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Key Questions/ Chapter Outline	Core Concepts	Psychology Matters
3.1 What Sort of Learning Does Classical Conditioning Explain? The Essentials of Classical Conditioning Applications of Classical Conditioning	• Classical conditioning is a basic form of learning in which a stimulus that produces an innate reflex becomes associated with a previously neutral stimulus, which then acquires the power to elicit essentially the same response.	**Taste Aversions and Chemotherapy** Your friend risks developing a food aversion when the medicine makes her feel sick.
3.2 How Do We Learn New Behaviors by Operant Conditioning? Skinner's Radical Behaviorism The Power of Reinforcement The Problem of Punishment A Checklist for Modifying Operant Behavior Operant and Classical Conditioning Compared	• In operant conditioning, the consequences of behavior, such as rewards and punishments, influence the probability that the behavior will occur again.	**Using Psychology to Learn Psychology** If the Premack Principle doesn't work for you, try using behavioral principles to make studying itself more reinforcing.
3.3 How Does Cognitive Psychology Explain Learning? Insight Learning: Köhler in the Canaries with the Chimps Cognitive Maps: Tolman Finds Out What's on a Rat's Mind Observational Learning: Bandura's Challenge to Behaviorism Rethinking Behavioral Learning in Cognitive Terms Brain Mechanisms and Learning "Higher" Cognitive Learning	• According to cognitive psychology, some forms of learning must be explained as changes in mental processes, rather than as changes in behavior alone.	**Fear of Flying Revisited** A combination of classical conditioning, operant conditioning, and cognitive techniques makes fear manageable.

Critical Thinking Applied: Do Different People Have Different "Learning Styles"?

chapter 3 learning and human *nurture*

In 1924, John Watson boasted, "Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I'll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors." Decades later, the assumption behind Watson's boast became the bedrock on which the community called Walden Two was built: *Nurture* trumps *nature*. Or, to put it another way: Environment carries far more weight than heredity in determining our behavior.

So at Walden Two, residents can enter any sort of profession that interests them. And in their leisure time, they can do whatever they like: attend concerts, lie on the grass, read, or perhaps drink coffee with friends. They have no crime, no drug problems, and no greedy politicians. In exchange for this happy lifestyle, community members must earn four "labor credits" every day, doing work needed by the community.

(That's about four hours work—fewer hours for unpleasant tasks, such as cleaning sewers, but more for the easiest work, perhaps pruning the roses.) Following Watson's vision, the founder of Walden Two, a psychologist named Frasier, believed that people could have happy, fulfilling lives in an environment psychologically engineered to reward people for making socially beneficial choices. To reap these benefits, all a community need do is change the way it deals out rewards.

We should say *where* this community was built: all in the mind of behaviorist B. F. Skinner. You see, *Walden Two* is the name of a novel, written by Skinner (1948) to promote his ideas on better living through behavioral psychology. But so alluring was the picture he painted of this mythical miniature society that many real-world communes sprang up, using *Walden Two* as the blueprint.

None of the real communities based on *Walden Two* ran so smoothly as the one in Skinner's mind. Yet at least one such group, Twin Oaks, located in Virginia, thrives after 40 years—but not without substantial modifications to Skinner's vision (Kincade, 1973). In fact, you can visit this group electronically, through their website at www.twinoaks.org/index.html (Twin Oaks, 2007).

Nor was behaviorism's fate exactly as Skinner had envisioned it. Although the behaviorist perspective dominated psychology during much of the 20th century, its fortunes fell as cognitive psychology grew in prominence. But what remains is behaviorism's substantial legacy, including impressive theories of behavioral learning and a valuable set of therapeutic tools for treating learned disorders—such as fears and phobias. To illustrate what behaviorism has given us, consider the problem that confronted Sabra.

A newly minted college graduate, Sabra had landed a dream job at an advertising firm in San Francisco. The work was interesting and challenging, and she enjoyed her new colleagues. The only negative was that her supervisor had asked her to attend an upcoming conference in Hawaii—and take an extra few days of vacation there at the company's expense. Why was that a negative? Sabra had a fear of flying.

PROBLEM: Assuming that Sabra's fear of flying was a response that she had learned, could it also be treated by learning? If so, how?

A common stereotype of psychological treatment involves "reliving" traumatic experiences that supposedly caused a fear or some other symptom. Behavioral learning therapy, however, works differently. It focuses on the here-and-now, instead of the past: The therapist acts like a coach, teaching the patient new responses that can replace old problem behaviors. So, as you consider how Sabra's fear might be treated, you might think along the following lines:

- What behaviors would most likely be seen in people like Sabra, who are afraid of flying?
- What behaviors could Sabra learn that could replace or conflict with her fearful behavior?
- How could these new behaviors be taught?

Learning A lasting change in behavior or mental processes that results from experience.

While the solution to Sabra's problem involves learning, it's not the sort of hit-the-books learning that usually comes to the minds of college students. Psychologists define the concept of **learning** broadly, as *a process through which experience produces a lasting change in behavior or mental processes.* According to this definition, then, Sabra's "flight training" would be learning—just as much as taking golf lessons or reading this book are learning experiences.

To avoid confusion, two parts of our definition need some elaboration. First, we underscore the idea that learning may lead to a *lasting change in behavior.* Suppose that you go to your doctor's office and get a particularly unpleasant injection, during which the sight of the needle becomes associated with pain. The result: The next time you need a shot, you wince when you first see the needle. This persistent change in responding involves learning. In contrast, a simple, reflexive reaction, such as jumping when you hear an unexpected loud noise, does *not* qualify as learning because it produces no lasting change—nothing more than a fleeting reaction, even though it does entail a change in behavior.

Second, let's focus on the part of our definition that says learning affects *behavior* or *mental processes*. In the doctor's office example above, it is easy to see how learning affects behavior. But mental processes are more difficult to observe. How could you tell, for example, whether a laboratory rat had simply learned the behaviors required to negotiate a maze (turn right, then left, then right . . .) or whether it was following some sort of mental image of the maze, much as you would follow a road map? (And why should we care what, if anything, was on a rat's mind?) Let's venture a little deeper into our definition of learning by considering the controversy surrounding mental processes.

The "instinctive" behavior of these turtles returning to the sea is driven in part by heredity, but such behavior also relies on environmental cues. Scientists usually shun the term **instinct**, *preferring the term* **species-typical behavior**, *for reasons discussed in the text.*

Behavioral Learning versus Cognitive Learning The problem of observing mental events, whether in rats or in people, underlies a long-running controversy between the behaviorists and the cognitive psychologists that threads through this chapter. For over 100 years, the behaviorists have maintained that psychology could be a true science only if it disregarded subjective mental processes and focused solely on observable stimuli and responses. On the other side of the issue, cognitive psychologists have contended that the behavioral view is far too limiting and that understanding learning requires that we make inferences about hidden mental processes. In the following pages, we will see that both sides in this dispute have made important contributions to our knowledge.

Learning versus Instincts So, what does learning—either behavioral or cognitive learning—do for us? Nearly all human activity, from working to playing to interacting with family and friends, involves some form of learning. Without learning, we would have no human language. We wouldn't know who our family or friends were. We would have no memory of our past or goals for our future. And without learning, we would be forced to rely on simple reflexes and a limited repertoire of innate behaviors, sometimes known as "instincts."

In contrast with learning, instinctive behavior (more properly known as *species-typical behavior*) is heavily influenced by genetic programming. It occurs in essentially the same way across different individuals in a species. We see instincts at work in bird migrations, animal courtship rituals, and a few human behavior patterns, such as nursing in newborns. All these examples involve responses in which experience plays a small role, as compared to learned behaviors like operating a computer, playing tennis, or wincing at the sight of a needle. In general, human behavior is much more influenced by learning and much less influenced by instincts than that of other animals. For us, learning confers the flexibility to adapt quickly to changing situations and new environments. In this sense, then, learning represents an evolutionary advance over instincts.

CONNECTION • CHAPTER 9

Instinct refers to motivated behaviors that have a strong innate basis.

Simple and Complex Forms of Learning Some forms of learning can be quite simple. For example, if you live near a busy street, you may learn to ignore the sound of the traffic. This sort of learning, known as **habituation**, involves learning *not to respond* to stimulation. Habituation occurs in all animals that have nervous systems, from insects and worms to people. It helps you focus on important

Habituation Learning not to respond to the repeated presentation of a stimulus.

stimuli, ignoring stimuli that need no attention, such as the feel of the chair you are sitting on or the sound of the air conditioning in the background.

We find another relatively simple form of learning most obviously in humans: When everything else is equal, we have a preference for stimuli to which we have been previously exposed, as contrasted with novel stimuli. This **mere exposure effect** occurs whether or not the stimulus was associated with something pleasurable or even whether we were aware of the stimulus. The mere exposure effect probably accounts for the effectiveness of much advertising (Zajonc, 1968, 2001). It may also account for young children being less interested in a present than in the box in which the present came.

Other kinds of learning can be more complex. One type involves learning a connection between two stimuli—as when a school child associates the 12 o'clock bell with lunch. And another occurs when we associate our actions with rewarding and punishing consequences, such as a reprimand from the boss or an A from a professor. The first two sections of the chapter will emphasize these last two especially important forms of **behavioral learning**, which we will call *classical conditioning* and *operant conditioning*.

In the third section of the chapter, we shift the focus from external behavior to internal mental processes. There our look at *cognitive learning* will consider how sudden "flashes of insight" and imitative behavior require theories that go beyond behavioral learning—to explain how we solve problems or why children imitate behavior for which they see other people being rewarded. We will also discuss the acquisition of concepts, the most complex form of learning and the sort of learning you do in your college classes. Finally, the chapter will close on a practical note, by considering how to use the psychology of learning to help you study more effectively—and enjoy it.

Let's begin with a form of behavioral learning that accounts for many of your own likes and dislikes: *classical conditioning*.

3.1 KEY QUESTION
WHAT SORT OF LEARNING DOES CLASSICAL CONDITIONING EXPLAIN?

CONNECTION • CHAPTER 1
Structuralism and *functionalism* were two of the early "schools" of psychology.

Ivan Pavlov (1849–1936) would have been insulted if you had called him a psychologist. In fact, he had only contempt for the structuralist and functionalist psychology of his time, which he saw as being hopelessly mired in speculation about subjective mental life (Todes, 1997). Pavlov and the hundreds of student researchers who passed through Pavlov's Russian research "factory" were famous for their work on the digestive system—for which Pavlov eventually snared a Nobel prize (Fancher, 1979; Kimble, 1991).

Unexpectedly, however, the experiments on salivation (the first step in digestion) went awry, sending Pavlov and his crew on a detour into the psychology of learning—a detour that occupied Pavlov for the rest of his life. The problem they encountered was that their experimental animals began salivating even before food was put in their mouths (Dewsbury, 1997). In fact, saliva would start flowing when they saw the food or even when they heard the footsteps of the lab assistant bringing the food. (Normally, salivation occurs after food is placed in the mouth.)

This response was a puzzle. What, after all, was the biological function of salivating before receiving food? When Pavlov and his associates turned their attention to understanding these "psychic secretions" they made a series of discoveries that would change the course of psychology (Pavlov, 1928; Todes, 1997). Quite by accident, they had stumbled upon an objective model of learn-

Mere exposure effect A learned preference for stimuli to which we have been previously exposed.

Behavioral learning Forms of learning, such as classical conditioning and operant conditioning, that can be described in terms of stimuli and responses.

To study classical conditioning, Pavlov placed his dogs in a restraining apparatus. The dogs were then presented with a neutral stimulus, such as a tone. Through its association with food, the neutral stimuls became a conditioned stimulus eliciting salivation.

ing that could be manipulated in the laboratory to tease out the connections among stimuli and responses. This discovery, now known as **classical conditioning**, forms the Core Concept of this section:

core concept

Classical conditioning is a basic form of learning in which a stimulus that produces an innate reflex becomes associated with a previously neutral stimulus, which then acquires the power to elicit essentially the same response.

Classical conditioning A form of behavioral learning in which a previously neutral stimulus acquires the power to elicit the same innate reflex produced by another stimulus.

In the following pages we will see that classical conditioning accounts for some important behavior patterns found not only in animals but in people. By means of classical conditioning, organisms learn about cues that help them anticipate and avoid danger, as well as cues alerting them to food, sexual opportunity, and other conditions that promote survival. First, however, let's examine some of the fundamental features that Pavlov identified in classical conditioning.

The Essentials of Classical Conditioning

Pavlov's work on learning focused on manipulating simple, automatic responses known as *reflexes* (Windholz, 1997). Salvation and eye blinks are examples of such reflexes. They commonly result from stimuli that have biological significance: The blinking reflex, for example, protects the eyes; the salivation reflex aids digestion.

Pavlov's great discovery was that his dogs could associate these reflexive responses with *new* stimuli—*neutral stimuli* that had previously produced no response. Thus, they could *learn* the connection between a reflex and a new stimulus. For example, Pavlov found he could teach a dog to salivate upon hearing a certain sound, such as the tone produced by a striking a tuning fork or a bell. You have experienced the same sort of learning if your mouth waters when you read the menu in a restaurant.

To understand how these "conditioned reflexes" worked, Pavlov's team employed a simple experimental strategy. They first placed an untrained dog in a harness and set up a vial to capture the animal's saliva. Then, at intervals, they sounded a tone, after which they gave the dog a bit of food. Gradually, over a number of trials, the dog began to salivate in response to the tone alone.

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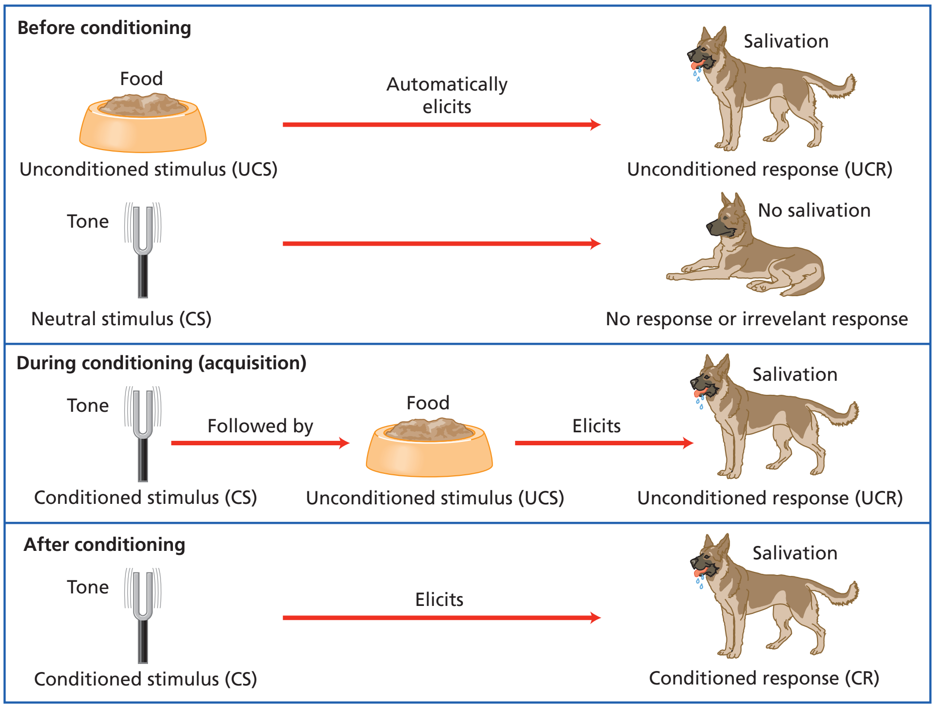
FIGURE 3.1
Basic Features of Classical Conditioning

Before conditioning the food (UCS) naturally elicits salivation (UCR). A tone from a tuning fork is a neutral stimulus and has no effect. During conditioning (the acquisition phase), the tone is paired with the food, which continues to elicit the salivation response. Through its association with the food, the previously neutral tone becomes a conditioned stimulus (CS), gradually producing a stronger and stronger salivation response.

(*Source:* P. G. Zimbardo and R. J. Gerrig, *Psychology and Life,* 15th ed. Published by Allyn and Bacon, Boston, MA. Copyright © 1999 by Pearson Education. Reprinted by permission of the publisher.)



Neutral stimulus Any stimulus that produces no conditioned response prior to learning. When it is brought into a conditioning experiment, the researcher will call it a conditioned stimulus (CS). The assumption is that some conditioning occurs after even one pairing of the CS and UCS.

Unconditioned stimulus (UCS) In classical conditioning, UCS is the stimulus that elicits an unconditioned response.

Unconditioned response (UCR) In classical conditioning, the response elicited by an unconditioned stimulus without prior learning.

Acquisition The initial learning stage in classical conditioning, during which the conditioned response comes to be elicited by the conditioned stimulus.

