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Learning
s unlikely as it may seem, the following situations have something in common:.

- On completion of a training course at the National Zoo, the star students demonstrate their newly acquired behaviors: Junior, a young orangutan, cleans up his cage for the chance to blow a whistle; a pair of 18-inch-long lizards jump 2 feet in the air to snatch insects from the tip of a forceps; a chinchilla weights itself by hopping into a basket on top of a scale; and Peela the tiger retrieves a floating keg from the moat in his exhibition area.

- Jason, an 11-year-old boy, diagnosed with attention deficit disorder has difficulty paying attention and concentrating in school. Using a technique known as neurofeedback, Jason has learned to monitor and control his brain waves, which has increased his ability to concentrate and pay attention to his studies, which in turn has lead to an improvement in his grades.

- While driving along a congested boulevard, a middle-aged man glances at a park bench and, for a moment, his heart pounds as he experiences a warm feeling throughout his body. At first, he can’t understand why passing this spot has evoked such a strong emotion. Then he remembers: It was the meeting place he once shared with his high school sweetheart over 20 years ago.

- Maria has chosen a complex piece for her piano recital. Several months ago, when the piece was new to her, she had to follow the sheet music closely, and she made numerous mistakes. But at the recital, she plays the same piece flawlessly from memory.

Although these situations occurred outside the confines of a school classroom, all are examples of learning. Most people equate learning with studying, but psychologists define it more broadly, as the process by which experience or practice results in a relatively permanent change in behavior or potential behavior. This definition certainly encompasses academic learning, but it covers many other forms of learning as well: learning to turn off lights when we leave a room, learning which way to put the key into the front door lock, learning how to avoid falling down on skis, learning how to dance.

In this chapter, we will explore several different kinds of learning. We will begin with a basic form of learning known as conditioning. Conditioning is a general term—used for animals as well as for human beings—that refers to the acquisition of fairly specific patterns of behavior in the presence of well-defined stimuli. For example, conditioning has occurred if a dog always runs to fetch her leash when her owner puts on her running shoes. The dog has learned to associate a particular stimulus—her owner putting on her shoes—with a particular activity—going for a walk. In fact, all four examples of learning with which we opened this chapter illustrate conditioning of one sort or another. Although the examples we have used to introduce conditioning may seem simplistic or unimportant, conditioning is essential to our ability to survive in and adapt to a changing world (Hergenhahn & Olson, 1993).

After exploring conditioning, we will probe more complex forms of learning that are not tied to the immediate environment. Grouped under the heading of cognitive learning because they depend on thinking and reasoning processes, these include insight and observational learning, or vicarious learning. When, after pondering a math problem or similar puzzle, you suddenly see the solution in its complete form,
Classical (or Pavlovian) conditioning  The type of learning in which a response naturally elicited by one stimulus comes to be elicited by a different, formerly neutral stimulus.

Unconditioned stimulus (US) A stimulus that invariably causes an organism to respond in a specific way.

Unconditioned response (UR) A response that takes place in an organism whenever an unconditioned stimulus occurs.

Conditioned stimulus (CS) An originally neutral stimulus that is paired with an unconditioned stimulus and eventually produces the desired response in an organism when presented alone.

Conditioned response (CR) After conditioning, the response an organism produces when only a conditioned stimulus is presented.

You are experiencing insight. When you imitate the steps of professional dancers you saw last night on television, you are demonstrating observational learning. Like conditioning, cognitive learning is one of our survival strategies. Through cognitive processes, we learn which events are safe and which are dangerous without having to experience those events directly. Cognitive learning also gives us access to the wisdom of people who lived hundreds of years ago, and it will give people living hundreds of years from now some insight into our experiences and way of life.

Our discussion begins with classical conditioning. This simple kind of learning serves as a convenient starting point for examining what learning is and how it can be observed.

Classical Conditioning

How did Pavlov’s discovery of classical conditioning help to shed light on learning?

Ivan Pavlov (1849–1936), a Russian physiologist who was studying digestive processes, discovered classical conditioning almost by accident. Because animals salivate when food is placed in their mouths, Pavlov inserted tubes into the salivary glands of dogs to measure how much saliva they produced when they were given food. He noticed, however, that the dogs salivated before the food was in their mouths: The mere sight of food made them drool. In fact, they even drooled at the sound of the experimenter’s footsteps. This aroused Pavlov’s curiosity. What was making the dogs salivate even before they had the food in their mouths? How had they learned to salivate in response to the sound of the experimenter’s approach?

To answer these questions, Pavlov set out to teach the dogs to salivate when food was not present. He devised an experiment in which he sounded a bell just before the food was brought into the room. A ringing bell does not usually make a dog’s mouth water but, after hearing the bell many times just before getting fed, Pavlov’s dogs began to salivate as soon as the bell rang. It was as if they had learned that the bell signaled the appearance of food, and their mouths watered on cue even if no food followed. The dogs had been conditioned to salivate in response to a new stimulus—the bell—that would not normally have prompted that response (Pavlov, 1927). Figure 5–1, shows one of Pavlov’s procedures in which the bell has been replaced by a touch to the dog’s leg just before food is given.

Elements of Classical Conditioning

Generally speaking, classical (or Pavlovian) conditioning involves pairing an involuntary response (for example, salivation) that is usually evoked by one stimulus with a different, formerly neutral stimulus (such as a bell or a touch on the leg). Pavlov’s experiment illustrates the four basic elements of classical conditioning. The first is an unconditioned stimulus (US), such as food, which invariably prompts a certain reaction—salivation, in this case. That reaction—the unconditioned response (UR)—is the second element and always results from the unconditioned stimulus: Whenever the dog is given food (US), its mouth waters (UR). The third element is the neutral stimulus—the ringing bell—which is called the conditioned stimulus (CS). At first, the conditioned stimulus is said to be “neutral” with respect to the desired response (salivation), because dogs do not salivate at the sound of a bell unless they have been conditioned to react in this way by repeatedly presenting the CS and US together. Frequent pairing of the CS and US produces the fourth element in the classical conditioning process: the conditioned response (CR). The conditioned response is the behavior that the animal has learned in response to the conditioned stimulus. Usually, the unconditioned response and the conditioned
response are slightly different versions of the same response—salivation, in our example (see Figure 5–2).

You may have conditioned your own pet the same way that Pavlov trained his dogs. For instance, your cat may begin to purr when she hears the sound of a can being opened in the kitchen. The taste and smell of food are unconditioned stimuli (USs) that cause, among other responses, purring (the UR). Based on experience, your cat associates the sound of the can opener (the CS) with the food; over time, the CS by itself causes your cat to purr even before food is presented (the CR).

Changes in behavior brought about by classical conditioning are not limited to dogs and cats. Classical conditioning plays a significant role in the lives of almost all living things (Krasne & Glanzman, 1995). Moreover, this seemingly simple paradigm has yielded an enormous amount of information about how learning takes place. For example, recently psychologists have probed the biological basis of classical conditioning in an effort to understand Alzheimer’s disease (see On the Cutting Edge: Classical Eyeblink Conditioning and Clues to Alzheimer’s Disease).

### Classical Conditioning in Humans

You might wonder what Pavlov’s dogs and reflexive responses have to do with human learning. Quite simply, human beings also learn behaviors through classical conditioning. Consider, for example, the positive thoughts and feelings that we associate with the smell of freshly baked bread or cake. We are not born with these reactions. They are learned through classical conditioning. Similarly, you might become tense or anxious when you hear the kind of music that always precedes a

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**Figure 5–1**

**Pavlov’s apparatus for classically conditioning a dog to salivate.**

The experimenter sits behind a one-way mirror and controls the presentation of the conditioned stimulus (touch applied to the leg) and the unconditioned stimulus (food). A tube runs from the dog’s salivary glands to a vial, where the drops of saliva are collected as a way of measuring the strength of the dog’s response.
frightening or startling scene in a scary film, because you have come to identify this style of music with such scenes. Or think for a moment about phobias—irrational fears of particular things, activities, or situations, such as cats, spiders, or snakes, or high places (acrophobia), closed places (claustrophobia), or busy public places (agoraphobia).

