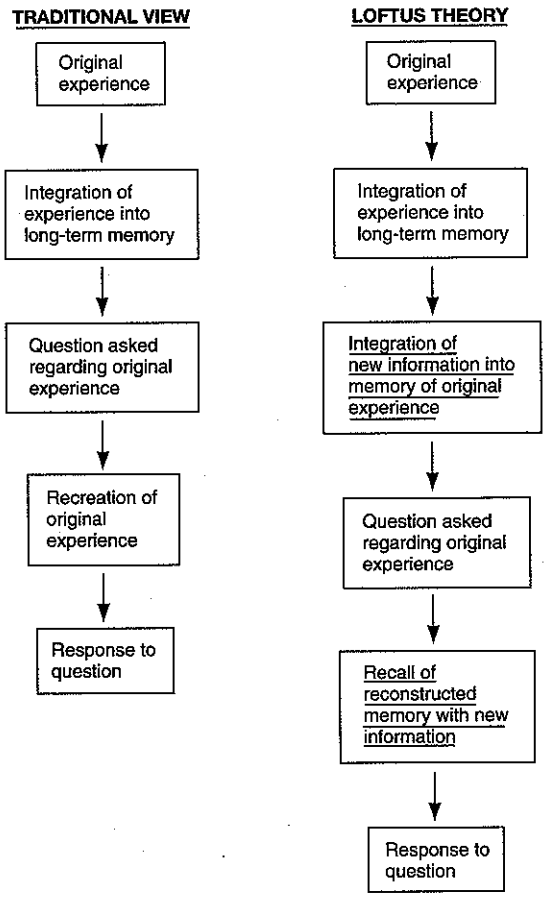

FIGURE 16-1 Recall of an event in response to a question.

formation that was unintentionally integrated into the participants' memories of the event.

Applying this idea to eyewitnesses in criminal investigations, Loftus pointed out that witnesses to a crime are often questioned more than once. They might be asked questions by police at the scene of the crime, interviewed by the prosecuting attorney assigned to the case, and again questioned in court. During these various question-and-answer sessions, it is not unlikely that false presuppositions will be made, possibly unintentionally, in numerous ways. Common, innocent-sounding questions such as "What did the guy's gun look like?" or "Where was the getaway car parked?" have been shown to increase the chances that witnesses will remember a gun or a getaway car whether or not those items were actually there (Smith & Ellsworth, 1987). Although the attorneys, the judge, and the jury are making the assumption that the witness is re-creating what was actually seen, Loftus contends that what is being remembered by the witness is a "regenerated image based on the altered memorial representation" (p. 571).

RECENT APPLICATIONS

Several studies represent the ongoing influence of Loftus's impressive body of work on eyewitness testimony. One study citing her 1975 article examined how lawyers' complicated questions negatively affect eyewitness accuracy and confidence (Kebbell & Giles, 2000). All participants watched identical videotaped events and were questioned a week later about what they saw. Half the participants were asked questions in confusing language (you know, that lawyer-speak of "Is it not true that . . . ?"), while others were asked the same questions in simple language. The results were clear: the participants receiving the confusing form of the questions were less accurate in their eyewitness reports and were also less confident of their answers than those in the straightforward-question condition. Other research has demonstrated that when eyewitnesses are shown more than one photographic lineup of criminal suspects (a common event in law enforcement), their accuracy in identifying the correct perpetrator decreases significantly as they incorporate the newer faces into their reconstruction of the original event (Pezdek & Blandon-Gitlin, 2005).

Another intriguing study applied Loftus's work to reports of "fantastic memories," that is, memories that bear greater similarity to fantasy than reality, such as alien abductions, out-of-body experiences, extrasensory perception (ESP) events, encounters with ghosts, and so on (French, 2003). Clearly, if these reports of memories were true, they would provide proof that these paranormal occurrences are real. However, research tells us time and time again that such events have *never* been scientifically demonstrated. So, what accounts for the memories? The answer may lie in the fallibility and unreliability of human memory as discussed in this reading and, perhaps, the ability of our brains to *create* memories of events that never actually happened. As French points out, "A number of psychological variables that have been

shown to correlate with susceptibility to false memories (e.g., hypnotic susceptibility, tendency to dissociate, etc.) also correlate with the tendency to report paranormal experiences" (French, p. 153).

In addition to her ongoing work in the area of eyewitness testimony, Elizabeth Loftus is currently one of the leading experts in the heated controversy over repressed childhood memories. On one side of this debate are those people who claim to have been abused sexually sometime in their past but who have only recently, often with the help of a therapist, remembered the abuse. The usual explanation for the sudden recall of these victims assumes that the traumatic memories have been repressed in the unconscious and have only recently been revealed. On the other side are those who are suddenly accused of the abuse but who categorically deny it and claim that these memories are pure fantasy or have been somehow implanted during therapy (see Garry & Loftus, 1994, for a review of this controversy). This falls squarely into the area of Loftus's memory research.