Conditioned stimulus (CS) In classical conditioning, a previously neutral stimulus that comes to elicit the conditioned response. Customarily, in a conditioning experiment, the neutral stimulus is called a conditioned stimulus when it is first paired with an unconditioned stimulus (UCS).

Conditioned response (CR) In classical conditioning, a response elicited by a previously neutral stimulus that has become associated with the unconditioned stimulus.

In general, Pavlov and his students found that a **neutral stimulus** (one without any reflex-provoking power, such as a tone or a light), when paired with a natural reflex-producing stimulus (food), will by itself gradually begin to elicit a learned response (salivation) that is similar to the original reflex. It's essentially the same conditioning process behind the association of romance with flowers or chocolate.

Figure 3.1 illustrates the main features of Pavlov's classical conditioning procedure. At first glance, the terms may seem a bit overwhelming. Nevertheless, you will find it immensely helpful to study them carefully now so that they will come to mind easily later—when we analyze complicated, real-life learning situations, as in the acquisition and treatment of fears, phobias, and food aversions.

Acquisition Classical conditioning always involves an **unconditioned stimulus** (**UCS**), a stimulus that automatically—that is, without conditioning—provokes a reflexive response. Pavlov used food as the UCS, because it reliably produced the salivation reflex. In the language of classical conditioning, then, this is called an *unconditioned reflex* or, more commonly, an **unconditioned response** (**UCR**). It is important to realize that the UCS–UCR connection is "wired in" and so involves no learning. Dogs don't have to learn to salivate when they receive food, just as you don't have to learn to cry out when you feel pain: Both are unconditioned responses.

Acquisition, the initial learning stage in classical conditioning, pairs a new stimulus—a neutral stimulus (the tone produced by a tuning fork, for example)—with the unconditioned stimulus. Typically, after several trials the neutral stimulus will elicit essentially the same response as does the UCS. So, in Pavlov's experiment, when the sound alone began to produce salivation, this formerly neutral stimulus has become a **conditioned stimulus** (**CS**). Although the response to the conditioned stimulus is essentially the same as the response originally produced by the unconditioned stimulus, we now refer to it as the **conditioned response** (**CR**). The same thing may have happened to you in grade school, when your mouth watered (a conditioned response) at the sound of the lunch bell (a conditioned stimulus).

With those terms firmly in mind, look at the graph of acquisition in a typical classical conditioning experiment, which appears in the first panel of Figure

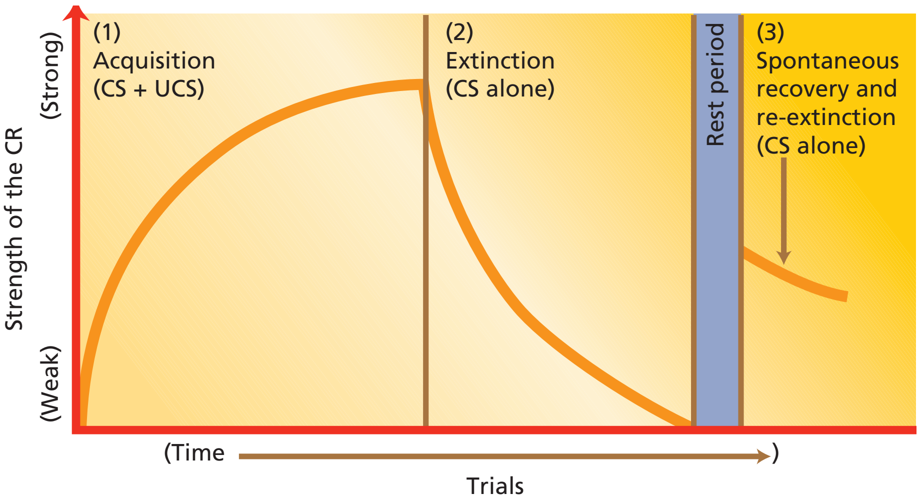


FIGURE 3.2
Acquisition, Extinction, and Spontaneous Recovery

During acquisition (CS + UCS), the strength of the CR increases rapidly. During extinction, when the UCS no longer follows the CS, the strength of the CR drops to zero. The CR may reappear after a brief rest period, even when the UCS is still not presented; only the CS alone occurs. The reappearance of the CR is called "spontaneous recovery."

(*Source:* P. G. Zimbardo and R. J. Gerrig, *Psychology and Life,* 15th ed. Published by Allyn and Bacon, Boston, MA. Copyright © 1999 by Pearson Education. Reprinted by permission of the publisher.)

3.2, where gradual acquisition of the conditioned response is reflected in the upward sweep of the line. Note that, at first, only weak responses are elicited by the conditioned stimulus. With continued CS–UCS pairings, however, the conditioned response increases in strength.

In conditioning, as in telling a joke, timing is critical. In most cases, the CS and UCS must occur *contiguously* (close together in time) so that the organism can make the appropriate connection during acquisition. The range of time intervals between the CS and UCS that will produce the best conditioning depends on the type of response being conditioned. For motor responses, such as eye blinks, a short interval of one second or less is best. For visceral responses, such as heart rate and salivation, longer intervals of 5 to 15 seconds work best. Conditioned fear optimally requires even longer intervals of many seconds or even minutes between the CS and the UCS. Taste aversions, we will see, can develop after even after several hours' delay. (Why these time differentials exist is not known with certainty, but they probably have survival value. For example, in the case of taste aversions, rats seem to be genetically programmed to eat small amounts of an unfamiliar food and, if they don't get sick, return to the food after a few hours.)

These, then, are the building blocks of classical conditioning: the CS, UCS, CR, UCR, and the timing that connects them. So, why did it take Pavlov three decades and 532 experiments to study such a simple phenomenon? There was more to classical conditioning than first met Pavlov's eyes. Along with *acquisition,* he also discovered the details of *extinction, spontaneous recovery, generalization,* and *discrimination*—which we will now explore.

Extinction and Spontaneous Recovery Suppose that, as a result of your grade-school experience with lunch bells, your mouth still waters at the sound of a bell at a school in your neighborhood. But, does this conditioned response have to remain permanently in your behavioral repertoire? The good news, based on experiments by Pavlov's group, suggests that it does not. Conditioned salivation responses in Pavlov's dogs were easily eliminated by withholding the UCS (food) over several trials in which the CS (the tone) was presented alone. In the language of classical conditioning, we call this **extinction**. It occurs when a conditioned response disappears after repeated presentations of the CS without the UCS. Figure 3.2 shows how the conditioned response (salivation) becomes weaker and weaker during extinction trials.

Extinction (in classical conditioning) The weakening of a conditioned response in the absence of an unconditioned stimulus.

Now for the bad news: Let's imagine that your mouth-watering conditioned response to the lunch bell has been extinguished. (The cafeteria repeatedly ran out of food just before you got there.) But, after a time (summer vacation), when you again hear the bell, the conditioned response makes a *spontaneous recovery,* and you find yourself again drooling on your shirt. Much the same thing (without the shirt) happened with Pavlov's dogs: After undergoing extinction training, they would again begin salivating when they heard the tone. In technical terms, this **spontaneous recovery** occurs when *the CR reappears after extinction and after a period without exposure to the CS.* Happily, when spontaneous recovery happens, the conditioned response nearly always reappears at a lower intensity, as you can see in Figure 3.2. In practice, then, the CR can gradually be eliminated, although sometimes this may require several extinction sessions.

CONNECTION • CHAPTER 13
Behavioral therapies are based on classical conditioning and operant conditioning.

Spontaneous recovery is of considerable importance in behavioral therapy for phobias and fears, such as Sabra's aversion to flying. But spontaneous recovery has theoretical importance, too. It tells us that extinction does not involve a complete elimination of the response from the organism's behavioral repertoire. Rather, extinction merely suppresses the conditioned response. During extinction, the organism actually learns a competing response *not to respond* to the conditioned stimulus (Adelson, 2004; Travis, 2004).

Generalization Now, switching to a visual CS, suppose you have developed a fear of spiders. Most likely, you will probably respond the same way to spiders of all sizes and markings. We call this **stimulus generalization**: giving a conditioned response to stimuli that are similar to the CS. Pavlov demonstrated stimulus generalization in his laboratory by showing that a well-trained dog would salivate in response to a tone of a slightly different pitch from the one he had used during conditioning. As you would expect, the closer the new sound was to the original, the stronger the response.

In everyday life, we find stimulus generalization in people who have acquired fears as a result of traumatic events. So, a person who has been bitten by a dog may develop a fear of all dogs, rather than a fear of the specific dog responsible for the attack. Likewise, stimulus generalization accounts for an allergy sufferer's sneeze upon seeing a paper flower. In short, by means of stimulus generalization we learn to give old responses in new situations.

Discrimination Learning When you were in grade school, you may have learned to salivate at the sound of the lunch bell, but—thanks to *stimulus discrimination*—your mouth probably didn't water when the doorbell rang. Much the opposite of stimulus generalization, **stimulus discrimination** occurs when an organism learns to respond to one stimulus but not to stimuli that are similar. Pavlov and his students demonstrated this experimentally when they taught dogs to distinguish between two tones of different frequencies. Once again, their procedure was simple: One tone was followed by food, while another was not. Over a series of trials, the dogs gradually learned the discrimination, evidenced in salivation elicited by one tone and not the other. Beyond the laboratory, stimulus discrimination is the concept that underlies advertising campaigns aimed at conditioning us to discriminate between particular brands, as in the perennial battle between Pepsi and Coke.

Conditioning an Experimental Neurosis If you have ever had a class in which you couldn't figure out what the teacher wanted, you have faced a vexing problem in discrimination learning. Transposing this problem to the laboratory, Pavlov confronted dogs with the seemingly simple task of distinguishing between a circle and an ellipse. One stimulus was always paired with food, and the other was always paired with a painful electric shock. The task became more difficult, however, over a series of trials, when Pavlov gradually changed the ellipse to become more and more circular—to the point that the dogs could not tell the images apart. And how did they respond? As the discrimination became increasingly difficult, their responses grew more erratic. Finally, as the animals became more confused between the circle and the ellipse, they would snarl and snap at the handlers. Because such agitated responses resemble behavior of "neurotic" people who become irritable and defensive when they have difficult choices to make, this behavior pattern was

Spontaneous recovery The reappearance of an extinguished conditioned response after a time delay.

Stimulus generalization The extension of a learned response to stimuli that are similar to the conditioned stimulus.

Stimulus discrimination Learning to respond to a particular stimulus but not to stimuli that are similar.

dubbed **experimental neurosis**. Even today, this pattern stands as a model for the deterioration of behavior seen in both people and animals under stress.

Applications of Classical Conditioning

The beauty of classical conditioning is that it offers a simple explanation for many behaviors, from cravings to aversions. But it offers more than an explanation: It also gives us the tools for eliminating unwanted human behaviors—although Pavlov himself never attempted any therapeutic applications. Instead it fell to the American behaviorist, John Watson, to apply classical conditioning techniques to people.

*John Watson and Rosalie Rayner conditioned Little Albert to fear furry objects like this Santa Claus mask (*Discovering Psychology, 1990*).*

The Notorious Case of Little Albert Over 80 years ago, John Watson and Rosalie Rayner first demonstrated conditioned fear in a human (Brewer, 1991; Fancher, 1979). In an experiment that would be considered unethical today, Watson and Rayner (1920/2000) conditioned an infant named Albert to react fearfully to a white laboratory rat. They created the fear response by repeatedly presenting the rat, paired with an aversive UCS—the loud sound of a steel bar struck with a mallet. It took only seven trials for "Little Albert" to react with distress at the appearance of the rat (CS) alone. After Albert's response to the rat had become well established, Watson and Rayner showed that his aversion readily generalized from the rat to other furry objects, such as a Santa Claus mask and a fur coat worn by Watson (Harris, 1979).

Most likely, the experiment caused Albert only temporary distress, because his fear response extinguished rapidly, making it necessary for Watson and Raynor to renew the fear conditioning periodically. In fact, the need to recondition Albert nearly ended the whole experiment when Watson and Rayner were attempting to show that the child's fear could be generalized to a dog, a rabbit, and a sealskin coat. Watson decided to "freshen the reaction to the rat" by again striking the steel bar. The noise startled the dog, which began to bark at Albert, frightening not only Little Albert but both experimenters (Harris, 1979).

Unlike Little Albert's short-lived aversion to furry objects, some fears learned under highly stressful conditions can persist for years (LeDoux, 1996). During World War II, the Navy used a gong sounding at the rate of 100 rings a minute as a call to battle stations. For combat personnel aboard ship, this sound became strongly associated with danger—a CS for emotional arousal. The persistent effect of this association was shown in a study conducted 15 years after the war, when Navy veterans who had experienced combat still gave a strong autonomic reaction to the old "call to battle stations" (Edwards & Acker, 1962).

CONNECTION • CHAPTER 2

The *autonomic nervous system* regulates the internal organs.

Like those veterans, any of us can retain a readiness to respond to old emotional cues. Fortunately, however, classical conditioning also provides some tools for eliminating troublesome conditioned fears (Wolpe & Plaud, 1997). A good strategy combines extinction of the conditioned fear response with learning a relaxation response to the CS. This *counterconditioning* therapy, then, teaches patients to respond in a relaxed manner to the conditioned stimulus. The technique has been particularly effective in dealing with phobias. As you may have been thinking, we will want to consider counterconditioning as part of the treatment plan to help Sabra conquer her fear of flying.

CONNECTION • CHAPTER 13

Behavioral therapies based on *counterconditioning* are effective ways of treating phobias.

Conditioned Food Aversions All three of your authors have had bad experiences with specific foods. Phil got sick after eating pork and beans in the grade school lunchroom, Bob became ill after a childhood overdose of olives, and Vivian became queasy after eating chicken salad (formerly one of her favorite meals!). In all three cases, we associated our distress with the distinctive sight, smell, and taste of the food—but not to anything else in our environment. Even today, the taste, smell, or appearance of the specific food is enough to cause a feeling of nausea.

Unpleasant as it can be, learning to avoid a food associated with illness has survival value. That's why humans and many other animals readily form an association between illness and food—much more readily than between illness and

Experimental neurosis A pattern of erratic behavior resulting from a demanding discrimination learning task, typically one that involves aversive stimuli.

A conditioned taste aversion can make a coyote stop killing sheep.

a nonfood stimulus, such as a light or a tone. And, while most forms of classical conditioning require only a short delay between the CS and the UCS, food aversions can develop when a distinctive taste has been separated by hours from the onset of illness. "Must have been something I ate!" we say.

John Garcia and Robert Koelling (1966) first recognized this highly selective CS–UCS connection when they noticed that rats avoided drinking from the water bottles in the chambers where they had previously been made nauseous by radiation. Could it be the taste of the water in those bottles that the rats were associating with being sick? Subsequent experiments confirmed their suspicions and led to yet another important discovery. Rats readily learned an association between flavored water and illness, yet the rats could *not* be conditioned to associate flavored water with the pain of an electric shock delivered through a grid on the floor of the test chamber. This makes good "sense" from an evolutionary perspective, because illness can easily result from drinking (or eating) poisonous substances but rarely occurs following a sharp pain to the feet. Conversely, the experimenters found that rats easily learned to respond fearfully when bright lights and noise signaled an electric shock—but could *not* learn to connect those light and sound cues with subsequent illness.

Biological Predispositions: A Challenge to Pavlov The problem that the Garcia and Koelling experiments pose for classical conditioning is that conditioned aversions involve both nature and nurture. That is, the tendency to develop taste aversions appears to be "wired in" as a part of our biological nature, rather than purely learned. It is this biological basis for taste aversions that has caused psychologists to question some aspects of Pavlov's original theory of classical conditioning (Rescorla & Wagner, 1972).

Unlike conditioning dogs to respond to a tone, food aversions seem to be grounded in an innate (and therefore *unlearned*) disposition to associate sickness with food. We know this because people who develop food aversions don't normally make the same association to other stimuli that accompanied the food. For example, when Bob developed an aversion to olives, he developed no such aversion to other objects in the room at the time, such as a light or a book on the table. It was solely the olives that became an effective conditioned stimulus. Such observations suggest that organisms have an inborn preparedness, to associate certain stimuli with certain consequences, while other CS–UCS combinations are highly resistant to learning.

Moreover, food aversions can develop even when the time interval between eating and illness extends over several hours—as compared with just a few seconds in Pavlov's experiments. Again, this suggests that in food aversions we are not dealing with a simple classically conditioned response as Pavlov understood it but, instead, with a response that is based as much in nature (biology) as it is in nurture (learning).