To see how phobias can develop through classical conditioning, consider a classic experiment conducted by John Watson and Rosalie Rayner (Watson & Rayner, 1920). In this famous study, an 11-month-old boy, named “Little Albert,” was taught to fear a harmless laboratory rat. The experimenters started by showing Albert a white rat. At first the child displayed no apparent fear of the rodent. The infant crawled toward the rat and tried to play with it. But every time he approached the rat, the experimenters made a loud noise by striking a steel bar. Because nearly all children are afraid of loud noises, Albert’s natural reaction was fear. After just a few of these experiences, Albert would cry whenever he saw the rat and quickly withdraw from it in fear. This is a simple case of classical conditioning. An unconditioned stimulus—the loud noise—caused the unconditioned response of fear. Next, the loud noise was associated several times with the rat (CS). Soon the rat alone caused Albert to behave as if he were afraid (CR).

Several years later, psychologist Mary Cover Jones demonstrated a method by which children’s fears can be unlearned by means of classical conditioning (Jones, 1924). Her subject was a 3-year-old boy named Peter who, like Albert, had a fear of white rats. Jones paired the sight of a rat with a pleasant experience—eating candy. While Peter sat alone in a room, a caged white rat was brought in and placed far enough away so that the youngster would not be frightened. At this point, Peter was given plenty of candy to eat. On each successive day of the experiment, the cage was moved closer and was followed by the presentation of candy until, eventually, Peter showed no fear of the rat. In this case, eating candy (US) elicited a

![Diagram of classical conditioning process]

**Figure 5–2**
A paradigm of the classical conditioning process.
As we will see in Chapter 6 (Memory), one of the most interesting problems in memory research is how the brain encodes memory. By the early 1980s, researchers had determined that the cerebellum was crucial to classical eyeblink conditioning, but they didn’t know exactly how the learning takes place.

Through studies involving electrophysiological recordings, Steinmetz (1998) was able to pin down the learning to the activity of specific groups of neurons in the cerebellum. Steinmetz found that the CS and the US travel via different pathways in the brain stem. The airpuff US travels from the eye to the brain stem, and from there the impulse goes to the cerebellum. For the CS, Steinmetz used a tone. He found that this signal was directed to a different area of the brain stem and from there to a different portion of the cerebellum. Steinmetz has shown that a third portion of the cerebellum, the interpositus nucleus, receives input from both the CS and US, and it is here that the learning takes place.

Steinmetz’s studies of eyeblink conditioning strongly suggest that the cerebellum demonstrates neural plasticity (see Chapter 2, The Biological Basis of Behavior) and that it is the place where the conditioned response is encoded. Following an extensive review of several studies of eyeblink conditioning, Green and Woodruff-Pak (2000) point out that the hippocampus is also actively involved in eyeblink conditioning, citing evidence that damage to the hippocampus impairs the classical conditioning response. Thus, the “simple” response that we call eyeblink classical conditioning is actually learned in at least two different parts of the brain.

Because degeneration of the hippocampus is a major factor in Alzheimer’s Disease (see Chapter 6: Memory, and Chapter 10: Life Span Development), researchers have recently begun to consider if eye-blink conditioning, which requires adequate hippocampal functioning, may be used as a diagnostic tool for detecting the onset of Alzheimer’s disease (Woodruff-Pak, 2001a). Studies have shown that damage to the hippocampus leads to a slower acquisition of the eyeblink response (Woodruff-Pak, 2001b; Woodruff-Pak, Green, Heifets, & Pak, 2002). If these results are confirmed, knowledge of the biological basis of eyeblink conditioning may point the way to a better understanding of how to diagnose and ultimately treat Alzheimer’s patients.
Desensitization therapy is based on the belief that we can overcome fears by learning to remain calm in the face of increasingly fear-arousing situations. Here people being desensitized for a fear of heights are able to swing high above the ground without panicking.

Classical Conditioning and the Immune System

In another example of classical conditioning in humans, researchers have devised a novel way to treat a group of diseases, called *autoimmune disorders*, which cause the immune system to attack healthy organs or tissues. Although powerful drugs can be used to suppress the immune system and thus reduce the impact of the autoimmune disorder, they may produce nausea and headaches and may also damage organs such as the pancreas and liver, so they must be administered sparingly. The challenge, then, is to find a treatment that will suppress the immune system without damaging vital organs. Several researchers discovered that, through classical conditioning techniques, they could use formerly neutral stimuli either to elevate or to suppress the activity of the immune system (Ader & Cohen, 1975; Hollis, 1997; Markovic, Dimitrijevic, & Jankovic, 1993). Here’s how it works: The researchers use immune-suppressing drugs as USs and pair them with a specific CS, such as a distinctive smell or taste. After only a few pairings of the drug (US) with the smell or taste (CS), the CS alone suppresses the immune system (the CR) without any dangerous side effects! While the use of classical conditioning to treat autoimmune disorders shows promise, additional research is still necessary to validate its effectiveness and evaluate its potential application as a therapy (Miller & Cohen, 2001).

Classical Conditioning Is Selective

If people can develop phobias when objects are linked with frightening or anxiety-arousing stimuli, why don’t people have phobias about almost everything? As M. E. P. Seligman notes, “Only rarely, if ever, do we have pajama phobias, grass phobias, electric-outlet phobias, hammer phobias, even though these things are likely to be associated with trauma in our world” (1971, p. 455). Why should this be?

To Seligman, the answer lies in *preparedness* and *contrapreparedness*. Some stimuli serve readily as CSs for certain kinds of responses (preparedness), and other stimuli do not (contrapreparedness). All the common objects of phobias—heights, snakes, cats, the dark, and so on—are “related to the survival of the human species through the long course of evolution” (Seligman, 1971, p. 455). Thus, humans may be
prepared to develop fear responses and phobias about these things, but we are very unlikely to acquire phobias about flowers.

**ENDURING ISSUES**

**heredity environment**

**The Evolutionary Basis of Fear**

To what extent does our evolutionary heritage condition our fears, and to what extent are fears the result of our experiences? Recent studies suggest that the two work in tandem (Mineka & Oehman, 2002). For example, some stimuli unrelated to human survival through evolution, but which we have learned to associate with danger, can serve as CSs for fear responses. Pictures of handguns and butcher knives, for example, are as effective as pictures of snakes and spiders in conditioning fear in some people (Lovibond, Siddle, & Bond, 1993). These studies suggest that preparedness may be the result of learning rather than evolution. Other studies have shown that people who do not suffer from phobias can rather quickly unlearn fear responses to spiders and snakes if those stimuli appear repeatedly without painful or threatening USs (Honeybourne, Matchett, & Davey, 1993). Thus even if humans are prepared to fear these things, that fear can be overcome through conditioning. In other words, our evolutionary history and our personal learning histories interact to increase or decrease the likelihood that certain kinds of conditioning will occur.

Preparedness also underlies **conditioned food (or taste) aversion**, a learned association between the taste of a certain food and a feeling of nausea and revulsion. Animals rarely require more than one occasion of being poisoned to learn not to eat a particular food. John Garcia discovered this phenomenon by accident in the midst of experiments on the effects of exposure to radiation (Garcia, Kimeldorf, Hunt, & Davies, 1956). Exposing rats in a special chamber to high doses of radiation that made them sick, Garcia noticed that the rats were drinking less and less water when in the radiation chamber, although they drank normally in their “home” cages. Garcia realized that the water bottles in the radiation chamber were plastic, perhaps giving the water a different taste from the water contained in glass bottles in the home cages. He theorized that the taste of the water from the plastic bottles had served as a conditioned stimulus (CS) that the rats associated with radiation (US); as a result of this conditioning, the plastic-tasting water by itself made the rats feel ill (CR).

Conditioned food aversion is puzzling. Classical conditioning generally requires many presentations of the CS and US with a short interval between the appearance of the two. But conditioned food aversion can take place after only one bad experience; moreover, the interval between eating the food (the US) and falling ill (the UR) can be quite long—up to 12 hours among rats (Braveman & Bornstein, 1985; Brooks, Bowker, Anderson, & Palmatier, 2003; Chester, Lumeng, Li, & Grahame, 2003).

Why do taste-illness combinations produce such rapid and long-lasting learning? Garcia traces the answer to evolution: Rapid learning of taste-illness combinations increases animals’ chances of survival. Rats, for example, are scavengers: They will nibble at almost anything, so they are quite likely to come into contact with potentially toxic foods. It makes sense that over thousands of generations rats would have evolved a nervous system that is especially good at remembering taste-illness combinations (Garcia & Keolling, 1966).
Birds, however, depend on vision to find and identify their food; it follows that birds should have evolved a nervous system that is especially good at remembering sight-illness combinations—and this turns out to be the case. In one study, both rats and quail were fed water that was flavored with salt, colored blue, and contaminated with a chemical that would make both animals ill. Later, they were offered a choice between water just colored blue and water just flavored with salt. The rats chose the blue water and avoided the salty water; the quails did just the reverse. The rats seemed to have associated the salty flavor cues with their illness, whereas the birds associated the blue visual cue with their illness (Wilcoxon, Dragoin, & Kral, 1971). In other words, each species seems to have been prepared or preprogrammed for certain types of learning that are critical to its own survival.