Loftus's book *The Myth of Repressed Memories: False Memories and Allegations of Sexual Abuse* (Loftus & Ketcham, 1994) summarized her findings in this area and combined them into a cohesive argument. Loftus contends, and appears to have demonstrated in numerous studies, that repressed memories simply do not exist. In fact, she is at the forefront of psychologists who question the entire notion and existence of an unconscious. A main feature of Loftus's argument is that experimental evidence repeatedly demonstrates that especially traumatic memories tend to be the ones we remember *best*. And yet, clinicians often report these instances of repressed memories of sexual abuse that rise to the surface during specific and intense forms of therapy. How can these two seemingly opposing views be reconciled? Loftus suggests three possible memory distortions that might explain what clinicians see as repression (Loftus, Joslyn, & Polage, 1998). First, early sexual abuse may simply be forgotten, not repressed. She cites research demonstrating that when children do not understand the sexual nature of an abusive event, it tends to be remembered poorly. Second, it is possible that people in therapy *say* they had no memory of a traumatic event, but, in reality, they never actually forgot it. Avoiding thinking about something is different than forgetting it. And third, Loftus contends that some "people may *believe* that a particular traumatic event occurred and was repressed when, in fact, it did not happen in the first place. Under some circumstances, some combination of these distortions could lead to situations that are interpreted as repression" (p. 781).

You can imagine that Loftus's position on repressed and recovered memories is not without critics (e.g., Spitzer & Avis, 2006; Steinberg, 2000). After all, her rejection of the power of repression is opposed to commonly held beliefs about psychology and psychotherapy that have been around since Freud. Moreover, many therapists and victims have a very personal stake in their belief that memories of abuse can be repressed for years and later recovered. However, a careful reading of Loftus's thorough and careful scientific work should cause anyone to question this belief.

CONCLUSION

Elizabeth Loftus is considered by most to be the leading researcher in the areas of memory reconstruction and eyewitness inaccuracy. Her research in these areas continues. Her findings over the years have held up quite well to challenges and have been supported by other researchers in the field.

Little doubt exists within the psychological and legal professions today that eyewitness reports are subject to many sources of error such as postevent information integration. Because of the body of research by Loftus and others, the power and reliability of eyewitnesses in judicial proceedings are now justifiably questioned. Loftus has been one of the most sought-after expert witnesses (usually for the defense) to demonstrate to juries the care they must use when evaluating the testimony of eyewitnesses.

As Loftus herself summarizes in her 1994 book, "I study memory and I am a skeptic" (Loftus & Ketcham, 1994, p. 7). Perhaps we all should be.

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Spitzer, B., & Avis, J.M. (2006). Recounting graphic sexual abuse memories in therapy: The impact on women's healing. *Journal of Family Violence* 21(3), 173–184.

Steinberg, M. (2000). The stranger in the mirror. *Psychology Today, 33,* 34.

Chapter

V

HUMAN DEVELOPMENT

The human development branch of psychology is concerned with the complex set of developmental changes virtually everyone goes through from birth to death. It is one of the largest and most complex specialties in the behavioral sciences. Although we grow up to be unique individuals, a great deal of our development is similar and predictable and occurs according to certain relatively fixed schedules. Included among the most influential areas of research in developmental psychology are the processes of attachment or bonding between infant and mother, the development of intellectual abilities, and the changes relating to the aging process.

Some of the most famous and influential research ever conducted in psychology is discussed in this section. Harry Harlow's work with monkeys demonstrated the importance of early infant attachments in later psychological adjustment. The sweeping discoveries of Jean Piaget formed the entire foundation of what we know today about cognitive development; a small sample of his research is included here in detail so that you may glimpse the ingenuity of his methods and clarity of his reported findings. Next is a famous body of research by Lawrence Kohlberg focusing on how moral character develops and why some people appear to behave at a higher moral level than others. In addition, because human development is a lifelong process, a discussion of the well-known article by Ellen Langer and Judith Rodin (often referred to as "the plant study") is included to illustrate how everyone, no matter their stage in life, needs to feel in control of their own choices, activities, and destinies.

Reading 17: DISCOVERING LOVE

Harlow, H. F. (1958). The nature of love. *American Psychologist, 13,* 673–685.

Sometimes you may think, that research psychologists have gone too far. How can something such as love be studied scientifically? However you define love,