Such biological predispositions go far beyond taste and food aversions. Psychologists now believe that many of the common fears and phobias arise from *genetic preparedness,* built into us from our ancestral past, disposing us to learn fears of things associated with harm: snakes, spiders, blood, lightning, heights, and closed spaces. We can even see how concern over mutilation or other bodily harm contributes to fears of seemingly modern objects or situations, such as injections, dentistry, or flying.

Conditioning Coyotes: An Application Returning to conditioned food aversions, let's see how psychologists have applied their knowledge to a practical problem in the world outside the laboratory. Specifically, John Garcia and his colleagues have demonstrated how aversive conditioning can dissuade wild coyotes from attacking sheep. They did so by wrapping toxic lamb burgers in sheepskins and stashing them on sheep ranches: When roaming coyotes found and ate these meaty morsels, they became sick and—as predicted—developed a distaste for lamb meat. The result was a 30 to 50% reduction in sheep attacks. So powerful was this aversion for conditioned coyotes that, when captured and placed in a cage with a sheep, the coyotes would not get close to it. Some even vomited at the sight of a sheep (Garcia, 1990). Perhaps the most amazing result was this: Despite their success with conditioning coyotes, the scientists have been unable to modify the behavior of sheep ranchers to get them to apply the research. Apparently, sheep ranchers have a strong aversion to feeding lamb to coyotes!

So, what is the big lesson coming out of all this work on learned aversions and fears? *Conditioning involves both nature and nurture.* That is, conditioning depends not only on the learned relationship among stimuli and responses but also on the way an organism is genetically attuned to certain stimuli in its environment (Barker et al., 1978; Dickinson, 2001). What any organism can—and cannot—learn in a given setting is to some extent a product of its evolutionary history (Garcia, 1993). And that is a concept that Pavlov never understood.

PSYCHOLOGYMATTERS

Taste Aversions and Chemotherapy

Imagine that your friend Jena is about to undergo her first round of chemotherapy, just to make sure that any stray cells from the tumor found in her breast will be destroyed. To her surprise, the nurse enters the lab, not with the expected syringe, but with a dish of licorice-flavored ice cream. "Is this a new kind of therapy?" she asks. The nurse replies that it is, indeed, explaining that most patients who undergo chemotherapy experience nausea, which can make them "go off their feed" and quit eating, just when their body needs nourishment to fight the disease. "But," says the nurse, "We have found a way around the problem. If we give patients some unusual food before their chemotherapy, they will usually develop an aversion only to that food." She continued, "Did you ever hear of Pavlov's dogs?"

Conditioned food aversions make evolutionary sense, as we have seen, because they helped our ancestors avoid poisonous foods. As is the case with some of our other evolutionary baggage, such ancient aversions can cause modern problems. Cancer patients like Jena often develop aversions to normal foods in their diets to such an extent that they become malnourished. The aversions are nothing more than conditioned responses in which food (the CS) becomes associated with nausea. Chemotherapy personnel trained in classical conditioning use their knowledge to prevent the development of aversions to nutritive foods by arranging for meals not to be given just before the chemotherapy. And, as in Jena's case, they also present a "scapegoat" stimulus. By consuming candies or ice cream with unusual flavors before the treatments, patients develop taste aversions only to those special flavors. For some patients, this practical solution to problems with chemotherapy may make the difference between life and death (Bernstein, 1988, 1991).

CheckYourUnderstanding

1. **APPLICATION:** Give an example of classical conditioning from your everyday life and identify the CS, UCS, CR, and UCR.

2. **RECALL:** Before a response, such as salivation, becomes a conditioned response, it is a(n) _____.

3. **APPLICATION:** If you learned to fear electrical outlets after getting a painful shock, what would be the CS?

4. **UNDERSTANDING THE CORE CONCEPT:** Which one of the following could be an *unconditioned* stimulus (UCS) involved in classical conditioning?
   a. food
   b. a flashing light
   c. music
   d. money

Answers **1.** Everyday examples of classical conditioning involve learning taste aversions (such as a dislike for olives) or fears (such as a fear of going to the dentist) because these stimuli had been previously paired with unpleasant or painful stimuli. **2.** innate reflex or UCR **3.** the electrical outlet **4.** a—because it is the only one that produces an innate reflexive response (UCR).

3.2 KEY QUESTION HOW DO WE LEARN NEW BEHAVIORS BY OPERANT CONDITIONING?

With classical conditioning, you can teach a dog to salivate, but you can't teach it to sit up or roll over. Why? Salivation is a passive, involuntary reflex, while sitting up and rolling over are much more complex responses that we usually think of as voluntary. To a behavioral psychologist, however, such "voluntary" behaviors are really controlled by *rewards* and *punishments*. And because rewards and punishments play no role in classical conditioning, another important form of learning must be at work. Psychologists call it *operant conditioning*. (An *operant*, incidentally, is an observable behavior that an organism uses to "operate" in, or have an effect on, the environment. Thus, if you are reading this book to get a good grade on the next test, reading is an operant behavior.) You might also think of **operant conditioning** as a form of learning in which the *consequences* of behavior can encourage behavior change. The Core Concept of this section puts the idea this way:

core concept

In operant conditioning, the consequences of behavior, such as rewards and punishments, influence the probability that the behavior will occur again.

Common rewarding consequences include money, praise, food, or high grades—all of which can encourage the behavior they follow. By contrast, punishments such as pain, loss of privileges, or low grades can discourage the behavior with which they are associated.

As you will see, the theory of operant conditioning is an important one for at least two reasons. First, operant conditioning accounts for a much wider spectrum of behavior than does classical conditioning. And second, it explains *new* behaviors—not just reflexive behaviors.

Skinner's Radical Behaviorism

The founding father of operant conditioning, American psychologist B. F. Skinner (1904–1990), based his whole career on the idea that the most powerful influences on behavior are its *consequences:* what happens immediately after the behavior. Actually, it wasn't Skinner's idea, originally. He borrowed the notion of behavior being controlled by rewards and punishments from another American psychologist, Edward Thorndike, who had demonstrated how hungry animals would work diligently to solve a problem by trial and error to obtain a food reward. Gradually, on succeeding trials, erroneous responses were eliminated and effective responses were "stamped in." Thorndike called this the **law of effect**. (See Figure 3.3.) The idea was that an animal's behavior leads to pleasant or unpleasant results that influence whether the animal will try those behaviors again.

The first thing Skinner did with Thorndike's psychology, however, was to rid it of subjective and unscientific speculation about the organism's feelings, intentions, or goals. What an animal "wanted" or the "pleasure" it felt was not important for an objective understanding of the animal's behavior. As a radical behaviorist, Skinner refused to consider what happens in an organism's mind, because such speculation cannot be verified by observation. For example, eating can be observed, but we can't observe the inner experiences of hunger, the desire for food, or pleasure at eating.

Operant conditioning A form of behavioral learning in which the probability of a response is changed by its consequences—that is, by the stimuli that follow the response.

Law of effect The idea that responses that produced desirable results would be learned, or "stamped" into the organism.

Reinforcer A condition (involving either the presentation or removal of a stimulus) that occurs after a response and strengthens that response.

The Power of Reinforcement

While we often speak of "reward" in casual conversation, Skinner preferred the more objective term **reinforcer**. By this he meant any stimulus that *follows* and *strengthens* a response. Food, money, and sex serve this function for most people. So do attention, praise, or a smile. All are examples of **positive reinforcement**, which strengthens a response by occurring after the response and making the behavior more likely to occur again.

Most people know about positive reinforcement, of course, but fewer people understand the other main way to strengthen operant responses. It involves the reinforcement of behavior by the *removal* of an unpleasant or aversive stimulus. Psychologists call this **negative reinforcement**. (The word *negative* here is used in the mathematical sense of *subtract* or *remove,* while *positive* means *add* or *apply.*) So, using an umbrella to avoid getting wet during a downpour is a behavior learned and maintained by negative reinforcement. That is, you use the umbrella to avoid or remove an unpleasant stimulus (getting wet). Likewise, when a driver buckles the seat belt, the annoying sound of the seat-belt buzzer stops, providing negative reinforcement. Remember, it is the "subtraction" or removal of the unpleasant stimulus that creates negative reinforcement.

FIGURE 3.3
A Thorndike Puzzle Box

Unlike Pavlov's dogs, Thorndike's cats faced a problem: how to open the door in the puzzle box to get a food reward lying just outside. To solve this problem, the animals used *trial-and-error learning,* rather than simple reflexive responses. At first, their responses seemed random, but gradually they eliminated ineffective behaviors. And when the effects of their behavior were desirable (that is, when the door finally opened and the animals got the food), they used this strategy on subsequent trials. This change in behavior based on outcome of previous trials is called the *law of effect.* Much the same trial-and-error learning occurs when you learn a skill, such as shooting a basketball.

Reinforcing Technology: The "Skinner Box" One of B. F. Skinner's (1956) important innovations consisted of a simple device for studying the effects of reinforcers on laboratory animals: a box with a lever that an animal could press to obtain food. He called this device an **operant chamber**. Nearly everyone else called it a "Skinner box," a term he detested. Over the years, thousands of psychologists have used the apparatus to study operant conditioning.

The virtue of the operant chamber lay in its capacity to control the timing and the frequency of reinforcement, factors that exert important influences on behavior, as you will soon see. Moreover, the Skinner box could be programmed to conduct experiments at any time of day—even when the researcher was home in bed.

Positive reinforcement A stimulus presented after a response and increasing the probability of that response happening again.

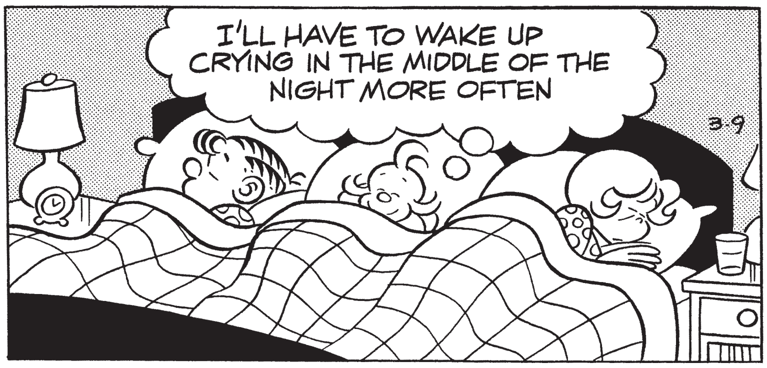
Negative reinforcement The removal of an unpleasant or aversive stimulus, contingent on a particular behavior. Compare with *punishment*.

Operant chamber A boxlike apparatus that can be programmed to deliver reinforcers and punishers contingent on an animal's behavior. The operant chamber is often called a "Skinner box."

Reinforcement contingencies Relationships between a response and the changes in stimulation that follow the response.

Contingencies of Reinforcement The timing and frequency of reinforcement determines its effect on behavior. So, while college and university students receive some reinforcement for their studying from grade reports delivered two or three times a year, such a schedule has little effect on their day-to-day behavior. Many professors realize this, of course, so they schedule exams and assignments and award grades periodically throughout their courses, as a means of encouraging continual studying, rather than making one big push at the end of the semester.

Here's the point: Whether we're talking about college students, Fortune 500 CEOs, or laboratory rats, any plan to influence operant learning requires careful consideration of the timing and frequency of rewards. How often will they receive reinforcement? How much work must they do to earn a reinforcer? Will they get a reward for every response or only after a certain number of responses? We will consider these questions below in our discussion of **reinforcement contingencies**, involving the many possible ways of associating responses and reinforcers.



(*Source:* Hi & Lois © King Features Syndicate.).

Continuous versus Intermittent Reinforcement Suppose you want to teach your dog a trick—say, sitting up on command. It would be a good idea to begin the training program with

B. F. Skinner is shown reinforcing the animal's behavior in an operant chamber, or "Skinner box." The apparatus allows the experimenter to control all the stimuli in the animal's environment.

Just to set the record straight, we'd like to mention a bit of trivia about the "baby tender" crib that Skinner devised for his daughter, Deborah (Benjamin & Nielsen-Gammon, 1999). It consisted of an enclosed, temperature-controlled box that unfortunately bore a superficial resemblance to the operant chambers used in his experiments. The public learned about the "baby tender" from an article by Skinner in the magazine Ladies' Home Journal. *The story took on a life of its own, and, years later, stories arose about Deborah Skinner's supposed psychotic breakdown, lawsuits against her father, and eventual suicide—none of which were true. In fact, Deborah grew up to be a well-adjusted individual who loved her parents.*

Positive reinforcement exerts a powerful influence on our behavior. This competitor, for example, must train for years to achieve this reinforcement. What schedule of reinforcement was she on? Is the trophy a primary or secondary reinforcer?

Continuous reinforcement A type of reinforcement schedule by which all correct responses are reinforced.

Shaping An operant learning technique in which a new behavior is produced by reinforcing responses that are similar to the desired response.

Intermittent reinforcement A type of reinforcement schedule by which some, but not all, correct responses are reinforced; also called partial reinforcement.

a reward for every correct response. Psychologists call this **continuous reinforcement**. It's a useful tactic early in the learning process, because rewarding every correct response and ignoring the incorrect ones provides feedback on how well each response was performed. In addition, continuous reinforcement is useful for **shaping** complex new behaviors. Shaping, which is often used in animal training, involves the deliberate use of rewards (and sometimes punishments) to encourage better and better approximations of the desired behavior. (You have experienced shaping in school, as a teacher taught you to read, write, or play a musical instrument by gradually setting higher standards.) By means of shaping, the teacher can continually "raise the bar," or increase the performance level required for earning a reward. This tells the learner when performance has improved. In general, then, we can say that *continuous reinforcement is a good strategy for shaping new behaviors.*

Continuous reinforcement does have some drawbacks. For one thing, a failure to reward a correct response on one trial could easily be misinterpreted as a signal that the response was not correct. For another, continuous reinforcement loses its reinforcing quality as the organism becomes satiated, as you can imagine if someone were training you to shoot free throws by rewarding you with big slices of chocolate cake. Your first piece of cake may be highly rewarding, but by the time you have had 10 or 12 servings, the reward value dissipates.

Happily, once the desired behavior becomes well established (for example, when your dog has learned to sit up), the demands of the situation change. The learner no longer needs rewards to discriminate a correct response from an incorrect one. It's time to shift to **intermittent reinforcement** (also called *partial* *reinforcement*), the rewarding of some, but not all, correct responses. A less frequent schedule of reward—perhaps, after every third correct response—can still serve as an incentive for your dog to sit up on command. In general, whether we're dealing with people or animals, *intermittent reinforcement is the most efficient way to maintain behaviors that have already been learned* (Robbins, 1971; Terry, 2000). As a practical matter, the transition to intermittent reinforcement can be made easier by mixing in social reinforcement ("Good dog!") with more tangible rewards (food, for example).

A big advantage of intermittent reinforcement comes from its resistance to *extinction*. The operant version of **extinction** occurs when reinforcement is withheld, as when a gambler stops playing a slot machine that never pays off. So, why do responses strengthened by partial reinforcement resist extinction more strongly than do responses that have been rewarded continuously? Imagine two gamblers and two slot machines. One machine inexplicably pays off on every trial, and another, a more typical machine, pays on an unpredictable, intermittent schedule. Now, suppose that both devices suddenly stop paying. Which gambler will catch on first? The one who has been rewarded for each pull of the lever (continuous reinforcement) will quickly notice the change, while the gambler who has won only occasionally (on partial reinforcement) may continue playing unrewarded for a long while.

Continuous reinforcement is useful for training animals, but intermittent reinforcement is better for maintaining their learned behaviors.

Schedules of Reinforcement Now that we have convinced you that intermittent reinforcement has considerable power, you should know that it occurs in two main forms or **schedules of reinforcement**. One, the **ratio schedule**, rewards a subject after a certain *number of responses*. The other, known as an **interval schedule**, provides a reward after a certain *time interval*. Let's look at the advantages and disadvantages of each.

Ratio Schedules Suppose that you own a business and pay your employees based on the amount of work they perform: You are maintaining them on a *ratio schedule* of reinforcement. That is, ratio schedules occur when rewards depend on the *number of correct responses*. (See Figure 3.4.) Psychologists make a further distinction between two subtypes of ratio schedules, *fixed ratio* and *variable ratio* schedules.

Fixed ratio (FR) schedules commonly occur in industry, when workers are paid on a piecework basis—a certain amount of pay for a certain amount of production. So, if you own a tire factory and pay each worker a dollar for every ten tires produced, you are using a fixed ratio schedule. Under this scheme the amount of work (the number of responses) needed for a reward remains constant, but the faster people work, the more money they get. Not surprisingly, management likes FR schedules because the rate of responding is usually high (Terry, 2000; Whyte, 1972).