Humans also develop food aversions based on a variety of cues, including taste, appearance, and smell (Logue, Ophir, & Strauss, 1981). In fact, the conditioned aversion response is so ingrained that even when we know a particular food did not make us sick, we still tend to form an aversion to the food we ate before we became ill. For example, one psychologist described a dinner party at which he and several other guests all picked up an intestinal virus that left many of them with an aversion to tarragon chicken (the main dish) or any food with tarragon flavor (Mazur, 1994). Even though they knew that the tarragon chicken was not the source of their illness, they were unable to overcome the powerful conditioned response. Similarly, patients undergoing treatment for cancer frequently develop taste aversions. Because the drugs used in chemotherapy can cause nausea, patients commonly develop strong taste aversions for foods eaten both before and after injections of these chemicals, even though they know that the foods do not bring on their nausea (Jacobsen, Bovbjerg, Schwartz, & Andrykowski, 1994).

### CHECK YOUR UNDERSTANDING

1. Predictable behavior that occurs in response to well-defined stimuli is the simplest type of learning. It is called
   - a. operant conditioning
   - b. cognitive learning
   - c. classical conditioning
   - d. observational learning

2. Pavlovian conditioning involves pairing a (an) _____ response with a (an) _____ stimulus.
   - a. involuntary/neutral
   - b. neutral/involuntary
   - c. involuntary/involuntary
   - d. neutral/neutral

3. Your cat comes running when she hears you open a kitchen cabinet door. The sound of the cabinet is a (an)
   - a. US
   - b. CS
4. Conditioned food aversion requires how many bad experiences?

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**Operant Conditioning**

*Why is it easy to teach a dog to come when it is called, but difficult to teach it not to chase rabbits?*

Classical conditioning is concerned with involuntary behavior that invariably follows a particular event, but most of our behavior is *voluntary* rather than triggered by outside events. Dogs learn to sit or heel on command. Children learn to pick up their toys either to avoid punishment or to gain some reward from their parents. We learn to put money into machines and pull on levers or push buttons to obtain soft drinks, food, entertainment, or a chance to win money. These and similar actions can be classified as *operant behavior*. They are learned behaviors that are designed to operate on the environment to gain a reward or avoid a punishment; they are not automatic reflexes caused by biologically important stimuli. This kind of learning is called *operant* or *instrumental conditioning*. We now turn to the basic principles of operant conditioning.

**Elements of Operant Conditioning**

Around the turn of the twentieth century, while Pavlov was busy with his dogs, Edward Lee Thorndike (1874–1949), an American psychologist and educator, was using a simple wooden cage to determine how cats learn (Thorndike, 1898). Thorndike placed a hungry cat in the close quarters of the “puzzle box,” with food just outside the cage where the cat could see and smell it (see Figure 5–3). To get to the food, the cat had to figure out how to open the latch on the cage door. In the beginning, it took the cats quite a while to discover how to open the door. But each time a cat was put back into the puzzle box, it took less time to open the door, until the cat eventually could escape from the box in almost no time.

Thorndike’s experiments illustrate two factors that are essential in operant or instrumental conditioning. The first is the *operant response*. Operant conditioning occurs when one response, called the *operant response*, operates on the environment to produce specific consequences. By pawing at the latch (the operant response) the cats were able to open the door.

The second essential element in operant conditioning is the *consequence* that follows the behavior. By opening the door, Thorndike’s cats gained either freedom or a piece of fish for escaping from their constraining puzzle boxes. Similarly, a dog may get a biscuit for sitting on command; and a child may receive praise or a chance to play a computer game for helping to clear the table. Consequences like these, which *increase* the likelihood that the operant behavior will be repeated, are called *reinforcers*. By contrast, consequences that *decrease* the chances that an operant behavior will be repeated are called *punishers*. Imagine what might happen if...
Thorndike’s law of effect states that behavior will be strengthened (reinforced) if it is followed by a satisfying effect, and weakened (punished) if it is followed by an unsatisfying effect. Thorndike’s understanding of the importance of reinforcement is reflected in his law of effect: Behavior that brings about a satisfying effect (reinforcement) is likely to be performed again, whereas behavior that brings about a negative effect (punishment) is likely to be suppressed. Contemporary psychologists often refer to the principle of reinforcement rather than the law of effect, but the two terms refer to the same phenomenon.

Types of Reinforcement

Positive and Negative Reinforcement

Psychologists distinguish among several kinds of reinforcers. **Positive reinforcers**, such as food or pleasant music, add something rewarding to a situation. By contrast, **negative reinforcers** subtract something unpleasant from a situation by removing a noxious or unpleasant stimulus. You might find it helpful to use the plus symbol (+) to refer to a positive (+) reinforcer that adds (+) something rewarding to the environment and the minus sign (−) to refer to a negative (−) reinforcer that subtracts (−) something negative or unpleasant from the environment. Animals will learn to press bars and open doors not only to obtain food and water (positive reinforcement) but also to escape from electric shocks or loud noises (negative reinforcement).

Both positive and negative reinforcement result in the learning of new behaviors or the strengthening of existing behaviors. Remember, in everyday conversation when we say that we have “reinforced” something, we mean we have strengthened it. “Reinforced concrete” is strengthened by the addition of steel rods or steel mesh; generals “send reinforcements” to strengthen a military force; people “reinforce” their arguments by marshaling facts that strengthen them. Similarly, in operant conditioning, all reinforcements—whether positive or negative—strengthen behavior. For example, a child might practice the piano to receive praise (positive reinforcement) or avoid being scolded (negative reinforcement).
forcement) or to escape from doing tedious homework for a while (negative reinforcement), but in either case the end result is a higher incidence of piano playing.

Some researchers have suggested that in the classroom, linking rewards to learning might actually reduce natural motivation and creativity (Tagano, Moran, & Sawyers, 1991). Most of the evidence, however, confirms the positive effects of rewards. In fact, one extensive analysis of more than 100 studies revealed that when used appropriately, rewards do not compromise intrinsic motivation or creativity (Eisenberger & Cameron, 1996). To the contrary, when applied properly, rewards may promote creativity. Rewarding highly creative behavior on one task often enhances subsequent creativity on other tasks (Eisenberger & Rhoades, 2001).

**Punishment**

So far, we have focused on the way reinforcers affect behavior. But behavior can also be controlled by punishment. For most of us, receiving a fine for speeding or littering reduces the likelihood that we will speed or litter in the future. Being rudely turned down when we ask someone for a favor makes it less likely that we will ask that person for a favor again. In both these cases, the unpleasant aftereffect reduces the likelihood that we will repeat that behavior. Be sure you understand the difference between punishment and negative reinforcement: Reinforcement of whatever kind strengthens (reinforces) behavior; negative reinforcement strengthens behavior by removing something unpleasant from the environment. By contrast, punishment adds something unpleasant to the environment, and as a result it tends to weaken behavior.

Although the examples listed above suggest that punishment works, we can all think of situations in which punishment clearly does not work. Some children continue to misbehave even after they have been punished repeatedly for that misbehavior. The family dog may sleep on the couch at night despite being punished for this behavior every morning. And some criminals continue to commit crimes when facing both threatened and real punishment. So an important question comes to mind: Under what conditions does punishment work? (Gershoff, 2002).

A punishment is any consequence that decreases the chances that a particular behavior will be repeated. This man being carried to the pillory in colonial New England will probably think twice before repeating whatever misdeed he committed, because public humiliation is a powerful form of punishment.
For punishment to be effective, it must be imposed properly. First, punishment should be **swift**. Children who misbehave should be punished right away so they know that what they have done is wrong. Punishment should also be **sufficient** without being cruel. If a parent merely warned a child not to bully other children, the effect might be less pronounced than if the warning were accompanied by the threat of being “grounded” for a day. Effective punishment should be certain: parents should try to punish children each and every time they misbehave. And punishment should be consistent: the common practice of making the punishment for each successive misdeed more severe than the last is not as effective as maintaining a constant level of punishment.