Variable ratio (VR) schedules are less predictable. Telemarketers work on a VR schedule, because they never know how many phone calls they must make before they get the next sale. Slot machine players also respond on a variable ratio schedule. In both cases continually changing the requirements for reinforcement keeps responses coming at a high rate—so high, in fact, that the VR schedule usually produces more responding than any other reinforcement schedule. In a demonstration of just how powerful a VR schedule could be, Skinner showed that a hungry pigeon would peck a disk 12,000 times an hour for rewards given, on the average, for every 110 pecks!

Extinction (in operant conditioning) A process by which a response that has been learned is weakened by the absence or removal of reinforcement. (Compare with *extinction in classical conditioning*.)

Schedule of reinforcement A program specifying the frequency and timing of reinforcements.

Ratio schedule A program by which reinforcement depends on the number of correct responses.

Interval schedule A program by which reinforcement depends on the time interval elapsed since the last reinforcement.

Fixed ratio (FR) schedule A program by which reinforcement is contingent on a certain, unvarying number of responses.

Variable ratio (VR) schedule A reinforcement program by which the number of responses required for a reinforcement varies from trial to trial.

What schedule of reinforcement encourages this man to buy lottery tickets?

Interval Schedules Time is of the essence on an interval schedule. That is, with an interval schedule, reinforcement depends on responses made within a certain *time period* (rather than on the total number of responses given). (See Figure 3.4.) Psychologists distinguish two kinds of interval schedules: *fixed interval* and *variable interval* schedules.

Fixed interval (FI) schedules commonly occur in the work world, where they may appear as a periodic paycheck or praise from the boss at a monthly staff meeting. A student who studies for a weekly quiz is also on a fixed interval schedule. In all such cases, the interval does not vary, so the time period between rewards remains constant. You may have already guessed that fixed interval reinforcement usually results in a comparatively low response rate. Ironically, this is the schedule most widely adopted by business. Even a rat in a Skinner box programmed for a fixed interval schedule soon learns that it must produce only a limited amount of work during the interval to get its reward. Pressing the lever more often than required to get the food reward is just wasted energy. Thus, both rats and humans on fixed interval schedules may display only modest productivity until near the end of the interval, when the response rate increases rapidly. (Think of college students facing a term paper deadline.) Graphically, in Figure 3.4 you can see the "scalloped" pattern of behavior that results from this flurry of activity near the end of each interval.

Variable interval (VI) schedules are, perhaps, the most unpredictable of all. On a VI schedule, the time interval between rewards (or punishments) varies. The resulting rate of responding can be high, although not usually as high as for the VR schedule. For a pigeon or a rat in a Skinner box, the variable interval schedule may be a 30-second interval now, 3 minutes next, and a 1-minute wait later. In the classroom, pop quizzes exemplify a VI schedule, as do random visits by the boss on the job. Fishing represents still another example: The angler never knows how long it will take before the fish start biting again, but the occasional, unpredictable fish delivers reward enough to encourage fishing behavior over long intervals. And watch for responses typical of a VI schedule while waiting for an elevator: Because the delay between pressing the call button and the arrival of the elevator varies each time, some of your companions will press the button multiple times, as if more responses within an unpredictable time interval could control the elevator's arrival.

Primary and Secondary Reinforcers You can easily see why stimuli that fulfill basic biological needs or desires will provide reinforcement: Food reinforces a hungry animal, and water reinforces a thirsty one. Similarly, the opportunity for sex becomes a reinforcer for a sexually aroused organism. Psychologists call such stimuli **primary reinforcers**.

But money or grades present a different problem: You can't eat them or drink them. Nor do they directly satisfy any physical need. So why do such things reinforce behavior so powerfully? Neutral stimuli, such as money or grades, acquire a reinforcing effect by association with primary reinforcers and so become **conditioned reinforcers or secondary reinforcers** for operant responses. The same thing happens with praise, smiles of approval, gold stars, "reward cards" used by merchants, and various kinds of status symbols. In fact, virtually any stimulus can become a secondary or conditioned reinforcer by being associated with a primary reinforcer. With strong conditioning, secondary reinforcers such as money, status, or awards can even come to be ends in themselves.

Piggy Banks and Token Economies The distinction between primary and secondary reinforcers brings up a more subtle point: Just as we saw in classical conditioning, operant conditioning is not pure learning, but it is built on a biological

Fixed interval (FI) schedule A program by which reinforcement is contingent upon a certain, fixed time period.

Variable interval (VI) schedule A program by which the time period between reinforcements varies from trial to trial.

Primary reinforcer A reinforcer, such as food or sex, that has an innate basis because of its biological value to an organism.

Conditioned reinforcer or **secondary reinforcer** A stimulus, such as money or tokens, that acquires its reinforcing power by a learned association with primary reinforcers.

base; hence our "wired-in" preferences for certain reinforcers—to which "junk" food manufacturers pander with their sweet and fatty treats.

Biology is also seen on the behavioral side of operant conditioning. And that's why Keller and Marian Breland, two psychologists who went into the animal training business, had so much trouble with their trained pigs. As you probably know, pigs are very smart animals. Thus, the Brelands had no difficulty teaching them to pick up round wooden tokens and deposit them in a "piggy bank." The problem was that, over a period of weeks, these porcine subjects reverted to piggish behavior: They would slow down, repeatedly dropping the token, root at it, pick it up and toss it in the air, and root it some more. And this happened in pig after trained pig. What was happening? The Brelands (1961) called this **instinctive drift**, which they defined as the tendency for innate response tendencies to interfere with learned behavior. The Brelands found similar patterns of instinctive drift in critters as diverse as raccoons and chickens. No wonder, then, that people can't make their cats refrain for long from scratching the furniture.

Happily, psychologists have had better luck in using tokens with people than with pigs. Mental institutions, for example, have tapped the power of conditioned reinforcers by setting up so-called *token economies* to encourage desirable and healthy patient behaviors. Under a **token economy**, the staff may reinforce grooming or taking medication with plastic tokens. Patients soon learn that they can exchange the tokens for highly desired rewards and privileges (Ayllon & Azrin, 1965; Holden, 1978). As an adjunct to other forms of therapy, token economies can help mental patients learn useful strategies for acting effectively in the world (Kazdin, 1994).

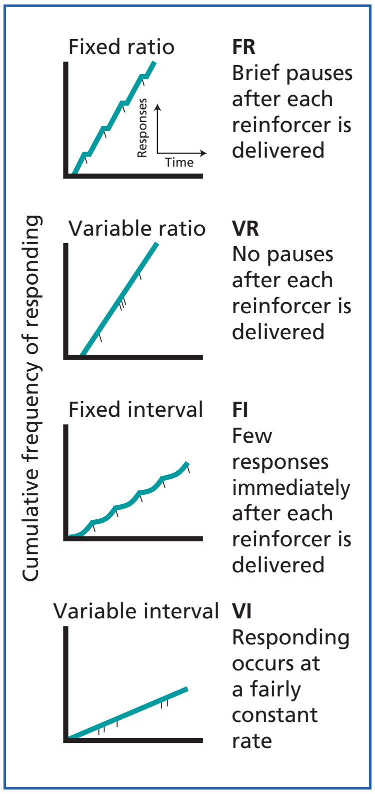


FIGURE 3.4
Reinforcement Schedules

The graphs show typical patterns of responding produced by four different schedules of reinforcement. (The hash marks indicate when reinforcement is delivered.) Notice that the steeper angle of the top two graphs shows how the ratio schedules usually produce more responses over a given period of time than do the interval schedules.

Preferred Activities as Reinforcers: The Premack Principle The opportunity to perform desirable activities can reinforce behavior just as effectively as food or drink or other primary reinforcers. For example, people who exercise regularly might use a daily run or fitness class as a reward for getting other tasks done. Likewise, teachers have found that young children will learn to sit still if such behavior is reinforced later with the opportunity to run around and make noise (Homme et al., 1963).

The principle at work here says that the opportunity to engage in a preferred activity (active, noisy play) can be used to reinforce a less preferred one (sitting still and listing to the teacher). Psychologists call this the **Premack principle**, after its discoverer. David Premack (1965) first demonstrated this concept in thirsty rats, which would spend more time running in an exercise wheel if the running were followed by an opportunity to drink. Conversely, another group of rats that were exercise deprived, but not thirsty, would increase the amount they drank, if drinking were followed by a chance to run in the wheel. In exactly the same way, then, parents can use the Premack principle to get children to engage in otherwise unlikely behavior. For example, the opportunity to play with friends (a preferred activity) could be used to reinforce the less-preferred activity of making the bed or doing the dishes.

Reinforcement across Cultures The laws of operant learning apply to all animals with a brain. The biological mechanism underlying reinforcement is, apparently, much the same across species. On the other hand, exactly what serves as a reinforcer varies wildly. Experience suggests that food for a hungry organism and water for a thirsty one will act as reinforcers because they satisfy basic needs related to survival. But what any particular individual will choose to satisfy those needs may depend as much on learning as on survival instincts—especially in humans, where secondary reinforcement is so important. For us, culture plays an especially powerful role in determining what will act as reinforcers. So, while people in some cul-

Instinctive drift The tendency of an organism's innate (instinctive) responses to interfere with learned behavior.

Token economy A therapeutic method, based on operant conditioning, by which individuals are rewarded with tokens, which act as secondary reinforcers. The tokens can be redeemed for a variety of rewards and privileges.

Premack principle The concept, developed by David Premack, that a more-preferred activity can be used to reinforce a less-preferred activity.

tures would find eating a cricket reinforcing, most people of Euro-American ancestry would not. Similarly, disposing of a noisy cricket might seem both sensible and rewarding to a Baptist, yet aversive to a Buddhist. And, just to underscore our point, we note that watching a game of cricket would most likely be rewarding to a British cricket fan—although punishingly dull to most Americans.

So, culture shapes preferences in reinforcement, but reinforcement also shapes culture. When you first walk down a street in a foreign city, all the differences that catch your eye are merely different ways that people have found to seek reinforcement or avoid punishment. A temple houses cultural attempts to seek rewards from the deity. Clothing may reflect attempts to seek a reinforcing mate or to feel comfortable in the climate. And a culture's cuisine evolves from learning to survive on the native plants and animals. It is in this sense, then, that we can see culture broadly as a set of behaviors originally learned by operant conditioning and shared by a group of people.

Foods that many people around the world enjoy may not be a source of reinforcement for the typical North American.

The Problem of Punishment

Punishment as a means of influencing behavior poses several difficulties, as schoolteachers and prison wardens will attest. In some respects, punishment acts as the opposite of reinforcement. Thus, **punishment** is an *aversive* consequence used to *weaken* the behavior it follows. But, like reinforcement, punishment comes in two main forms. One, called **positive punishment**, requires the *application of an aversive stimulus*—as, when you touch a hot plate, the painful consequence reduces the likelihood of your repeating that behavior. The other main form of punishment, known as **negative punishment**, results from the *removal of a reinforcer*—as when parents take away a misbehaving teen's car keys. Technically—in the strictest meaning of the term—an aversive stimulus is punishing only if it actually weakens the behavior it follows. In this sense, then, spankings or speeding tickets may or may not be punishment, depending on the results.

Unlike reinforcement, however, punishment must be administered consistently. Intermittent punishment is far less effective than punishment delivered after every undesired response. In fact, *not punishing* an occurrence of unwanted behavior can have the effect of rewarding it—as when a supervisor overlooks the late arrival of an employee.

Punishment versus Negative Reinforcement You have probably noted that punishment and negative reinforcement both involve unpleasant stimuli. So, to avoid confusion, let's see how punishment and negative reinforcement differ, using the following examples (Figure 3.5). Suppose that an animal in a Skinner box can turn off a loud, unpleasant noise by pressing a lever. This response produces negative reinforcement. Now compare that with the other animal in Figure 3.5 for which the loud noise serves as a punishment for pressing the lever.

Please note that punishment and negative reinforcement lead to opposite effects on behavior (Baum, 1994). Punishment *decreases* a behavior or reduces its probability of recurring. In contrast, negative reinforcement—like positive reinforcement—always *increases* a response's probability of occurring again.

Don't forget that the descriptors "positive" and "negative" mean "add" and "remove." Thus, both positive reinforcement and positive punishment involve administering or "adding" a stimulus. On the other hand, negative reinforcement and negative punishment always involve withholding or removing a stimulus. For a concise summary of the distinctions between positive and negative reinforcement and punishment, please see Table 3.1.

Punishment An aversive consquence which, occurring after a response, diminishes the strength of that response. (Compare with *negative reinforcement*.)

Positive punishment The application of an aversive stimulus after a response.

Negative punishment The removal of an attractive stimulus after a response.

The Uses and Abuses of Punishment Our society relies heavily on punishment and the threat of punishment to keep people "in line." We fine people, spank them, and give them bad grades, parking tickets, and disapproving looks. Currently, American jails and prisons contain more than 2 million people (Benson, 2003),

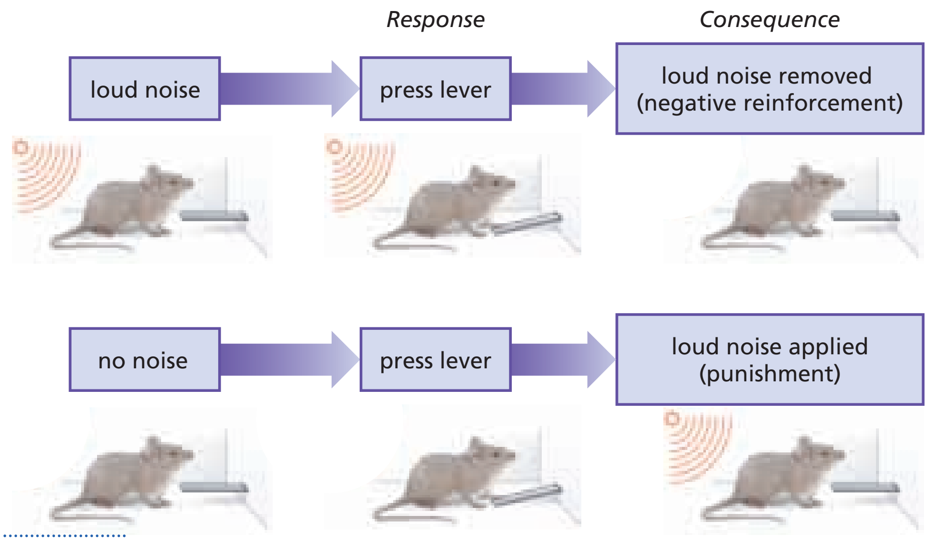


FIGURE 3.5
Negative Reinforcement and Punishment Compared

while the United States currently maintains one in every 32 of its citizens in jail or prison or on probation or parole (Bureau of Justice Statistics, 2007).

One reason we use punishment so often is that it can produce an immediate change in behavior—which, incidentally, reinforces the punisher. Several other factors also encourage a punishment habit. For one, punishers may feel good while delivering the punishment, sensing that they are "settling a score" or "getting even" or making the other person "pay." This is why we speak of revenge as being "sweet," a sentiment that seems to underlie public attitudes toward the punishment of lawbreakers (Carlsmith, 2006).

But, punishment—especially the sort of punishment involving pain, humiliation, or imprisonment—usually doesn't work as well in the long run (American Psychological Association, 2002b). Punished children may continue to misbehave; reprimanded employees may sabotage efforts to meet production goals.

TABLE 3.1 Four Kinds of Consequences

		Apply (add) Stimulus (positive)	Remove (subtract) Stimulus (negative)
What is the effect of the stimulus (consequence) on behavior?	The probability of the behavior increases.	**Positive reinforcement** Example: An employee gets a bonus for good work (and continues to work hard).	**Negative reinforcement** Example: You take aspirin for your headache, and the headache vanishes (so you take aspirin the next time you have a headache).
	The probability of the behavior decreases.	**Positive punishment** Example: A speeder gets a traffic ticket (and drives away more slowly).	**Negative punishment** Example: A child who has stayed out late misses dinner (and comes home early next time).

Three important points to keep in mind as you study this table:

1. "Positive" and "negative" mean that a stimulus (consequence) has been added (presented) or subtracted (removed). These terms have nothing to do with "good" or "bad."
2. We can often predict what effect a particular consequence will have, but the only way to know for sure whether it will be a reinforcer or a punisher is to observe its effect on behavior. For example, although we might guess that a spanking would punish a child, it might actually serve as a reinforcer to strengthen the unwanted behavior.
3. From a cognitive viewpoint, we can see that reinforcement consists of the presentation of a pleasant stimulus or the removal of an unpleasant one. Similarly, punishment entails the presentation of an unpleasant stimulus or the removal of a pleasant one.

And in the United States, people still commit crimes, despite the fact that we imprison criminals in numbers greater than any other nation on Earth (International Centre for Prison Studies, 2007). So, why is punishment so difficult to use effectively? There are several reasons.

First, *the power of punishment to suppress behavior usually disappears when the threat of punishment is removed* (Skinner, 1953). Drivers will observe the speed limit when they know the highway patrol is watching. Johnny will refrain from hitting his little brother when his parents are within earshot. And you will probably give up your wallet to a mugger who points a gun at you. That is, most people will comply with a demand accompanied by the threat of strong and certain punishment. But they may act quite differently when they know punishment is unlikely. This explains why motorists rarely slow down for "construction speed" signs on the highways: They know that the police rarely enforce these zones. In general, you can be certain of controlling someone's behavior through punishment or threat of punishment only if you can control the environment all of the time. Such total control is usually not possible, even in a prison.

Second, *the lure of rewards may make the possibility of punishment seem worth the price*. This seems to be a factor that encourages drug dealing—when the possibility of making a large amount of money outweighs the possibility of prison time (Levitt & Dubner, 2005). And, in a different way, the push-pull of punishment and rewards also affects dieters, when the short-term attraction of food may overpower the unwanted long-term consequences of weight gain. Again, if you attempt to control someone's behavior through punishment, you may fail if you do not control the rewards, as well.

Third, *punishment triggers escape or aggression*. When punished, organisms usually try to flee from or otherwise avoid further punishment. But if escape is blocked, they are likely to turn aggressive. Corner a wounded animal, and it may savagely attack you. Put two rats in a Skinner box with an electrified floor grid, and the rats will attack each other (Ulrich & Azrin, 1962). Put humans in a harsh prison environment, and they may riot—or, if they are prison guards, they may abuse the prisoners (Zimbardo, 2004b, 2007).

Further, in a punitive environment, whether it be a prison, a school, or a home, people learn that punishment and aggression are legitimate means of influencing other. The punishment–aggression link also explains why abusing parents so often come from abusive families and why aggressive delinquents so often come from homes where aggressive behavior toward the children is commonplace (Golden, 2000). Unfortunately, the well-documented fact that punishment so often leads to aggression remains widely unknown to the general public.

Here's a fourth reason why punishment is so often ineffective: *Punishment makes the learner apprehensive, which inhibits learning new and more desirable responses*. Unable to escape punishment, an organism may give up its attempts at flight or fight and surrender to an overwhelming feeling of hopelessness. This passive acceptance of a punitive fate produces a behavior pattern called *learned helplessness* (Overmier & Seligman, 1967). In people, this reaction can produce the mental disorder known as depression (Terry, 2000).

CONNECTION • CHAPTER 12

Depression is one of the most common mental disorders.

If you want to produce a constructive change in attitudes and behavior, then learned helplessness and depression are undesirable outcomes. The same goes for aggression and escape. Moreover, punishment fails to help learners see what to do because it focuses attention on what *not* to do. All of these outcomes interfere with new learning. By contrast, individuals who have not been punished feel much freer to experiment with new behaviors.

And a fifth reason why punitive measures may fail: *Punishment is often applied unequally*, even though that violates our standards of fair and equal treatment. For example, parents and teachers punish boys more often than girls.

Then, too, children (especially grade school children) receive more physical punishment than do adults. And, to give one more example, our schools—and probably our society at large—more often punish members of minority groups than members of the majority (Hyman, 1996).

Prison riots and other aggressive behavior may result from highly punitive conditions.

Does Punishment Ever Work? In limited circumstances, punishment can work remarkably well. For example, punishment can halt the self-destructive behavior of children with autism, who may injure themselves severely, in some cases, by banging their heads or chewing the flesh off their fingers. A mild electric shock or a splash of cold water in the face can quickly put a stop to such unwanted behavior, although the effects may be temporary (Holmes, 2001). It can also be combined effectively with reinforcement—as when students receive good grades for studying and failing grades for neglecting their work.

Punishment is also more likely to be successful if it involves a *logical consequence:* a consequence that is closely related to the undesirable behavior—as contrasted with an *un*related punishment, such as spanking or grounding. So, if a child leaves a toy truck on the stairs, a logical consequence might be that the toy "disappears" for a week. To give another example, a logical consequence of coming home late for dinner is getting a cold dinner.

Rather than a purely punitive approach to misbehavior, we suggest you consider some combination of logical consequences, extinction, and the rewarding of desirable alternative responses. And when you do decide to use punishment, it should meet the following conditions:

- *Punishment should be swift*—that is, immediate. Any delay will impair its effectiveness, so "You'll get spanked when your father gets home" is a poor punishment strategy.
- *Punishment should be certain*—consistently administered every time the unwanted response occurs. When "bad" behavior goes unpunished, the effect can actually be rewarding.
- *Punishment should be limited in duration and intensity*—just enough to stop the behavior but appropriate enough to "make the punishment fit the crime."
- *Punishment should clearly target the behavior* and be a *logical consequence of the behavior,* rather than an attack on character of the person (humiliation, sarcasm, or verbal abuse) or physical pain.
- *Punishment should be limited to the situation in which the response occurred.*
- *Punishment should not give mixed messages* to the punished person (such as, "You are not permitted to hit others, but I am allowed to hit you").
- *The most effective punishment is usually negative punishment,* such as loss of privileges, rather than the application of unpleasant stimuli, such as a spanking.

A Checklist for Modifying Operant Behavior

Think of someone whose behavior you would like to change. For the sake of illustration, let's consider your nephew Johnny's temper tantrums, which always seem to occur when you take him out in public. Operant conditioning offers a selection of tools that can help: positive reinforcement, punishment, negative reinforcement, and extinction.

- *Positive reinforcement* is a good bet, if you can identify and encourage some desirable behavior in place of the unwanted behavior. The most effective parents and teachers often do this by distraction—by shifting the child's attention to some other reinforcing activity. And don't overlook the Premack principle, by which Johnny gets to do something he likes if he refrains from temper outbursts.
- *Punishment* may be tempting, but we have seen that it usually produces unwanted effects, such as aggression or escape. In addition, punishment usually has a bad effect on the relationship between punisher and the person being punished. Moreover, punishment is difficult to employ with unfailing consistency. If you do decide to punish Johnny for his tantrums, consider making it a logical consequence, such as "time out" in his room while he is making his scene—doing so swiftly, certainly, but without undue harshness.
- *Negative reinforcement* carries many of the same drawbacks as punishment, because it involves unpleasant stimulation. In its most common form, the parents attempt to use nagging (an aversive stimulus) until the desired behavior occurs, whereupon the nagging presumably stops (negative reinforcement). Such tactics rarely work to anyone's satisfaction. The only time negative reinforcement really works well is when the aversive conditions were imposed naturally and impersonally—as when you have headache and take aspirin, which produces negative reinforcement when your headache goes away. In Johnny's case, if he were required to take his temper tantrum to his room (a punishment), then being allowed to come out of his room when his misbehavior stops could be an effective negative reinforcement.
- *Extinction* guarantees solution, but only if you control all the reinforcers. In Johnny's case, extinction simply means not giving in to the temper tantrum and not letting him have what he wants (attention or candy, for example). Instead, you simply allow the tantrum to burn itself out. This can be embarrassing, because children intuitively pick the most public places for such displays—a good sign that they are doing so for attention. Another problem with extinction, however, is that it may take a while, so extinction is not a good option if the subject is engaging in dangerous behavior, such as playing in a busy street.

The best approach—often recommended by child psychologists—combines several tactics. In Johnny's case, this might involve both reinforcing his desirable behaviors and using extinction or logical consequences on his undesirable ones.

We recommend memorizing the four items on this checklist: *positive reinforcement, punishment, negative reinforcement,* and *extinction.* Then, whenever you are dealing with someone whose behavior is undesirable, go through the list and see whether one or more of these operant tactics might do the trick. And remember: The behavior you may want to change could be your own!

Operant and Classical Conditioning Compared

Now that we have looked at the main features of operant and classical conditioning, let's compare them side by side. As you can see in Table 3.2, the *consequences* of behavior—especially, rewards and punishments—distinguish operant conditioning different from classical conditioning. But note this point of potential confusion: As the example in Figure 3.6 shows, food acts as a reward in operant conditioning, but in classical conditioning, food acts as an unconditioned stimulus. The important thing to note is that in classical conditioning the food comes *before* the response—and therefore it cannot serve as a reward.

Because classical conditioning and operant conditioning differ in the order in which the stimulus and response occur, classically conditioned behavior is largely a response to *past stimulation.* (Think of Pavlov's dogs salivating after hearing a bell.) Operant behavior is directed at attaining some *future* reinforcement or

TABLE 3.2 Classical and Operant Conditioning Compared

Classical Conditioning	Operant Conditioning
Behavior is controlled by stimuli that precede the response (by the CS and UCS).	Behavior is controlled by consequences (rewards, punishments, and the like) that *follow* the response.
No reward or punishment is involved (although pleasant and aversive stimuli may be used).	Often involves reward (reinforcement) or punishment.
Through conditioning, a new stimulus (the CS) comes to produce "old" (reflexive) behavior.	Through conditioning, a new stimulus (a reinforcer) produces new behavior.
Extinction is produced by withholding the UCS.	Extinction is produced by withholding reinforcement.
Learner is passive (responds reflexively): Responses are involuntary. That is, behavior is *elicited* by stimulation.	Learner is active (operant behavior): Responses are voluntary. That is, behavior is *emitted* by the organism.

avoiding a punishment. (Think of a dog sitting up to get a food reward.) To say it another way, operant conditioning requires a stimulus that follows the response, whereas classical conditioning ends with the response. (See Figure 3.7.)

Another difference between the two types of conditioning lies in the kinds of behaviors they target. Operant conditioning encourages *new behaviors*—whether they be pulling slot machine levers, making beds, brushing teeth, going to work, or studying for an exam. Classical conditioning, on the other hand, emphasizes eliciting *old responses to new stimuli*—such as salivating at the sound of a bell or flinching at the sound of a dentist's drill.

You may have also noticed that extinction works in slightly different ways in the two forms of learning. In classical conditioning, extinction requires with-

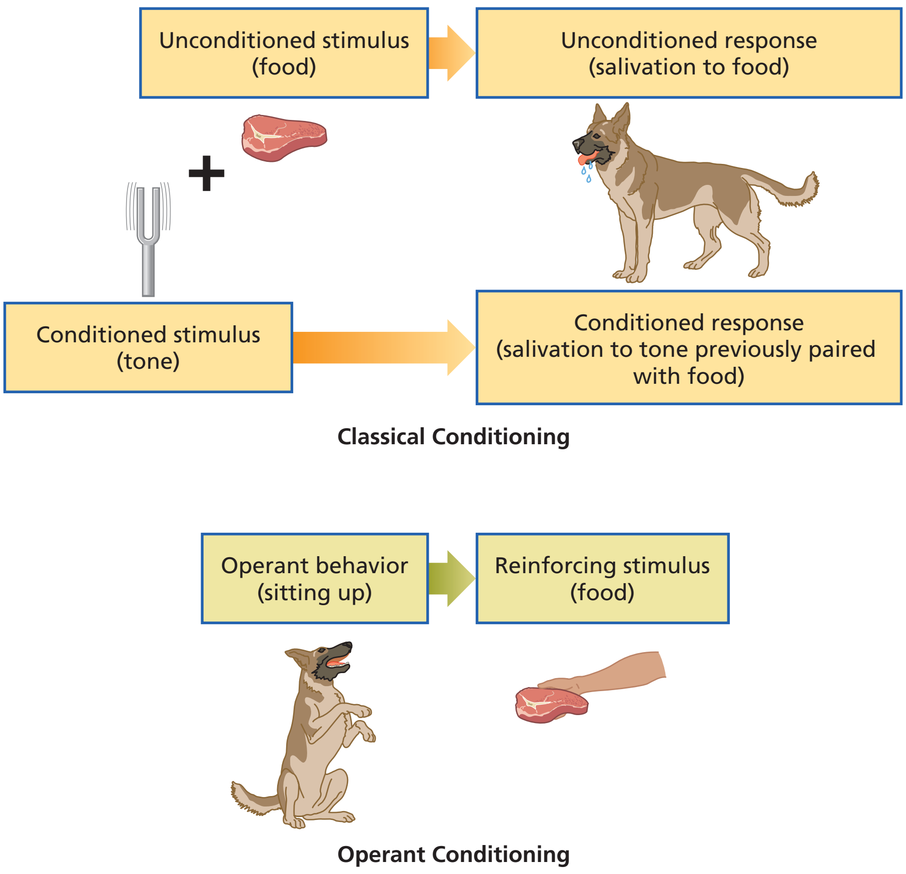
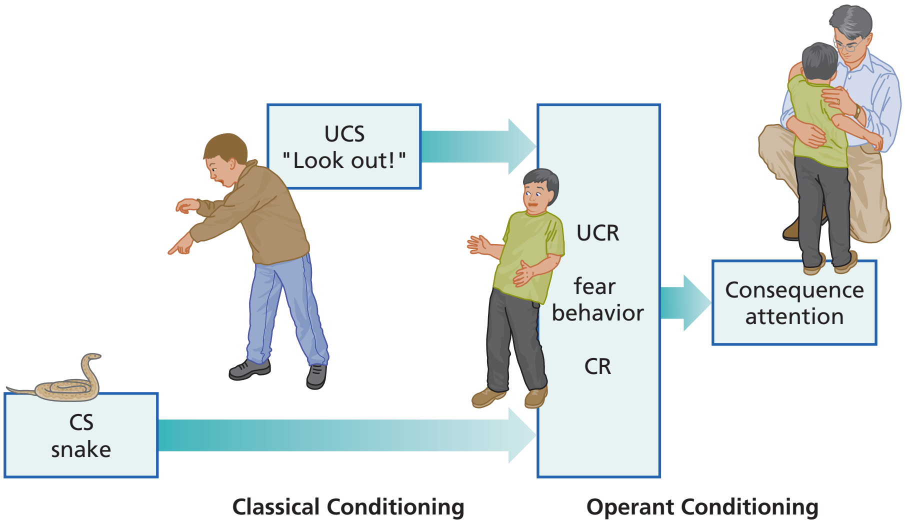


FIGURE 3.6
The Same Stimulus Plays Different Roles in Classical Conditioning and Operant Conditioning

The same stimulus (food) can play vastly different roles, depending on which type of conditioning is involved. In classical conditioning, it can be the UCS, while in operant conditioning it can serve as a reinforcer for operant behavior. Note also that classical conditioning involves the association of two stimuli that occur *before* the response. Operant conditioning involves a reinforcing (rewarding) or punishing stimulus that occurs *after* the response.

FIGURE 3.7
Classical and Operant Conditioning Can Work Together

A response originally learned through classical conditioning can be maintained and strengthened by operant reinforcement.



holding the unconditioned stimulus. In operant conditioning, extinction results from withholding the reinforcer.

Operant conditioning and classical conditioning differ in several other important ways that you see in Table 3.2. For one, operant behavior is not based on an automatic reflex action, as was the dog's salivation or Little Albert's crying. Accordingly, operant behavior seems more "voluntary"—more under the control of the responder. To paraphrase a proverb: You can stimulate a dog to salivation (a reflex), but you can't make it eat (an operant behavior).

But don't make the mistake of thinking that classical and operant conditioning are competing explanations for learning. They can be complementary. In fact, responses that were originally learned by classical conditioning will often be maintained later by operant conditioning. How might this happen? Consider a snake phobia. Suppose that the fear of snakes was originally learned by classical conditioning when a snake (CS) was paired with a frightening UCS (someone yelling, "Look out!"). Once the phobic response is established, it could be maintained and strengthened by operant conditioning, as when bystanders give attention to the fearful person (Figure 3.7).

PSYCHOLOGYMATTERS

Using Psychology to Learn Psychology

You may have tried the Premack principle to trick yourself into studying more, perhaps by denying yourself TV time or a trip to the refrigerator until your homework was done. It works for some people, but if it doesn't work for you, try making the studying itself more enjoyable and more reinforcing.

For most of us, getting together with people we like is reinforcing, regardless of the activity. So, you can make some (not all) of your studying a social activity. That is, schedule a time when you and another classmate or two can get together to identify and clarify important concepts and to try to predict what will be on the next test.

Don't focus just on vocabulary. Rather, try to discover the big picture—the overall meaning of each section of the chapter. The Core Concepts are a good place to start. Then you can discuss with your friends how the details fit in with the Core Concepts. You will most likely find that the social pressure of an upcoming study group will help motivate you to get your reading done and identify murky points. When you get together for your group study session, you will find that explaining what you have learned reinforces your own learning. The real reinforcement comes, however, from spending some time—studying—with your friends!