The proper application of punishment can change behavior quickly, which is critical in certain cases. A child who likes to play in the street or who enjoys poking things into electric outlets must be stopped quickly and, in these instances, punishment may be the best course of action. But even in situations like these, punishment has significant drawbacks (Gershoff, 2002; Skinner, 1953). First, punishment only suppresses behavior: It doesn’t teach a more desirable behavior. If the punisher or the threat of punishment is removed, the negative behavior is likely to recur. Drivers who are speeding on a highway generally slow down when they see a radar-equipped police car on the side of the road, because the police car introduces the threat of punishment. But as soon as the threat is past, they tend to speed up again. Thus, punishment rarely works when long-term changes in behavior are sought (Pogarsky & Piquero, 2003).

Second, punishment often stirs up unpleasant emotions that can impede learning. For example, when children are learning to read and a teacher or parent scolds them every time they mispronounce a word, they are likely to become frightened and confused. As a result they may mispronounce more words and get scolded more often. In time, they may become so overwhelmed with fear that they do not want to read at all. Moreover, studies have shown that children who frequently experience corporal punishment have a higher incidence of depression, antisocial behavior, and increased difficulty relating to their peers (Matta, 2002).

Third, punishment may convey the notion that inflicting pain on others is justified, thereby inadvertently teaching undesirable aggressive behavior (Gershoff, 2002). In laboratory studies, monkeys that are punished tend to attack other monkeys; likewise, pigeons other pigeons, and so on (B. Schwartz, 1989). Finally, punishment often makes people angry, and angry people frequently become more aggressive and hostile.

If punishment must be used to suppress undesirable behavior, it should be terminated when more desirable behavior occurs (to negatively reinforce that behavior). Positive reinforcement (praise, rewards) should also be used to strengthen the desired behavior. This approach is more productive than punishment alone, because it teaches an alternative behavior to replace the actions that prompted the punishment. Positive reinforcement also makes the learning environment less threatening overall. As a method for controlling behavior, punishment is one of the least pleasant options, because it is often ineffective and can have negative side effects. Most of us would prefer to avoid using punishment at all, relying instead on the threat of punish-
ment when behavior is getting out of control. If the threat of punishment induces a change to more desirable behavior, punishment need not be imposed at all. Psychologists call this **avoidance training**.

Avoidance training with animals in a laboratory usually includes some sort of warning devices, such as a light or a buzzer. For example, an animal might be placed in a box with a wire floor that can deliver a mild shock. The animal must learn to press a bar in the box after hearing the buzzer, but before the shock starts, to prevent the shock from occurring. At first this usually happens accidentally. But once the animal discovers that pressing the bar prevents the shock, it will run to the bar whenever it hears the buzzer, thus avoiding the shock altogether.

We, too, derive lessons from avoidance training, as when we learn to carry an umbrella when it looks like rain or not to touch a hot iron. But sometimes avoidance learning outlives its usefulness. Children taught not to go into deep water may avoid deep water even after they have learned how to swim. In other cases, avoidance behavior may persist long after the fear has been removed. So while fear is essential for learning the avoidance response, it is not always necessary for **sustaining** the learned response.

**ENDURING ISSUES**

**diversity universality**

### What Is Punishment?

We do not know whether a particular entity is reinforcing or punishing until we see whether it increases or decreases the occurrence of a response. We might assume that candy, for example, is a reinforcer for children, but some children don’t like candy. We might also assume that having to work alone rather than in a group of peers would be punishing, but some children prefer to work alone. Teachers must understand the children in their classes as individuals before they decide how to reward or punish them. Similarly, what is reinforcing for men may not be reinforcing for women, and what is reinforcing to people in one culture might not have the same effect for people in other cultures.

In addition, an event or object might not be consistently rewarding or punishing over time. So even if candy is initially reinforcing for some children, if they eat large amounts of it, it can become neutral or even punishing. We must therefore be very careful in labeling items or events as reinforcers or punishers.

### Operant Conditioning Is Selective

In our discussion of preparedness in classical conditioning, we saw that some stimuli serve readily as CSs for certain kinds of responses, whereas other stimuli do not. Classical conditioning is more likely to occur when a natural fit exists between the stimulus and the response—for example, a fear response to snakes or an aversive response to an unpleasant odor. Similarly, in operant conditioning, some behaviors are easier to train than others. In general, the behaviors that are easiest to condition are those that animals typically would perform in the training situation. For example, Shettleworth (1975) used food pellets to teach food-deprived hamsters to spend more time doing a variety of things: washing their faces, digging, scent marking, scratching, rearing up on their hind legs, and scraping a wall with their paws. The hamsters quickly learned to spend much more time rearing up on their hind legs, scraping walls, and digging, but there was only a slight increase in the amount of time they spent washing their faces, scratching, and scent marking. The first three
A chicken can easily be trained to “dance,” like this one shown hopping from one foot to the other, but it is hard to teach a chicken to lie down and roll over. This illustrates the importance of preparedness in operant conditioning: Learning is less likely for any behavior that an animal isn’t likely to perform naturally.

**Learned Helplessness**

In the preceding section, we saw that the random delivery of reinforcements (beyond an organism’s control) may result in superstitious behavior. But what happens if an animal experiences random exposure to painful or aversive stimuli over which it has no control? In a classic two-part experiment by Seligman and Maier (1967) (see Figure 5–4), two groups of dogs were placed in an experimental chamber that delivered an identical series of electric shocks to their feet at random intervals. The dogs in the control group could turn off (or escape) the shock by pushing a panel with their noses. The dogs in the experimental group, however, could not turn off the shock—they were, in effect, helpless.

In the second part of the experiment, both the experimental and control animals were placed in a different situation: both groups could escape shock by jumping over a hurdle. The dogs in the control group quickly learned to avoid the shock by jumping over the hurdle when a warning light came on. However, the dogs which had previously experienced unavoidable shocks failed to learn either to avoid the shock (jumping in response to the warning light) or to escape the shock (jumping after the shock started). In fact, many of the animals that had previously experienced inescapable shocks also became less active, experienced a loss of appetite, and displayed many of the symptoms associated with depression in humans. This failure to avoid or escape from an unpleasant or aversive stimulus that occurs as a result of previous exposure to unavoidable painful stimuli is referred to as learned helplessness.

Seligman and his colleagues have since conducted numerous experiments in learned helplessness and have produced similar results in both animals and humans (Maier & Seligman, 1976; Peterson, Maier, & Seligman, 1993b; Overmier, 2002).

**Superstitious Behavior**

Whenever something we do is followed closely by a reinforcer, we will tend to repeat the action—even if the reinforcement is not produced directly by what we have done. For example, if the first time you put a coin in a slot machine, you are rewarded by a payoff, you will be more likely to continue to feed the machine. In an experiment by American psychologist B. F. Skinner (1948), a pigeon was placed in a cage that contained only a food hopper. There was nothing the bird could do directly to get food, but at random intervals Skinner dropped a few grains of food into the hopper. He found that the pigeon began to repeat whatever it had been doing just before it was given food: standing on one foot, hopping around, or strutting around with its neck stretched out. None of these actions had anything to do with getting the food—it was pure coincidence that the food appeared when the bird was standing on one foot, for example, but that action would usually be repeated. Skinner labeled the bird’s behavior superstitious.

Humans can learn superstitions in the same way (Aeschleman, Rosen, & Williams, 2003). If we happen to be wearing a particular piece of jewelry or a certain pair of socks when something good happens to us, we may come to believe that these incidental factors caused the positive incident, or reinforcement. We may even develop elaborate explanations for accidental or randomly occurring reinforcements.
Learned helplessness. Dogs who had previously been able to avoid being shocked quickly learned to avoid shocks by jumping over a hurdle when a warning light came on. Other dogs, who had not been able to avoid the original series of shocks, did not learn to jump the hurdle in response to the light.

For example, when faced with a series of unsolvable problems, most college students not only eventually give up but many of them make only half-hearted attempts to solve new problems, even when the new problems are easily solvable. In fact, even if they succeed at solving new problems, they have difficulty recognizing that their behavior had anything to do with their success. Similarly, children raised in an abusive family, where punishment is unrelated to a child’s behavior, often develop feelings of powerlessness. Such children, even when placed in relatively normal environments outside their home, often appear listless, passive, and indifferent. They make little attempt to either seek rewards or avoid discomfort. In recent years, researchers have begun to explore the neurological mechanisms that underlie learned helplessness (Hammack, 2002; Minor & Hunter, 2002; Saade, Balleine, & Minor, 2003) and to devise effective therapies to help people overcome it (Cemalcilar, Canbeyli, & Sunar, 2003; Flannery, 2002).