Check Your Understanding

1. **APPLICATION:** Give an example of a response that a pet dog or cat might learn that could be explained by Thorndike's *law of effect.*
2. **APPLICATION:** Give an example of *negative reinforcement* from your own life.
3. **APPLICATION:** Suppose that you have taught your dog to roll over for the reward of a dog biscuit. Then, one day you run out of dog biscuits. Which schedule of reinforcement would keep your dog responding the longest time?
   a. continuous reinforcement
   b. intermittent reinforcement
   c. negative reinforcement
   d. noncontingent reinforcement
4. **RECALL:** Give an example of something that serves as a conditioned reinforcer for most people.
5. **APPLICATION & ANALYSIS:** Suppose that you are trying to teach Stevie not to hit his sister. What operant techniques would you use? Also, explain why neither extinction nor negative reinforcement would be wise in this case.
6. **UNDERSTANDING THE CORE CONCEPT:** What is a feature of operant conditioning that distinguishes it from classical conditioning?

Answers **1.** Any response that was learned by being rewarded—such as sitting up for a food reward or scratching at the door to be let in the house—involves Thorndike's law of effect. **2.** Negative reinforcement occurs any time that your behavior causes an unpleasant stimulus to stop bothering you. Examples include taking aspirin to stop a pain, going to the dentist for a toothache, or opening an umbrella in the rain. **3.** b **4.** Money is probably the most common example. **5.** The best approach is probably some combination of reinforcing alternative responses and "time out" for hitting behavior. Under extinction alone, Stevie would still continue to hit his sister for a period of time, until the behavior is extinguished, which might inflict an undue hardship on the sister. Negative reinforcement would also be undesirable, because it would require contriving for Stevie an unpleasant or painful stimulus that you would remove when his behavior improved: This would have all the disadvantages of punishment. **6.** In operant conditioning, learning depends on stimuli that occur after the response. These stimuli include rewards and punishments. By contrast, classical conditioning focuses on stimuli that occur before the response.

3.3 KEY QUESTION
HOW DOES COGNITIVE PSYCHOLOGY EXPLAIN LEARNING?

According to biologist J. D. Watson's (1968) account in *The Double Helix,* he and Francis Crick cracked the genetic code one day in a flash of insight following months of trial and error. You may have had a similarly sudden, if less famous, insight when solving a problem of your own. Such events present difficulties for strict behaviorists because they obviously involve learning, but they are hard to explain in terms of Pavlovian or Skinnerian conditioning.

Many psychologists believe that an entirely different process, called *cognitive learning,* is responsible for such flashes of insight. From a cognitive perspective, learning does not always show itself immediately in behavior. Instead, learning can be reflected in mental activity alone—as the Core Concept for this section says:

According to cognitive psychology, some forms of learning must be explained as changes in mental processes, rather than as changes in behavior alone.

core concept

Let's see how cognitive psychologists have approached this task of examining the covert mental processes behind learning. To do so, we first take you on a trip to the Canary Islands, off the coast of northern Africa.

Insight Learning: Köhler in the Canaries with the Chimps

Isolated on the island of Tenerife during World War I, Gestalt psychologist Wolfgang Köhler *(KER-ler)* had time to think long and hard about learning. Disenchanted with the behaviorists' explanation for learning, Köhler sought to develop his own theories. To his way of thinking, psychology had to recognize mental processes as an essential component of learning, even though mental events had

CONNECTION • CHAPTER 7
Gestalt psychology is best known for its work on perception.

The ruins of Köhler's old laboratory, known as La Casa Amarilla (the Yellow House), can still be seen near the town of Puerto de La Cruz (Johnson, 2007). You can see a satellite view of it, using the following coordinates in Google Earth: latitude 28° 24′52.23″ N and longitude 16° 31′47.93″ W. If you enjoy historical mysteries, you might read **A Whisper of Espionage,** *a book exploring the possibility that Köhler was not only studying chimpanzee behavior but also spying on allied shipping from his laboratory's vantage point on the coast of Tenerife during World War I (Ley, 1990).*

Insight learning A form of cognitive learning, originally described by the Gestalt psychologists, in which problem solving occurs by means of a sudden reorganization of perceptions.

been spurned as subjective speculation by the behaviorists. To press his point, Köhler took advantage of a primate research facility, constructed by the German government on Tenerife. There he contrived experiments designed to reveal cognitive learning in observable behavior (Sharps & Wertheimer, 2000; Sherrill, 1991).

In a series of famous studies, Köhler showed that his chimps could learn to solve complex problems, not just by trial-and-error (an explanation favored by behaviorists), but by "flashes of insight" that combined simpler responses learned previously. One such experiment involved Sultan, a chimp that had learned to pile up boxes and scramble on top of them to reach fruit suspended high in his cage and to use sticks to obtain fruit that was just out of reach. When Köhler presented Sultan with a novel situation that combined the two problems—with fruit suspended even higher in the air—the chimp first attacked it unsuccessfully with sticks, in trial-and-error fashion. Then, in apparent frustration, Sultan threw the sticks away, kicked the wall, and sat down. According to Köhler's report, the animal then scratched his head and began to stare at some boxes nearby. After a time of apparent "thinking," he suddenly jumped up and dragged a box and a stick underneath the fruit, climbed on the box, and knocked down his prize with the stick.

Remarkably, Sultan had never before seen or used such a combination of responses. This behavior, Köhler argued, was evidence that the animals were not mindlessly using conditioned responses but were learning by *insight:* by reorganizing their *perceptions* of problems. He ventured that such behavior shows how apes, like humans, learn to solve problems by suddenly perceiving familiar objects in new forms or relationships—a decidedly mental process, rather than a merely behavioral one. He called this **insight learning** (Köhler, 1925). Insight learning, said Köhler, results from an abrupt reorganization of the way a situation is perceived.

Behaviorism had no convincing explanation for Köhler's demonstration. Neither classical nor operant conditioning could account for Sultan's behavior in stimulus–response terms. Thus, the feats of Köhler's chimps demanded the cognitive explanation of perceptual reorganization.

The sort of learning displayed by Köhler's chimps defied explanation by the behaviorists—in terms of classical conditioning and operant conditioning. Here you see Sultan, Köhler's smart animal, solving the problem of getting the bananas suspended out of reach by stacking the boxes and climbing on top of them. Köhler claimed that Sultan's behavior demonstrated insight learning.

Cognitive Maps: Tolman Finds Out What's on a Rat's Mind

Not long after Köhler's experiments with chimpanzees, the rats in Edward Tolman's lab at Berkeley also began behaving in ways that flew in the face of accepted behavioral doctrine. They would run through laboratory mazes as if following a mental "map" of the maze, rather than mindlessly executing a series of learned behaviors. Let's see how Tolman managed to demonstrate these "mindful" responses.

Mental Images—Not Behaviors If you have ever walked through your house in the dark, you have some idea what Tolman meant by "cognitive map." Technically, a **cognitive map** is a mental image that an organism uses to navigate through a familiar environment. But could such a simple-minded creature as a rat have such complex mental imagery? And, if so, how could the existence of these cognitive maps be demonstrated? A cognitive map, Tolman argued, was the only way to account for a rat quickly selecting an alternative route in a maze when the preferred path to the goal is blocked. In fact, rats will often select the shortest detour around a barrier, even though taking that particular route was never previously reinforced. Rather than blindly exploring different parts of the maze through trial and error (as behavioral theory would predict), Tolman's rats behaved as if they had a mental representation of the maze. (Figure 3.8 shows the arrangement of such a maze.)

In further support of his claim that learning was *mental,* not purely behavioral, Tolman offered another experiment: After his rats had learned to run a maze, he flooded it with water and showed that the rats were quite capable of swimming though the maze. Again, this demonstrated that what the animals had learned was a *concept,* not just behaviors. Instead of learning merely a sequence of right and left turns, Tolman argued, they had acquired a more abstract mental representation of the maze's spatial layout (Tolman & Honzik, 1930; Tolman et al., 1946).

Cognitive map In Tolman's work a cognitive map was a mental representation of a maze or other physical space. Psychologists often used the term *cognitive map* more broadly to include an understanding of connections among concepts. (Note that your *Grade Aid* study guide uses the related term *concept map* for the diagrams showing the relationships among concepts in every chapter.) Thus, a cognitive map can represent either a physical or a mental "space."

Learning without Reinforcement In yet another study that attacked the very foundations of behaviorism, Tolman (1948) allowed his rats to wander freely about a maze for several hours. During this time, the rats received no rewards at all—they simply explored the maze. Yet, despite the lack of reinforcement, which behaviorists supposed to be essential for maze learning, the rats later learned to run the

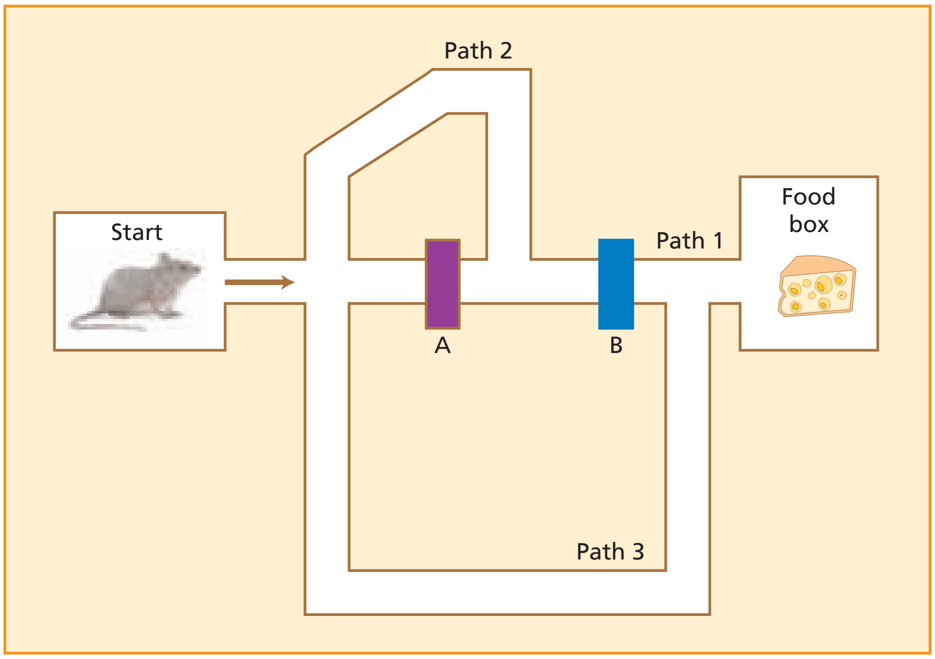


FIGURE 3.8
Using Cognitive Maps in Maze Learning

Rats used in this experiment preferred the direct path (Path 1) when it was open. When it was blocked at A, they preferred Path 2. When Path 2 was blocked at B, the rats usually chose Path 3. Their behavior indicated that they had a cognitive map of the best route to the food box.

(*Source:* From "Degrees of Hunger, Reward and Nonreward, and Maze Learning in Rats," by E. C. Tolman and C. H. Honzik, *University of California Publication of Psychology,* Vol. 4, No. 16, December 1930.)

In the BoBo doll experiment, a boy and girl imitate the aggressive behavior that they have seen from an adult.

maze for a food reward more quickly than did other rats that had never seen the maze before. Obviously, they had learned the maze during the exploratory period, even though no hint of learning could be seen in their behavior at the time. Tolman called this *latent learning*.

The Significance of Tolman's Work As with Köhler's experiments, what made Tolman's work both significant and provocative was its challenge to the prevailing views of Pavlov, Watson, and the other behaviorists. While Tolman accepted the idea that psychologists must study observable behavior, he showed that simple associations between stimuli and responses could not explain the behavior observed in his experiments. Tolman's *cognitive* explanations, therefore, presented a provocative challenge to behaviorism (Gleitman, 1991).

Subsequent experiments on cognitive maps in rats, chimpanzees, and humans have broadly supported Tolman's work (Olton, 1992). More recently, brain imaging has pointed to the hippocampus as a structure involved in "drawing" the cognitive map in the brain (Jacobs & Schenk, 2003). So, it seems clear that Tolman was on target: Organisms learn the spatial layout of their environments by exploration, and they do so even if they are not reinforced for exploring. From an evolutionary perspective, the ability to make cognitive maps would be highly adaptive in animals that must forage for food (Kamil et al., 1987).

In the following section we shall see that Albert Bandura followed in Tolman's footsteps by toppling yet another pillar of behaviorism: the idea that rewards and punishments act only on the individual receiving them. Bandura proposed that rewards and punishments can be effective even if we merely see someone else get them. (This is why casinos make such a fuss over jackpot winners.) Bandura's work, then, suggests that the consequences of behavior can operate indirectly, through *observation*. Let's see how he demonstrated this idea.

Observational Learning: Bandura's Challenge to Behaviorism

Does observing violent behavior make viewers more likely to become violent? A classic study by Albert Bandura suggests that it does—at least in the children he invited to his lab for a simple experiment. All it took to bring out aggressive behavior in these children was watching adults seeming to enjoy punching, hitting, and kicking an inflated plastic clown (a BoBo doll). When later given the opportunity, the children who had seen the adult models showed far more aggressive behavior toward the doll than did children in a control condition who had not observed the aggressive models (Bandura et al., 1963). Subsequent studies showed that children will similarly imitate aggressive behaviors they have seen on film—yes, even when the models were merely cartoon characters.

Learning by Observation and Imitation An important implication of Bandura's BoBo doll study is that learning by observation and imitation can affect our behavior in situations where we have had no previous opportunity for personal experience. Thus, learning can occur not only by direct experience but also by watching the behavior of another person, or *model*. If the model's actions appear successful—that is, if the model seems to find it reinforcing—we may seek to behave in the same way. You can think of learning by observation and imitation as an extension of operant conditioning, by which we observe someone else getting rewards but act as though we had also received a reward.

Psychologists call this *social learning* or **observational learning**. It accounts for children learning aggressive behavior by imitating aggressive role models who are perceived as successful or admirable or who seem to be enjoying themselves. Observational learning also accounts for how people learn athletic skills, how to drive a car, and how to behave with friends and then shift roles in a job inter-

Observational learning A form of cognitive learning in which new responses are acquired after watching others' behavior and the consequences of their behavior.

view. And it accounts for changes in clothing fashions and the rapid spread of slang expressions.

Observational learning occurs in nonhuman species, too, as when a mother cat teaches her kittens how to hunt. One study demonstrated that even a creature as simple-brained as the octopus can learn by example from watching the behavior of other octopi (Fiorito & Scotto, 1992). And, not to be outdone, a clever bowerbird in an Australian national park has achieved some notoriety through observational learning by fooling tourists with its imitation of a cell phone ringing (Winters, 2002).

Effects of Media Violence As you might have guessed, much of the research on observational learning has focused on the impact of violence in film and video (Huesmann et al., 2003). Predictably, the issue is a controversial one, because much of the evidence is *correlational* (Anderson & Bushman, 2002). That evidence makes a credible case, based on more than 50 studies showing that observing violence is associated with violent behavior. But does observing violence *cause* violent behavior? Or is it the other way around? Or, could it be that violent people are drawn to violent films and videos?

Thanks to more than 100 *experimental* studies, however, the experts have concluded that observing violence increases the likelihood of violent behavior (Huesmann & Moise, 1996; Primavera & Heron, 1996). And if that were not sufficient, we have experimental evidence that viewers of media violence show less emotional arousal and distress, when they subsequently observe violent acts—a habituation-like condition known as *psychic numbing* (Murray & Kippax, 1979). Finally, psychologist Elliot Aronson makes a case that extensive media violence is one important factor contributing to violent tragedies, such as the Columbine High School shootings (Aronson, 2000).

CONNECTION • CHAPTER 1
Only an *experimental* study can determine cause and effect.

Not all imitation is harmful, of course. We also learn by imitation about charitable behavior, comforting others in distress, and driving on the legal side of the road. In general, we can say that people learn much—both prosocial (helping) and antisocial (hurting) behaviors—through observation of others. This capacity to learn from watching enables us to acquire behaviors efficiently, without going through tedious trial and error. So, while observational learning seems to be a factor in violent behavior, it also enables us to learn socially useful behaviors by profiting from the mistakes and successes of others.

Observational Learning Applied to Social Problems around the Globe
Television is one of the most powerful sources of observational learning—and not necessarily of the undesirable sort that we have just noted. Here at home the long-running children's program, *Sesame Street,* uses such well-loved characters as Big Bird and the Cookie Monster to teach language, arithmetic, and courtesy through observational learning. And in Mexico, TV executive Miguel Sabido has deliberately drawn on Bandura's work in creating the popular soap opera *Ven Conmigo* (Come with Me), which focuses on a group of people who connect through a literacy class. After the initial season, enrollment in adult literacy classes in the broadcast area shot up to nine times the level in the previous year (Smith, 2002b).

The idea was taken up by a nonprofit group, Populations Communications International, which has promoted it worldwide. As a result, television dramas are now aimed not only at literacy but at promoting women's rights and safe sex and at preventing HIV and unwanted pregnancies. Such programs can be wildly popular, reaching large numbers of devoted fans in dozens of countries and regions around the world, including Latin American, Africa, South and East Asia, the Middle East, the Caribbean, and the Philippines. In China observers learn about the value of girls; in Tanzania they learn that AIDS is transmitted by people, not by mosquitoes; and in India the programs question the practice of child marriages. In the Caribbean, soap operas now promote responsible environmental practices.

Does it work? Very well, say professors Arvind Singhal and Everett Rogers (2002), who are currently gathering data on such projects. Because of a soap opera broadcast in India, a whole village signed a letter promising to stop the practice of child marriages. Similarly, Tanzanians now increasingly approve of family planning. And in rural villages in India, the enrollment of girls in school has risen between 10 and 38%. Overall, it appears that the use of television as a means of producing positive social change is a success story, showing that psychological theory and research can make a significant difference in people's lives.

Rethinking Behavioral Learning in Cognitive Terms

In the last few decades of the 20th century, a new breed of *cognitive-behavioral psychologists* ventured deep into the territory of classical and operant conditioning, giving those behavioral theories a cognitive tweak (Leslie, 2001). One of the big issues they raised focuses on the survival value of classical conditioning for an animal (Hollis, 1997). Specifically, Leon Kamin (1969) has shown that the crucial feature of the conditioned stimulus is its *informativeness.* In his landmark conditioning experiments, Kamin presented an animal with multiple stimuli, such as lights and sounds—sometimes alone and sometimes in pairs. He found that only those stimuli that reliably helped the animal predict the unconditioned stimulus would become conditioned stimuli and so produce a conditioned response—which explains why the most effective CS is one that *precedes* the UCS. We also saw another version of CS informativeness a few pages ago, when we discussed conditioned food aversions—where a *taste,* but not other stimuli present at the time, could serve as a warning of toxic food and, therefore, come to produce nausea as a conditioned response. As Robert Rescorla (1988), another leader of the cognitive-behavioral movement, has noted:

> Pavlovian conditioning is not a stupid process by which the organism willy-nilly forms associations between any two stimuli that happen to co-occur. Rather, the organism is better seen as an information seeker using logical and perceptual relations among events . . . to form a sophisticated representation of the world. (p. 154)

Cognitive-behavioral psychologists argue that operant conditioning also demands a cognitive explanation. As evidence, they point to Tolman's rats, following cognitive maps through a maze, and to the children pummeling the BoBo doll in Bandura's experiment. Reinforcement, they point out, changes not only behavior but the individual's *expectations* for future rewards or punishments in similar situations. Perhaps an example will help clarify this point: If you learn something in class that helps you get a better grade on the next exam, this affects your subsequent class attendance, because you now *expect* rewards for doing so. (See Table 3.3.)

Brain Mechanisms and Learning

What do we know about the biology behind learning? On the level of neurons, learning apparently involves physical changes that strengthen the synapses in groups of nerve cells—a process called **long-term potentiation** (Antonova et al., 2001; Kandel, 2000). Initially, the neurons in different brain areas involved in the learning task work very hard—for example, as a person learns the location of various objects, cells in the visual and parietal cortex may fire rapidly. But as learning progresses, the connections among the different cortical regions become stronger, and the firing pattern becomes less intense (Büchel et al., 1999).

Long-term potentiation A biological process involving physical changes that strengthen the synapses in groups of nerve cells that is believed to be the neural basis of learning.

In operant conditioning, the brain's reward circuitry also comes into play, especially parts of the frontal cortex and the limbic system, with its circuits rich

TABLE 3.3 Behavioral Learning and Cognitive Learning Compared

Behavioral Learning	Cognitive Learning
Focus is on observable events (stimuli and responses) only.	Inferences are made about mental processes that are not directly observable.
Learning consists of associations among stimuli and responses.	Learning as information processing: The learner seeks useful information from stimuli.
Main forms of learning are habituation, classical conditioning, and operant (instrumental) conditioning.	Learning also involves insight, observational learning, cognitive maps, and other more complex forms of learning.
Developed as a rebellion against the subjective methods of structuralism and functionalism: Behaviorism became the dominant perspective for much of the 20th century.	Developed as a rebellion against the narrow perspective of behaviorism: Cognitive psychology became the dominant perspective at the end of the 20th century.
Big names include Pavlov, Thorndike, Watson, Skinner.	Big names include Köhler, Tolman, Bandura, Kamin.

in dopamine receptors (O'Doherty et al., 2004; Roesch & Olson, 2004). Many experts now believe that the brain uses this circuitry to sense the rewards that are the essence of positive reinforcement (Fiorillo et al., 2003; Shizgal & Avanitogiannis, 2003). The limbic system also helps us remember the strong emotions, such as fear, so often associated with classical conditioning (Miller, 2004). And, in the next chapter, when we talk about memory, you will learn about some other parts of the brain that get involved in learning the places of objects in space and remembering events.

The Brain on Extinction While it can be important for our survival to remember emotion-laden events, it's also important to *forget* associations that turn out to be unimportant. So, just as wild animals need to forget about a water hole that has run dry, you must learn to deal with a change in train schedules or traffic laws. These examples, as you will remember, involve *extinction* of responses learned previously. And, recently, neuroscientists have found that extinction occurs when certain neurotransmitters, including glutamate and norepinephrine, block memories (Miller, 2004; Travis, 2004). These discoveries have stimulated the search for drugs that can block unwelcome memories of emotional experiences. One day, perhaps, such drugs can be given to people who have undergone extreme trauma in the hope of avoiding posttraumatic stress disorders—which are common among accident victims, rape survivors, and combat veterans. However, ethical questions remain about who decides which memories should be suppressed.

Linking Behavioral Learning with Cognitive Learning Neuroscientists Eric Kandel and Robert Hawkins (1992) have made a proposal that may connect behavioral learning and cognitive learning at the level of brain pathways. Their theory rests on the discovery that animals with relatively simple nervous systems have a single type of nerve circuit that enables them to learn simple behavioral responses. In the more complex brains of mammals, however, neuroscientists have found a second type of learning circuitry that apparently facilitates higher forms of learning, such as memory for events.

What is the significance of these findings? Kandel and Hawkins speculated that the two types of learning circuits may divide the task of learning along the same line that has long separated behavioral psychologists and cognitive psychologists. Some other psychologists now tentatively agree (Clark & Squire, 1998; Jog et al., 1999). The simpler circuit seems to be responsible for the sort of "mindless" learning that occurs when a dog drools at the sound of a bell or when a person acquires a motor skill, such as riding a bike or swinging a golf club. This kind of learning occurs slowly and improves with repetition over many trials. Significantly, classical conditioning and much of operant learning fit this description. By contrast, the second type of learning circuit seems to be responsible for more complex forms of learning that require conscious processing—the sort of learning that interests cognitive psychologists: concept formation, insight learning, observational learning, and memory for specific events. If further research verifies that this division reflects a fundamental distinction in the nervous system, we will be able to say that those on the behavioral and cognitive extremes were both (partly) right. They were talking about fundamentally different forms of learning.

Observational Learning and Mirror Neurons People obviously learn from their observations of others, as we saw in Bandura's "BoBo doll" studies. Similarly, if you see someone at the dinner table take a bite and grimace with disgust, you will be reluctant to taste the same dish—again, a form of observational learning. But the mystery has always been to understand how our brains respond to somebody else's rewards or punishments. The recent discovery of mirror neurons suggests a neurological basis for observational learning. The "mirror cells" in our brains apparently are finely tuned to help us "mirror" other people's sense of being rewarded or punished by activating the same circuits in our own brains (Jaffe, 2007).

CONNECTION • CHAPTER 2
Mirror neurons help us imitate other people's behavior.

"Higher" Cognitive Learning

It now seems clear that much of the complex and abstract learning required in college classes is fundamentally different from the learning that Pavlov, Watson, and Skinner studied. Acquiring knowledge about the field of psychology, for example, involves building mental images, assimilating concepts, and pondering ways they can be related. It's not that behavioral conditioning isn't involved in human learning—after all, students do work for grades and salivate when they see a pizza—but the principles of behavioral learning don't tell the whole story of "higher" cognitive learning.

The following chapters will take us deeper into this realm of cognitive learning, where we will discuss memory, thinking, concept formation, problem solving, and intelligence. There you will find out more about the mental structures that underlie cognition. The problem we will face is exactly the one that the behaviorists were hoping to avoid: In studying cognition, we must make inferences about processes that we cannot measure directly. We will find, however, that cognitive psychologists have developed some very clever methods for obtaining objective data on which to base their inferences. The newest of these—coming fully on line in the last decade or so—is brain imaging, which, as we will see, has brought psychologists very close to an objective glimpse at private mental processes.

But, before we move on to these topics in the next chapter, let's return to the problem with which we began the chapter: Sabra's fear of flying.

PSYCHOLOGYMATTERS

Fear of Flying Revisited

Which kind of learning—operant conditioning or classical conditioning—do you suppose lay behind Sabra's aversion to flying? Although we may never know exactly what caused her fear in the first place, we can guess that both forms of conditioning were involved. Fears commonly arise through direct experience involving classical conditioning. Alternatively, fears can be learned through observational learning, perhaps from a fearful parent or peer. And once the fear has been learned, operant conditioning can maintain it, because people are rewarded by avoiding the feared object.

These assumptions have led some airlines to experiment with a hybrid treatment known as *cognitive-behavioral therapy*, aimed at helping people overcome their fear of flying. Happily, Sabra located one of these programs a few weeks before the conference started. She contacted the airline and signed up for three weekend sessions to be held at a nearby airport.

She arrived at the appointed time, full of expectations and apprehensions. Would the therapist probe her childhood experiences and fantasies? Would she have to take tranquilizers? Or would she have to undergo some sort of terrifying treatment, such as flying upside-down in a small airplane?

Her worst expectations turned out to be unfounded. The treatment sessions were organized by a behavioral psychologist who gathered the nine participants in a small conference room. He began by saying that such fears are learned—much as you might learn to cringe when you hear a dentist's drill or the scraping of fingernails on a blackboard. But, because it is not important how such fears originated, this fear-of-flying program would focus on the present, not on the past, he said. Sabra began to feel more relaxed.

The conditioning-based therapy program combined several learning strategies. A classical conditioning component would involve extinction of her fear through gradual exposure to the experience of flying. Operant conditioning would play a role through social reinforcement from the therapist and other members of the group. In addition, a cognitive component would involve learning more about how airplanes work.

After a brief overview of the process they would experience over the next three weeks, the group took a tour of the airport, including the cabin of a passenger jet parked on the Tarmac. Then they went back to the conference room to learn about how a pilot controls an airplane and about the physical forces that keep it in the air. The group also watched some videos involving routine flights in a commercial jet. All in all, this first session went smoothly, and everyone seemed much more at ease than when they started.

The second weekend began with more classroom discussion. Then, the class went back into the airliner, where they took seats and went through a series of relaxation exercises designed to extinguish the participants' fears and to learn a new and more relaxed response to the experience of being in an airplane. This training included deep breathing and progressive relaxation of specific muscle groups all over the body. When everyone in the group reported feeling relaxed, they again watched videos of flight on the plane's TV monitors. This was followed by more relaxation exercises. The final activity for the second weekend involved starting the engines and going through the preflight routine—all the way up to takeoff . . . and more relaxation exercises.

The final weekend session was almost identical to the previous one. The only difference was that "graduation" involved an actual flight—a 20-minute trip out over the local countryside and back to the airport. It was, of course, voluntary, but only one of the nine people in the class chose not to go. Sabra went, but not without some anxiety. The therapist, however, encouraged the group to focus on the relaxation exercises they had learned, rather than on their feelings of fear. To the amazement of all who participated, these learning-based techniques helped them through the flight exercise without losing control of their emotional responses. Although no one's fear had vanished completely, everyone on board was able to bring it under control.

The happiest result was that Sabra was able to go to her meeting in Hawaii—where, by the way, she had a productive conference and a wonderful time. For our purposes we should also note that she has flown several times since then. Each trip gets just a little easier, she says—just as the psychology of learning would predict.

Check Your Understanding

1. **ANALYSIS:** Why was *insight,* rather than *trial-and-error,* the best explanation for Sultan's solution to the problem of reaching the food reward?

2. **RECALL:** What evidence did Tolman have that his rats had developed cognitive maps of a maze?

3. **APPLICATION:** If you were going to use Bandura's findings in developing a program to prevent violence among middle school children, you might
   a. have children watch videos of children who are responding constructively to aggressive acts on the playground.
   b. punish children who are aggressive and reward those who are not aggressive.
   c. have children punch a BoBo doll, to "get the aggression out of their system."
   d. punish children for aggressive acts performed at school.

4. **APPLICATION:** Mirror neurons seem to explain how observational learning works. So, looking at your answer to the previous question: What would the observers' mirror neurons be responding to?

5. **UNDERSTANDING THE CORE CONCEPT:** Pick one experiment described in this section of the chapter and discuss why it is difficult to explain in purely behavioral terms.

Answers **1.** Sultan had apparently given up on active trial-and-error attempts to solve the problem. Yet, after a period of inactivity, he abruptly found the solution, which involved piling the boxes so that he could climb on them and reach the fruit. Kohler argued that Sultan had achieved the solution mentally, through insight. **2.** When their usual path was blocked, Tolman's rats would usually take the shortest alternative path to the goal. **3.** a **4.** The mirror neurons in the observers would be responding to the behavior of the children who are responding constructively to aggressive acts. **5.** All of the following are difficult to explain behaviorally because each challenges a basic principle of operant or classical conditioning: Kohler's experiments on insight learning (learning = a reorganization of perceptions), Tolman's "cognitive map" experiments (evidence that animals learn concepts, rather than specific behaviors), Bandura's studies of observational learning (children learn behaviors for which other people are rewarded), and Kamin's experiments on the "informativeness" of stimuli (animals ignore potential conditioned stimuli that are not useful in predicting the unconditioned stimulus).

Critical Thinking Applied: Do Different People Have Different "Learning Styles"?

Without a doubt, people differ in the ways that they approach learning. As you can see by observing your classmates, everyone brings a different set of interests, abilities, temperamental factors, developmental levels, social experiences, and emotions to bear on learning tasks. But, can we say that these constitute distinct "learning styles"? For example, are some people "visual learners," who need to *see* the material, rather than hearing it, as, perhaps, an "auditory learner" must do?

Educators have been drawn to the concept of learning styles, in the hope that schools might be able to encourage learning by tailoring instruction to a student's learning styles. (A Google search, revealing over a half-million hits, shows just how compelling this idea has become.) The excitement about learning styles has, in turn, led to a proliferation of learning-styles inventories, each purporting to diagnose how each student learns best, with implications for how to fit each learner to the optimum teaching environment. Perhaps you have taken one such test. But is all this buzz based on fact or fantasy?

What Are the Issues?

From a critical perspective, the principal issue centers on the meaning of "learning styles." The term may seem intuitively clear—but does it mean same thing to everyone? And, are learning styles really *requirements,* or mere *preferences* for learning? In other words, if you are a "visual learner," to what extent does this truly impact your ability to learn when visuals are not available? One further issue centers on whether learning styles are unchangeable (like eye color) or whether people can adjust their approach to learning to fit the demands of the subject matter (say, literature, psychology, dentistry, or music).

What Critical Thinking Questions Should We Ask?

We need to ask about both the *source* and the *evidence.* That is, we need to know whether the sources of information on learning styles are credible. And we need to know whether their work is based on solid research or mere speculation. We also need to ask if any *biases* might have contaminated the research conclusions. Is there a possibility that those who profit from developing tests that identify different learning styles could have biases?

Finally, we should wonder whether advocates of the "learning styles" concept might not be guilty of the logical error of oversimplifying a complex problem. Learning involves an interaction of many factors: the learner, the material, the medium in which the material is presented, the organization of the presentation, the personalities of the teacher and learner, and the environment in which learning takes place, to name a few. So, you may not be able to learn in a distracting or dangerous environment (think of children in substandard inner city schools), no matter how the material is presented. Even if it is valid, the concept of "learning styles" may be simplistic.

What Conclusions Can We Draw?

Unfortunately, most of the publications on learning styles come from sources that have not taken the trouble to do the controlled studies needed to support their claims (Stahl, 1999). Further, even among learning-style enthusiasts, we find no agreed-upon list of distinct learning styles. So, although educators commonly talk about "verbal learners," "visual learners," and "kinesthetic (movement) learners," some inventories also claim to assess some combination of the following styles: tactile (touch), logical, social, solitary, active/reflective, sensing/intuitive, thinking/feeling, judging/perceiving, sequential/global.