Shaping Behavioral Change through Biofeedback

Patrick, an 8-year-old third grader, was diagnosed with attention deficit disorder (ADD). He was unable to attend to what was going on around him, restless, and unable to concentrate. An EEG showed increased numbers of slow brain waves. After a course of 40 training sessions, using special computer equipment that allowed Patrick to monitor his brain-wave activities, he learned how to produce more of the fast waves that are associated with being calm and alert. As a result, Patrick became much more “clued in” to what was going on around him and much less likely to become frustrated when things didn’t go his way (Fitzgerald, 1999; Fuchs, Birbaumer, Lutzenberger, Gruzelier, & Kaiser, 2003; Rossiter, 2002).

When operant conditioning is used to control certain biological functions, such as blood pressure, skin temperature (Violani & Lombardo, 2003) or heart rate, it is...
Biofeedback A technique that uses monitoring devices to provide precise information about internal physiological processes, such as heart rate or blood pressure, to teach people to gain voluntary control over these functions.

Neurofeedback A biofeedback technique that monitors brain waves using an EEG to teach people to gain voluntary control over their brain wave activity.

Biofeedback is referred to as biofeedback. Instruments are used to measure particular biological responses—muscle contractions, blood pressure, heart rate, brain waves. Variations in the strength of the response are reflected in the form of a light, a tone, or some other signal. By using the signal—the tone or light—the person can learn to control the response through shaping. For example, Patrick learned to control his brain waves by controlling the movement of a Superman icon on a computer screen. When biofeedback is used to monitor and control brain waves, as in Patrick’s case, it is referred to as neurofeedback (Fultz, 2002; Vernon et al., 2003).

Biofeedback and neurofeedback have become well-established treatments for a number of medical problems, including migraine headaches (Kropp, Siniatchkin, & Gerber, 2002; Walcutt, 2001), hypertension (Rau, Buehrer, & Weitkunat, 2003), asthma, irritable bowel conditions and peptic ulcers (Jorge, Habr, & Wexner, 2003). Biofeedback has also been used by athletes, musicians, and other performers to control the anxiety that can interfere with their performance. Marathon runners use it to help overcome the tight shoulders and shallow breathing that can prevent them from finishing races. Biofeedback has even been used in space: NASA has used biofeedback as part of a program to reduce the motion sickness astronauts experience at zero gravity.

Biofeedback treatment does have some drawbacks. Learning the technique takes considerable time, effort, patience, and discipline. But it gives patients control of their treatment, a major advantage over other treatment options and it has achieved impressive results in alleviating certain medical problems (Olton & Noonberg, 1980).

CHECK YOUR UNDERSTANDING

1. Any event whose presence increases the likelihood that ongoing behavior will recur is called
   ___ a. positive reinforcement
   ___ b. negative reinforcement
   ___ c. punishment
   ___ d. a generalized stimulus

2. Which of the following is not an example of operant behavior?
   ___ a. a rat pressing a bar after receiving food for this behavior
   ___ b. a rat pressing a bar to avoid a shock for this behavior
   ___ c. a child studying in order to get a teacher’s approval
   ___ d. eye blinking after a flash of light

3. When people and animals cannot avoid unpleasant situations, they are most likely to display
   ___ a. superstitious behavior
   ___ b. learned helplessness
   ___ c. avoidance behavior
   ___ d. higher-order conditioning

4. Controlling blood pressure by means of operant conditioning is known as
   ___ a. biofeedback
   ___ b. higher-order conditioning
   ___ c. classical conditioning
   ___ d. stimulus generalization

Answers: 1.a, 2.d, 3.b, 4.a
Comparing Classical and Operant Conditioning

What behavioral principles enable an animal trainer to teach a tiger to jump through a flaming hoop?

Despite the clear differences between classical and operant conditioning, the two forms of learning are alike in a number of ways. We look first at how responses are acquired.

Response Acquisition

Classical Conditioning  Except for conditioned food aversions, classical conditioning requires repeated pairing of the CS and US. Each pairing builds on the learner's previous experience. Psychologists refer to this “building phase” of learning as response acquisition; each pairing of the US and CS is called a trial. Learning does not increase indefinitely or by an equal amount on each successive trial (see Figure 5–5). At first, the likelihood or strength of the conditioned response increases significantly each time the conditioned stimulus and the unconditioned stimulus are paired. But learning eventually reaches a point of diminishing returns: The amount of each increase gradually becomes smaller until, finally, no further learning occurs, and the likelihood or strength of the CR remains constant despite further pairings of the US and CS.

Barry Schwartz (1989) has pointed out that the cumulative nature of most classical conditioning works to our benefit. Lots of different environmental stimuli are present when we experience pain, for example, yet most of those stimuli are irrelevant to the pain. If conditioning occurred on the basis of single events, then these irrelevant stimuli would all generate some type of CR, and we would soon become overwhelmed by the amount of learning—most of it inappropriate or unnecessary—that would take place. Because a number of pairings are usually required to produce a CR, however, in most cases only the relevant cues consistently produce this reaction.

We have seen that, up to a point, the more often the US and CS are paired, the stronger the learning. It turns out that the spacing of trials—that is, the time between one pairing and the next—is at least as important as their number. If the trials follow one another rapidly, or if they are very far apart, the subject may need many trials to achieve the expected response strength. If the trials are spaced evenly—neither too far apart nor too close together—learning will occur after fewer trials. Also the CS and US must rarely, if ever, occur alone (not paired). Pairing the CS and US on only some of the learning trials and presenting them separately on other trials is called intermittent pairing, a procedure that reduces both the rate of learning and the final level of learning achieved.

Operant Conditioning  Response acquisition in operant conditioning is somewhat more difficult than in classical conditioning. In classical conditioning, the US invariably elicits the UR, which is the behavior we want to link to the CS. But in operant conditioning, the behavior we want to teach is usually voluntary and is not inevitably triggered by outside events. As a result, ensuring that the behavior occurs at all often poses a significant challenge. Sometimes you simply have to wait for the subject to hit

Response acquisition  The “building phase” of conditioning during which the likelihood or strength of the desired response increases.

Intermittent pairing  Pairing the conditioned stimulus and the unconditioned stimulus on only a portion of the learning trials.

Figure 5–5  Response acquisition.
At first, each pairing of the US and CS increases the strength of the response. After a number of trials, learning begins to level off, and eventually it reaches a point of diminishing returns.
on the correct response. In the case of Thorndike’s cats, Thorndike simply waited for them to trip the latch to open the cage and then reinforced that behavior. Similarly, if parents wait long enough, most babies on their own will eventually make a sound like “mama” in the course of their babbling. Then they can reinforce the baby with smiles and hugs to increase the likelihood that the baby will say “mama” again in the future. (Because “ma” is among the easiest syllables for babies to pronounce, the word for “mother” sounds something like “mama” in many human languages, not just in English.)

Waiting for the correct response to occur spontaneously can be a slow and tedious process, however. If you were an animal tamer for a circus, imagine how long you would have to wait for a tiger to decide to jump through a flaming hoop so that you could reinforce that behavior! There are several ways to speed up the process and make it more likely that the desired response will occur so that it can then be reinforced. One possibility is to increase motivation: An alert and motivated child is more likely to perform some desired behavior than is a passive, unmotivated child.

Another way to speed up the process of operant learning is to reduce or eliminate the opportunities for making irrelevant responses, thereby boosting the chances that the correct response will occur. Many researchers interested in operant conditioning make extensive use of the **Skinner box**, a device named after B. F. Skinner, who pioneered the study of operant conditioning. A Skinner box for rats is small, with solid walls. It is relatively bare except for a bar with a cup underneath it (see Figure 5–6). In this simple environment, it doesn’t take long for an active, hungry rat to happen to step on the bar, thereby releasing food pellets into the cup, which reinforces the rat’s bar-pressing behavior.

Yet another way to speed up response acquisition during operant conditioning is to reinforce successive approximations to the desired response. This approach is called **shaping**. In a Skinner box, for example, we might first reward a rat for turning toward the response bar. Once the rat has learned this behavior, we might withhold reinforcement until the rat moves toward the bar. Later, we might reward it only for sniffing the bar or touching it with its nose or paw, and so on. In this way, by reinforcing successive approximations to the desired behavior, we gradually shape the bar-pressing response without waiting passively for the response to occur on its own.

The circus is a wonderful place to see the results of shaping. To teach a tiger to jump through a flaming hoop, the trainer might first reinforce the animal for simply jumping up on a certain pedestal. After that behavior has been learned, the tiger might be reinforced only for leaping from that pedestal to another. Next, the tiger might be required to jump through a hoop between the pedestals to gain its reward. Finally, the hoop might be set on fire and the tiger required to leap through the burning hoop to be rewarded. In much the same way, a speech therapist might reward a child with a lisp for closer and closer approximations of the correct sound of “s”. To learn about how you can use operant conditioning to modify your own behavior see *Applying Psychology: Modifying Your Own Behavior*.

**Extinction and Spontaneous Recovery**

We have seen how classical and operant conditioning result in the acquisition of new behaviors. But how long does such learning last, and, once lost, can it be recovered?

**Classical Conditioning** Let’s go back to Pavlov’s dogs, which had learned to salivate upon hearing a bell. What would you predict happened over time when the dogs heard the bell (CS) but no food (US) appeared? The answer is that the conditioned response to the bell—the amount of salivation—gradually decreased until...
eventually it stopped altogether. The dogs no longer salivated when they heard the bell. This process is called **extinction**. If the sound of a can being opened or a cupboard door opening (CS) is no longer associated with the sight or smell of food (US), your cat may no longer purr (CR) when it hears the CS. If scary music in films (CS) is not associated with frightening events on screen (US), you will eventually stop becoming tense and anxious (CR) when you hear that kind of music. These are all examples of extinction of classically conditioned responses.

Once a conditioned response has been extinguished, is the learning gone forever? Pavlov trained his dogs to salivate when they heard a bell, then extinguished the learning. A few days later, the same dogs were again taken to the laboratory. As soon as they heard the bell, their mouths began to water. The response that had been learned and then extinguished reappeared on its own, with no retraining. This phenomenon is known as **spontaneous recovery**. The dogs’ response was only about half as strong as it had been before extinction, but the fact that the response occurred at all indicated that the original learning was not completely lost during extinction (see Figure 5–7). Similarly, if your cat is away for a while and then returns home, it may run to the kitchen and start purring the first few times it hears cans or cupboard doors being opened. And if you stop going to the movies for some time, you may find, the next time you go, that scary music once again makes you tense or anxious. In both cases, responses that were once extinguished have returned spontaneously after the passage of time. Note, however, that responses that reappear during spontaneous recovery do not return at full strength, and generally they extinguish again very quickly.

How can extinguished behavior disappear, then reappear again at some later time? According to Mark Bouton (1993, 1994; 2002), extinction does not erase conditioned responses. Rather, extinction occurs because **new** learning during extinction interferes with the previously learned response. That is, stimuli that were paired with conditioned responses come to elicit responses different from, and sometimes incompatible with, those original conditioned responses. A buzzer paired with electric shock initially means “Pain is coming!” and comes to elicit a number of responses—changes in heart rate and blood pressure, for example—that accompany painful stimulation. During extinction, the association between the buzzer and pain disappears, and the buzzer therefore elicits another set of responses, which may be entirely different from the originally learned responses. In fact, these new responses may even antagonize or oppose those original responses. For example, if one response during training was an increased heart rate, but the new response during extinction is a decreased heart rate, the two clearly cannot happen at the same time. The result is **interference**, and spontaneous recovery consists of overcoming this interference.

According to Bouton, one way we overcome this interference is through what he terms the **renewal effect**. Imagine that you are conditioned in one setting (for example, a dim and dark laboratory), and then your conditioned response is extinguished in a very different setting (for example, a bright and cheerful room). Even with total extinction in the new setting, if you return to the original laboratory room, your conditioned response will immediately return. This occurs because the new, interfering responses learned during extinction are associated with stimuli in the new setting and not with stimuli in the original lab room. The originally learned stimulus-response connections, then, are still intact.

**Operant Conditioning**  Extinction and spontaneous recovery also occur in operant conditioning. In operant conditioning, extinction happens as a result of withholding reinforcement. Yet withholding reinforcement does not usually lead to an immediate decrease in the frequency of the response; in fact, when reinforcement is first discontinued, there is often a brief increase in responding before the strength

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**Extinction** A decrease in the strength or frequency of a learned response because of failure to continue pairing the US and CS (classical conditioning) or withholding of reinforcement (operant conditioning).

**Spontaneous recovery** The reappearance of an extinguished response after the passage of time, without further training.
Can you modify your own undesirable behaviors by using operant conditioning techniques? Yes, but first you must observe your own actions, think about their implications, and plan a strategy of intervention.

Begin by identifying the behavior you want to acquire: This is called the “target” behavior. You will be more successful if you focus on acquiring a new behavior rather than on eliminating an existing one. For example, instead of setting a target of being less shy, you might define the target behavior as becoming more outgoing or more sociable. Other possible target behaviors might include behaving more assertively, studying more, and getting along better with your roommates. In each case, you have spotlighted the behavior that you want to acquire rather than the behavior that you want to eliminate.

The next step is defining the target behavior precisely: What exactly do you mean by “assertive” or “sociable”? Imagine situations in which the target behavior could be performed. Then describe in writing the way in which you now respond to these situations. For example, if you would like to become more outgoing and sociable, you might write, “When I am sitting in a lecture hall, waiting for class to begin, I don’t talk to the people around me.” Next, write down how you would rather act in that situation: “In a lecture hall before class, I want to talk to at least one other person. I might ask the person sitting next to me how he or she likes the class or the professor, or simply comment on some aspect of the course.”

The third step is monitoring your present behavior: You may do so by keeping a daily log of activities related to the target behavior. This will establish your current “base rate” and give you something concrete against which to gauge improvements. At the same time, try to figure out whether your present, undesirable behavior is being reinforced in some way. For example, if you find yourself unable to study, record what you do instead (Get a snack? Watch television?) and determine whether you are inadvertently rewarding your failure to study.

The next step—the basic principle of self-modification—is providing yourself with a positive reinforcer that is contingent on specific improvements in the target behavior: You may be able to use the same reinforcer that now maintains your undesirable behavior, or you may want to pick a new reinforcer. For example, if you want to increase the amount of time you spend studying, you might reward yourself with a token for each 30 minutes of study. Then, if your favorite pastime is watching movies, you might charge yourself three tokens for an hour of television, whereas the privilege of going to a movie might cost six.

Remember that the new, more desirable behavior need not be learned all at once. You can use shaping or successive approximations to change your behavior gradually. A person who wants to become more sociable might start by giving rewards just for sitting next to another person in a classroom rather than picking an isolated seat. The person could then work up to rewarding increasingly sociable behaviors, such as first saying hello to another person, then striking up a conversation.

If you would like to try a program of self-improvement, a book by David Watson and Roland Tharp, Self-Directed Behavior: Self-Modification for Personal Adjustment (1997), is a good place to start. It contains step-by-step instructions and exercises that provide a useful guide.
and so on—and these new behaviors will interfere with the operant response of lever pressing, causing extinction. Spontaneous recovery is a brief victory of original training over these interfering responses.

How easy is it to extinguish behaviors learned through operant conditioning? The stronger the original learning, the longer it takes to stop the action from being performed. Also, the greater the variety of settings in which learning takes place, the

When reinforcement has been frequent, a learned behavior tends to be retained even after reinforcement is reduced. A dog “shaking hands” is an excellent example. Many previous rewards for this response tend to keep the dog offering people its paw even when no reward follows.
Stimulus generalization

Stimulus generalization is the transfer of a learned response to different but similar stimuli. Discrimination is an important part of learning, as any wild mushroom fancier knows. A dog or a human who can’t distinguish between an edible mushroom and a poisonous one is at a real disadvantage in the hunt for this food.

Stimulus generalization

The ability to respond to a stimulus that is similar to one to which you have learned to respond is called stimulus generalization. In Pavlov’s case, the conditioned response generalized from the ringing of a bell to other unusual noises in the testing room. Albert’s learned fear of white, furry rats generalized not only to white, furry rabbits but also to all kinds of white, furry objects—he came to fear cotton balls, a fur coat, and even a white-bearded Santa Claus mask.

Stimulus discrimination

Stimulus discrimination is not inevitable in classical conditioning. In a process called stimulus discrimination, we can train animals and people not to generalize but rather to make a learned response only to a single specific object or event. If we present several similar objects, only one of which is followed by the unconditioned stimulus, the subject will learn over time to respond only to that stimulus and to inhibit the response in the presence of all other stimuli. If Albert has been presented with a rat and a rabbit and cotton balls and other white, furry objects, but the loud noise (US) had occurred only when the rat appeared, he would have learned to discriminate the white rat from the other objects, and the fear response would not have generalized as it did.