Moreover, we have no evidence that any of these is any more than a preference (Krätzig & Arbuthnott, 2006). Nor is there evidence suggesting that different "styles" are equally effective with different learning tasks. (Imagine, for example, taking a "visual learner" approach to studying piano.) Regarding the tests for assessing students' learning styles, most such schemes have little supporting data for their claim that people with different scores learn the same material in different ways (Krätzig & Arbuthnott, 2006).

Some educators have also made claims about learning styles that confound learning styles with the popular, but mistaken, notion of "left-brained" and "right-brained" thinkers (Terry, 2000). But, as we saw in Chapter 2, this dichotomy is based on a fundamental misinterpretation of split-brain research: In a person with an intact corpus callosum, both hemispheres work cooperatively. What the proponents of left-brain/right-brain learning styles usually mean is that some people *prefer* learning verbally, while others *prefer* materials that are more visual–spatial. And, like all typologies, this one assumes that people fall neatly into distinct groups, even though it would be more accurate to see people as gradually shading from one end of the spectrum to the other. This questionable assumption may be one reason why little solid evidence exists to show that people who are described as having different learning styles actually do learn differently.

Many other learning style theories have been proposed, and with them tests have appeared on the market for assessing students' learning styles. Again, we should ask: What is the evidence? And is there a possibility that those who profit from the tests could have biases? Again, most such schemes have little supporting data for their claim that people with different scores learn the same material in different ways (Kratzig & Arbuthnott, 2006).

An exception may be an ambitious program developed by Sternberg and Grigorenko to assess students on their abilities for logical, creative, and practical thinking—arguably, three distinct forms of "intelligence" (Sternberg, 1994; Sternberg & Grigorenko, 1997). Students in an introductory psychology course were divided into groups that received instruction emphasizing the form of intelligence on which they had scored highest. (A control group of students was deliberately mismatched.) Tests at the end of the course indicated that students did best when the teaching emphasis matched their intellectual style. As a practical matter, however, such a fine-tuned approach is probably not feasible for implementation on a wide scale.

Cross-cultural research may also provide another reason to keep our minds open about learning styles (Winerman, 2006b). For example, studies by Richard Nisbett (2003) and his colleagues have shown that Asians and Americans often perceive the world quite differently, with Americans focusing on central objects and Asians taking in a scene more globally. (The difference is cultural: Americans of Asian ancestry perceive in essentially the same way as other Americans.) To illustrate the difference in these two styles of "seeing," picture in your mind a tiger against a jungle background. Nisbett's group found that the typical American spends more mental energy on putting prominent elements of the scene—the tiger—into logical categories, while Asians usually pay more attention to the context and background—the jungle.

Culture can also influence the way people approach classroom learning. For example, Americans generally believe that academic success is the result of innate intelligence, while East Asians emphasize discipline and hard work (Li, 2005). Which belief system would you guess might encourage most children to do well in school?

Other cultural differences can play a role in academic achievement, says Korean-born psychologist Heejung Kim. After struggling with classes that required group discussion, which was rare in her Korean educational experience, Kim (2002) decided to look for differences between the ways Asians and Americans approach academic tasks. As she predicted, when Asian and American college students were given problems to solve, the Americans usually benefited from talking over the problems with each other, while such discussion often inhibited problem solving by Asian students.

The lines on this image, used by Nisbett's team, show one individual's eye movements when scanning the scene. Americans spent more time looking at the tiger and other prominent objects in the picture, whereas Asians spent more time scanning details of the context and background.

In general, while we might best be cautious about most claims about "learning styles," we should remain open to new developments that may come out of cross-cultural research and from work on Sternberg's three-intelligences theory. Beyond that, we should acknowledge that interest in "learning styles" has encouraged teachers and professors to present the material in a variety of ways in their classes—including media, demonstrations, and various "active learning" techniques. Further, the available research suggests everyone learns better when the same material can be approached in more than one way—both visual and verbal, as well as through hands-on active learning (McKeachie, 1990, 1997, 1999).

But back to our main point: Your authors recommend a big dose of skepticism when interpreting the results of tests that purport to identify your learning style. And beware of people who might tell you that you are a visual learner, a reflective learner, or some such other type. Just because you prefer images to words, for example, does not mean that you should avoid reading and just look at the pictures. This sort of thinking erroneously suggests that each person learns in only one way. It also erroneously suggests that the way we learn is fixed and unchanging. Thus, we need to learn how to adapt the way we learn to the type of material to be learned: You wouldn't learn about music in exactly the same way you would learn about math. In fact, your college experience presents a wonderful opportunity to learn to think in new and unaccustomed ways.

Chapter Summary

Learning produces lasting changes in behavior or mental processes, giving us an advantage over organisms that rely more heavily on **reflexes** and **instincts.** Some forms of learning, such as **habituation,** are quite simple, while others, such as classical conditioning, operant conditioning, and cognitive learning, are more complex.

Behavioral learning (p. 94)
Habituation (p. 93)
Learning (p. 92)
Mere exposure effect (p. 94)

3.1 What Sort Of Learning Does Classical Conditioning Explain?

Core Concept 3.1: Classical conditioning is a basic form of learning in which a stimulus that produces an innate reflex becomes associated with a previously neutral stimulus, which then acquires the power to elicit essentially the same response.

The earliest learning research focused on **classical conditioning,** beginning with Ivan Pavlov's discovery that **conditioned stimuli** (after being paired with **unconditioned stimuli**) could elicit reflexive responses. His experiments on dogs showed how **conditioned responses** could be **acquired** and **extinguished** and undergo **spontaneous recovery** in laboratory animals. He also demonstrated **stimulus generalization** and discrimination learning. John Watson extended Pavlov's work to people, notably in his famous experiment on the conditioning of fear in Little Albert. More recent work, particularly studies of taste aversions, suggests, however, that classical conditioning is not a simple stimulus–response learning process but also has a biological component. In general, classical conditioning affects basic, survival-oriented responses. Therapeutic applications of Pavlovian learning include the prevention of harmful food aversions in chemotherapy patients.

Acquisition (p. 96)
Classical conditioning (p. 96)
Conditioned response (CR) (p. 99)
Conditioned stimulus (CS) (p. 96)
Experimental neurosis (p. 99)
Extinction (in classical conditioning) (p. 94)
Neutral stimulus (p. 96)
Spontaneous recovery (p. 98)
Stimulus discrimination (p. 98)
Stimulus generalization (p. 98)
Unconditioned response (UCR) (p. 96)
Unconditioned stimulus (UCS) (p. 96)

MyPsychLab Resources 3.1:

Explore: Three Stages of Classical Conditioning

Explore: Process of Extinction and Spontaneous Recovery

Explore: Process of Stimulus Generalization and Stimulus Discrimination in Classical Conditioning

3.2 How Do We Learn New Behaviors By Operant Conditioning?

Core Concept 3.2: In operant conditioning, the consequences of behavior, such as rewards and punishments, influence the probability that the behavior will occur again.

A more active form of learning, called **instrumental conditioning,** was first explored by Edward Thorndike, who established the **law of effect,** based on his study of trial-and-error learning. B. F. Skinner expanded Thorndike's work, now called **operant conditioning,** to explain how responses are influenced by their environmental consequences. His work identified and assessed various consequences, including **positive** and **negative reinforcement, punishment,** and an operant form of **extinction.** The power of operant conditioning involves producing new responses. To learn how this works, Skinner and others examined **continuous reinforcement,** as well as several kinds of **intermittent reinforcement contingencies,** including **FR, VR, FI,** and **VI schedules.** As for punishment, research has shown that it is more difficult to use than reward because it has several undesirable side effects. There are, however, alternatives, including operant extinction and rewarding of alternative responses, application of the **Premack principle,** and prompting and shaping new behaviors. These techniques have found practical use in controlling behavior in schools and other institutions, as well as in behavioral therapy for controlling fears and phobias.

Conditioned reinforcer or secondary reinforcer (p. 106)
Continuous reinforcement (p. 104)
Extinction (in operant conditioning) (p. 105)
Fixed interval (FI) schedules (p. 106)
Fixed ratio (FR) schedules (p. 105)
Instinctive drift (p. 107)
Intermittent reinforcement (p. 105)
Interval schedule (p. 105)
Law of effect (p. 102)
Negative punishment (p. 108)

Negative reinforcement (p. 103)
Operant chamber (p. 103)
Operant conditioning (p. 102)
Positive punishment (p. 108)
Positive reinforcement (p. 103)
Premack principle (p. 107)
Primary reinforcer (p. 106)
Punishment (p. 108)
Ratio schedule (p. 105)
Reinforcement contingencies (p. 103)
Reinforcer (p. 102)
Schedule of reinforcement (p. 105)
Shaping (p. 104)
Token economy (p. 107)
Variable interval (VI) schedule (p. 106)
Variable ratio (VR) schedule (p. 105)

MyPsychLab Resources 3.2:

Explore: Learned Helplessness: An Experimental Procedure
Simulation: Schedules of Reinforcement
Explore: The Shaping Process

3.3 How Does Cognitive Psychology Explain Learning?

Core Concept 3.3 **According to cognitive psychology, some forms of learning must be explained as changes in mental processes, rather than as changes in behavior alone.**

Much research now suggests that learning is not just a process that links stimuli and responses: Learning is also cognitive. This was shown in Köhler's work on **insight learning** in chimpanzees, in Tolman's studies of **cognitive maps** in rats, and in Bandura's research on **observational learning** and **imitation** in humans—particularly the effect of observing aggressive models, which spawned many studies on media violence and, recently, applications dealing with social problems, such as the spread of AIDS. All of this cognitive research demonstrated that learning did not necessarily involve changes in behavior nor did it require reinforcement. In the past three decades, cognitive scientists have worked on reinterpreting behavioral learning, especially operant and classical conditioning, in cognitive terms, as well as searching for the neural basis of learning. Some educators have, however, taken new developments in learning far beyond the evidence: Specifically, there is little empirical support for most of the claims in the "learning style" literature.

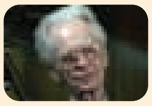
Cognitive map (p. 117)
Insight learning (p. 116)
Long-term potentiation (p. 120)
Observational learning (p. 118)

MyPsychLab Resources 3.3:

Watch: Bandura's BoBo Doll Experiment
Simulation: Latent Learning

Discovering Psychology Viewing Guide

Watch the following video by logging into MyPsychLab (www.mypsychlab.com). After you have watched the video, complete the activities that follow.



PROGRAM 8: LEARNING

PROGRAM REVIEW

1. Which of the following is an example of a fixed-action pattern?
   a. a fish leaping at bait that looks like a fly
   b. a flock of birds migrating in winter
   c. a person blinking when something gets in her eye
   d. a chimpanzee solving a problem using insight
2. What is the basic purpose of learning?
   a. to improve one's genes
   b. to understand the world one lives in
   c. to find food more successfully
   d. to adapt to changing circumstances
3. How have psychologists traditionally studied learning?
   a. in classrooms with children as participants
   b. in classrooms with college students as participants
   c. in laboratories with humans as participants
   d. in laboratories with nonhuman animals as participants
4. In his work, Pavlov found that a metronome could produce salivation in dogs because
   a. it signaled that food would arrive.
   b. it was the dogs' normal reaction to a metronome.
   c. it was on while the dogs ate.
   d. it extinguished the dogs' original response.
5. What is learned in classical conditioning?
   a. a relationship between an action and its consequence
   b. a relationship between two stimulus events
   c. a relationship between two response events
   d. classical conditioning does not involve learning
6. What point is Professor Zimbardo making when he says, "Relax," while firing a pistol?
   a. There are fixed reactions to verbal stimuli.
   b. The acquisition process is reversed during extinction.
   c. Any stimulus can come to elicit any reaction.
   d. Unconditioned stimuli are frequently negative.
7. What point does Ader and Cohen's research on taste aversion in rats make about classical conditioning?
   a. It can be extinguished easily.
   b. It takes many conditioning trials to be effective.
   c. It is powerful enough to suppress the immune system.
   d. It tends to be more effective than instrumental conditioning.
8. What is Thorndike's law of effect?
   a. Learning is controlled by its consequences.
   b. Every action has an equal and opposite reaction.
   c. Effects are more easily changed than causes.
   d. A conditioned stimulus comes to have the same effect as an unconditioned stimulus.
9. According to John B. Watson, any behavior, even strong emotion, could be explained by the power of
   a. instinct.
   b. inherited traits.
   c. innate ideas.
   d. conditioning.
10. In Watson's work with Little Albert, why was Albert afraid of the Santa Claus mask?
    a. He had been classically conditioned with the mask.
    b. The mask was an unconditioned stimulus creating fear.
    c. He generalized his learned fear of the rat.
    d. Instrumental conditioning created a fear of strangers.
11. What was the point of the Skinner box?
    a. It kept animals safe.

b. It provided a simple, highly controlled environment.
c. It set up a classical conditioning situation.
d. It allowed psychologists to use computers for research.

12. Skinner found that the rate at which a pigeon pecked at a target varied directly with
a. the conditioned stimulus.
b. the conditioned response.
c. the operant antecedents.
d. the reinforcing consequences.

13. Imagine a behavior therapist is treating a person who fears going out into public places. What would the therapist be likely to focus on?
a. the conditioning experience that created the fear
b. the deeper problems that the fear is a symptom of
c. providing positive consequences for going out
d. reinforcing the patient's desire to overcome the fear

14. When should the conditioned stimulus be presented in order to optimally produce classical conditioning?
a. just before the unconditioned stimulus
b. simultaneously with the unconditioned response
c. just after the unconditioned stimulus
d. just after the conditioned response

15. Operant conditioning can be used to achieve all of the following, *except*
a. teaching dogs to assist the handicapped.
b. teaching English grammar to infants.
c. teaching self-control to someone who is trying to quit smoking.
d. increasing productivity among factory workers.

16. Which psychologist has argued that in order to understand and control behavior, one has to consider both the reinforcements acting on the selected behavior and the reinforcements acting on the alternatives?
a. E. Thorndike
b. J. Watson
c. B. F. Skinner
d. H. Rachlin

17. If given a choice between an immediate small reinforcer and a delayed larger reinforcer, an untrained pigeon will
a. select the immediate small one.
b. select the delayed larger one.
c. experiment and alternate across trials.
d. not show any signs of perceiving the difference.

18. In order to produce extinction of a classically conditioned behavior, an experimenter would
a. reward the behavior.
b. pair the behavior with negative reinforcement.
c. present the conditioned stimulus in the absence of the unconditioned stimulus.
d. model the behavior for the organism.

19. In Pavlov's early work, bell is to food as
a. unconditioned response is to conditioned response.
b. conditioned stimulus is to unconditioned stimulus.
c. unconditioned response is to conditioned stimulus.
d. conditioned stimulus is to conditioned response.

20. Howard Rachlin has discovered that animals can be taught self-control through
a. reinforcement.
b. operant conditioning.
c. instrumental conditioning.
d. all of the above.

QUESTIONS TO CONSIDER

1. Approximately 2% of Americans are hooked on gambling, which experts claim can be just as addictive as drugs. Is compulsive gambling a disease or a learned behavior? Consider the kind of reinforcement gamblers get. Using the terms you learned in this program, how would you characterize the nature of the reinforcement and the reinforcement schedule? What techniques do you predict would work best to help compulsive gamblers change their behavior?
2. You are a school principal, and you are trying to get your students to help clean up the school. Given what you now know about the control of behavior, what sorts of techniques would you use in order to get students to comply?
3. What role does intention to learn play in classical and operant conditioning? Would these techniques work on people who do not know they are being used? Would they work on people who oppose their use?
4. Is it possible that children learn their native language through operant conditioning? When parents and young children interact, do the parents reinforce the use of some grammar and punish others? Are some aspects of language, such as the

rules of politeness, more likely to be taught through conditioning than other aspects?

ACTIVITIES

1. Design your own behavior change program based on the learning principles described in Program 8. First, identify a specific behavior. Instead of setting a broad goal, such as becoming more fit, design a strategy to reinforce a desired behavior—going for jogs, cutting out midnight snacks, or taking the stairs rather than the elevator. Analyze the specific behavior you would like to change in terms of antecedents-behavior-consequences. Then get a baseline measurement of the target behavior, try out your plan for a predetermined amount of time, and evaluate the results.
2. Have someone teach you something new, such as how to juggle, play basic guitar chords, or serve a tennis ball. Analyze the teacher's method. How does he or she apply principles of theories of learning? How would you change the teacher's method to be more effective?
3. Choose a member of your family and some trivial behavioral detail, such as standing still. See if you can train the person to reliably perform the behavior without having him or her catch on to what you're doing.