Response generalization

We often encounter situations in which the same stimulus triggers responses that are different from, but similar to, the one that was taught. In operant conditioning, this process is called response generalization.

Classical Conditioning

Classical Conditioning. Recall the case of Little Albert and his conditioned fear of white rats. When the experimenters later showed Albert a white rabbit, Albert cried and tried to crawl away, even though he had not been taught to fear rabbits. Similarly, Pavlov noticed that after his dogs had been conditioned to salivate when they heard a bell, their mouths would often water when they heard a buzzer or the ticking of a metronome, even though they had not been taught to salivate to buzzers or ticking sounds. Often in classical conditioning we see that a response learned to one CS also occurs in the presence of other, similar objects or situations.

Operant Conditioning

Operant Conditioning. Stimulus generalization can also occur in operant conditioning. For example, a baby who is hugged and kissed for saying “mama” when he sees his mother may begin to call everyone “mama”—males and females alike. Although the person whom the baby sees—the stimulus—changes, he responds with the same word. In the same way, the skills you learn when playing tennis may be generalized to badminton, Ping-Pong, and squash.

Discrimination and Generalization

Generalization and Discrimination. We have seen the kinds of circumstances that make us more likely to acquire or to extinguish conditioned responses. What kinds of situations make us more likely to generalize a learned response to a new situation?

Discrimination is an important part of learning, as any wild mushroom fancier knows. A dog or a human who can’t distinguish between an edible mushroom and a poisonous one is at a real disadvantage in the hunt for this food.
to salivate when it hears a high-pitched tone, it will salivate less when it hears a low-pitched tone, but the response is still salivation.

Discrimination in operant conditioning is accomplished by reinforcing *only* the specific, desired response, and then *only* in the presence of specific stimuli. For example, babies can learn to say “mama” only for their own mothers if they are reinforced for using “mama” correctly and not reinforced when they use the term for other people. In the same way, if they are reinforced only when they say “mama” and not when they say “gaga” or “baba,” they will learn that those responses are not appropriate.

**New Learning Based on Original Learning**

Learning would be severely limited if learned responses were elicited, or emitted, only in the presence of the specific stimuli that are present during training. We have already seen how learning can be expanded to different situations. Here, we see how original learning can be the basis for new learning. In classical conditioning, an existing conditioned stimulus can be paired with a new stimulus to produce a new conditioned response. This is called **higher-order conditioning**. Similarly, in operant conditioning, objects that have no intrinsic value can nevertheless become reinforcers because of their association with other, more basic reinforcers. These learned reinforcers are called **secondary reinforcers**.

**Higher-Order Conditioning in Classical Conditioning**

Pavlov demonstrated higher-order conditioning with his dogs. After Pavlov’s dogs had learned to salivate when they heard a bell, Pavlov was able to use the bell (without food) to teach the dogs to salivate at the sight of a black square. Instead of showing them the square and following it with food, he showed them the square and followed it with the bell until the dogs learned to salivate when they saw the square. In effect, the bell served as a substitute unconditioned stimulus and the black square became a new conditioned stimulus. This is an example of higher-order conditioning, not because it is more complex or because it incorporates any new principles, but simply because it is conditioning based on previous conditioning.

Higher-order conditioning is difficult to achieve because it races against extinction. The original US, the foundation of the original conditioning, is no longer presented along with the CS and, as we saw earlier, that is precisely the way to extinguish a classically conditioned response. During higher-order conditioning, Pavlov’s dogs were exposed to the square and the bell, but no food was presented. In fact, the square became a signal that the bell would not be followed by food, so the dogs soon stopped salivating to the square/bell pairing. For higher-order conditioning to succeed, then, the US has to be reintroduced occasionally: Food must be given to the dogs once in a while at the sound of the bell, so that they will continue to salivate when they hear the bell.

**Secondary Reinforcers in Operant Conditioning**

Classical conditioning and operant conditioning can act in concert. Specifically, we can use classical conditioning principles to explain why operant learning, particularly human operant learning, is not restricted to food reinforcers and painful punishers.

Some reinforcers, such as food, water, and sex, are intrinsically rewarding in and of themselves. These are called **primary reinforcers**. No prior learning is required to make them reinforcing. Other reinforcers have no intrinsic value, but they acquire value or a sense of reward through association with primary reinforcers. These are called **secondary reinforcers**, not because they are less important, but because prior learning or conditioning is required before they will function as reinforcers.
Much like conditioned stimuli, secondary reinforcers acquire reinforcing properties because they have been paired with primary reinforcers. In humans, money is one of the best examples of a secondary reinforcer. Although money is just paper or metal, through its association with food, clothing, and other primary reinforcers, it becomes a powerful secondary reinforcer. And through the principles of higher-order conditioning, stimuli paired with a secondary reinforcer can acquire reinforcing properties. Checks and credit cards, for example, are one step removed from money, but can also be highly reinforcing.

**Contingency**

A reliable “if-then” relationship between two events such as a CS and a US.

**Blocking**

A process whereby prior conditioning prevents conditioning to a second stimulus even when the two stimuli are presented simultaneously.

**Classical Conditioning**

Pavlov’s analysis of classical conditioning emphasized that the CS and US must occur close together in time for classical conditioning to take place. More recent research, however, has shown that the CS must also precede and provide predictive information about the US. Robert Rescorla (1966, 1967, 1988) refers to this *informative* relationship between CS and US as a *contingency*.

Imagine an experiment in which animals are exposed to a tone (CS) and a mild electrical shock (US). One group always hears the tone a fraction of a second *before* it experiences the shock. Another group sometimes hears the tone just before the shock, sometimes hears the tone a fraction of a second *after* the shock, and on still other occasions the tone and shock occur simultaneously. You would expect animals in the first group to show a fear response when they hear the tone alone. You might also expect the second group also to show a startle or fear response, because the US and CS always occurred closely together in time. In fact, however, the second group will show little, if any, conditioning. This is because the first group has learned a contingency between the tone and the shock. For them, the tone *always* precedes the shock, the tone always means that a shock is coming. Not surprisingly, the animals learn to fear the sound of the tone. For the second group, however, the tone says little or nothing about the shock: Sometimes it means that a shock is coming, sometimes it means that the shock is here, and sometimes it means that the shock is over and “the coast is clear.” Because the meaning of the tone is ambiguous for this second group, there is little or no conditioning of a fear response.

Although scientists once believed that conditioning was impossible if the CS followed the US, Rescorla’s work demonstrates that this is not the case. Imagine a situation in which the tone (the CS) always follows the shock (the US), a so-called *backward conditioning* experiment. After many conditioning trials, we play the tone alone. It’s true that we will not see a conditioned startle or fear response; after all, the tone does not predict that a shock is about to occur. But that does not mean that no conditioning has occurred. In fact, the tone predicts that the shock is all over and will not occur again for some time. Thus, the tone comes to produce a conditioned relaxation response rather than a fear response!

The idea that a CS must provide information about the US for conditioning to occur was confirmed by psychologist Leon Kamin in 1969. Kamin first conditioned a rat to fear a noise (CS) that was followed by a brief shock (US). Then, he added a second CS—a light—along with the noise. Contrary to what you might expect, the rats did not learn to fear the light even though it was regularly followed by a shock. Kamin concluded that the original learning had a *blocking* effect on new learning. Once the rats learned that noise signaled the onset of shock, adding yet another cue (a light) provided no new information about the likelihood of shock, so no new learning took place. According to Kamin, then, classical conditioning occurs only when a CS tells the learner something *new* or *additional* about the likelihood that the US will be forthcoming.
Operant Conditioning Contingencies also figure prominently in operant conditioning. Seldom, either in life or in the laboratory, are we rewarded every time we do something. And this is just as well. Experiments demonstrate that partial or intermittent reinforcement results in behavior that persists longer than behavior learned by continuous reinforcement. When they receive only occasional reinforcement, learners typically continue to respond apparently in hopes that they will eventually gain the desired reward. Vending machines and slot machines illustrate the effects of continuous and partial reinforcement on extinction. Each time you put the correct change into a vending machine, you get something such as food in return (reinforcement); if a vending machine is broken and you receive nothing for your coins, you are unlikely to drop additional coins into it! By contrast, casino slot machines pay off only occasionally; therefore, you might continue putting coins into a slot machine for a long time, even though you are not receiving anything in return.

Schedules of Reinforcement Whenever partial reinforcement is given, the rule for determining when and how often reinforcers will be delivered is called the schedule of reinforcement. Schedules are either fixed or variable, and may be based on either the number of correct responses or the elapsed time between correct responses. The most common reinforcement schedules are fixed-interval and variable-interval schedules, which are based on time, and fixed-ratio and variable-ratio schedules, which are based on the number of correct responses. Table 5–1 describes some everyday examples of reinforcement schedules. Figure 5–8 illustrates a response pattern that typically results from each type of reinforcement schedule.

On a fixed-interval schedule, learners are reinforced for the first correct response only after a certain time has passed following the previous correct response; that is, they have to wait for a set period before they can be reinforced again. With fixed-interval schedules, performance tends to fall off immediately after each reinforcement and then to pick up again as the time for the next reinforcement draws near. For example, when exams are given at fixed intervals—such as midterms and finals—students tend to increase the intensity of their studying just before an exam and then decrease it sharply right after the exam until shortly before the next one (see Figure 5–8).

A variable-interval schedule reinforces correct responses after varying lengths of time following the last reinforcement. One reinforcement might be given after 6 minutes, the next after 4 minutes, the next after 5 minutes, the next after 3 minutes. Subjects learn to give a slow, steady pattern of responses, being careful not to be so slow as to miss all the rewards. Thus, if several exams are given during a semester at unpredictable intervals, students have to keep studying at a steady rate all the time, because on any given day there might be an exam.

On a fixed-ratio schedule, a certain number of correct responses must occur before reinforcement is provided. This results in a high response rate because making many responses in a short time yields more rewards. Being paid on a piecework basis is an example of a fixed-ratio schedule. Farmworkers might get $3 for every 10 baskets of cherries they pick. The more they pick, the more money they make. Under a fixed-ratio schedule, a brief pause after reinforcement is followed by a rapid and steady response rate until the next reinforcement.

On a variable-ratio schedule, the number of correct responses necessary to gain reinforcement is not constant. The casino slot machine is a good example of a variable-ratio schedule: It may pay off, but you have no idea when. And because there is always a chance of hitting the jackpot, the temptation to keep playing is great. Learners on a variable-ratio schedule tend not to pause after reinforcement
**EXAMPLES OF REINFORCEMENT IN EVERYDAY LIFE**

<table>
<thead>
<tr>
<th><strong>Continuous reinforcement</strong> (reinforcement every time the response is made)</th>
<th>Putting money in the parking meter to avoid a ticket. Putting coins in a vending machine to get candy or soda.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fixed-ratio schedule</strong> (reinforcement after a fixed number of responses)</td>
<td>Being paid on a piecework basis—in the garment industry, workers may be paid a fee per 100 dresses sewn. Taking a multi-item test. This is an example of negative reinforcement—as soon as you finish those items on the test, you can leave!</td>
</tr>
<tr>
<td><strong>Variable-ratio schedule</strong> (reinforcement after a varying number of responses)</td>
<td>Playing a slot machine—the machine is programmed to pay off after a certain number of responses have been made, but that number keeps changing. This type of schedule creates a steady rate of responding, because players know if they play long enough, they will win. Sales commissions—you have to talk to many customers before you make a sale, and you never know whether the next one will buy. Again, the number of sales calls you make, not how much time passes, will determine when you are reinforced by a sale. And the number of sales calls will vary.</td>
</tr>
<tr>
<td><strong>Fixed-interval schedule</strong> (reinforcement after a fixed amount of time has passed)</td>
<td>You have an exam coming up, and as time goes by, and you haven’t studied, you have to make up for it all by a certain time, and that means cramming. Picking up a salary check, which occurs every week or every two weeks.</td>
</tr>
<tr>
<td><strong>Variable-internal schedule</strong> (reinforcement of first response after varying amounts of time)</td>
<td>Surprise quizzes in a course cause a steady rate of studying because you never know when they’ll occur, and so you have to be prepared all the time. Watching a football game, waiting for a touchdown. It could happen anytime—if you leave the room, you may miss it, so you have to keep watching continuously.</td>
</tr>
</tbody>
</table>

and have a high rate of response over a long period of time. Because they never know when reinforcement may come, they keep on trying. Similarly, salespeople working on commission know that every attempt will not produce a sale, but it is certain that the more customers they approach, the more sales they will make.

### Summing Up

Classical and operant conditioning both focus on building associations between stimuli and responses. Both are subject to extinction and spontaneous recovery as well as to generalization and discrimination. The main difference between the two is that in classical conditioning, the learner is passive and the desired behavior is usually involuntary, whereas in operant conditioning, the learner is active and the desired behavior is usually voluntary.

However, some psychologists play down these differences, suggesting that classical and operant conditioning are simply two different ways of bringing about the same kind of learning. For example, in operant conditioning, once the operant response

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**THINKING CRITICALLY**

**Schedules of Reinforcement**

Think about how you could apply the principles of behavioral learning to

1. Design the ideal slot machine, one that would keep people playing over and over again, even though they won very little money.
2. Design a reward system for a fifth-grade class that would result in both effort at schoolwork and good behavior.
3. Design an ideal lottery or mail-in contest.
4. Design an ideal payment system for salespeople (you may include both salary and commission).

For each type of reward system, think about what the reinforcers should be, what contingencies are operating, and what behaviors you want to elicit. Also think about how you would demonstrate to a skeptic that your procedures have actually resulted in a change in the desired direction.
The slot machine is a classic example of a variable-ratio schedule of reinforcement. The machine eventually pays off, but always after a variable number of plays. Because people keep hoping that the next play will be rewarded, they maintain a high rate of response over a long period of time.

becomes linked to a stimulus, the response looks and acts very much like an unconditioned response. If you have been reinforced repeatedly for stepping on the brake when a traffic light turns red, the red light comes to elicit braking behavior, just as an unconditioned stimulus elicits an unconditioned response in classical conditioning. Moreover, classical conditioning can be used to shape voluntary movements (P. L. Brown & Jenkins, 1968; Vossel & Rossman, 1986), and operant conditioning can be used to shape involuntary responses as we will see in the next section of the chapter.

**CHECK YOUR UNDERSTANDING**

1. To extinguish classical conditioning, break the association between which of the following pairs?
   ___a. US and UR
   ___b. CS and US
   ___c. US and CR

2. Identify the following schedules of reinforcement as fixed interval (FI), variable interval (VI), fixed ratio (FR) and variable ratio (VR).
   ___a. Reinforcement comes on the first correct response after two minutes from the last correct response.
   ___b. Reinforcement comes on every sixth correct response.
   ___c. Reinforcement comes after four correct responses, than after six more, than after five more.
   ___d. Reinforcement comes after varying lengths of time following the last correct response.

3. The process by which a learned response to a specific stimulus comes to be associated with a different but similar stimulus is called
   ___a. extinction
   ___b. classical conditioning
   ___c. stimulus generalization
   ___d. response generalization
4. What is it called when prior conditioning prevents conditioning to a second stimulus, even when the two are presented simultaneously?
___a. partial reinforcement
___b. blocking
___c. backward conditioning
___d. extinction

Cognitive Learning

Do children learn to behave violently by observing adults?

Classical and operant conditioning both depend on direct experience and stimulus control. Some psychologists insist that because the elements of these types of learning can be observed and measured, they are the only legitimate kinds of learning to study scientifically. Other psychologists, however, point to the importance of mental activities such as attention, expectation, thinking, and remembering as crucial to the process of learning. We learn how to find our way around a building or neighborhood, we learn what to expect from a given situation, we learn abstract concepts, and we can even learn about situations that we have never experienced firsthand. These kinds of cognitive learning are impossible to observe and measure directly, but they can be inferred from behavior; thus, they too are legitimate subjects for scientific inquiry. In fact, much of the recent research in the area of learning concerns cognitive learning: What goes on inside us when we learn.

Latent Learning and Cognitive Maps

Interest in cognitive learning actually began shortly after the earliest work in both classical and operant conditioning. Edward Chace Tolman, one of the pioneers in the study of cognitive learning, argued that we do not need to show our learning in order for learning to have occurred. Tolman called learning that is not apparent because it is not yet demonstrated latent learning.

Tolman demonstrated the process of latent learning in a famous experiment with C.H. Honzik in 1930. Two groups of hungry rats were placed in a maze and required to find their way from a start box to an end box. The first group found food pellets (a reward) in the end box; the second group found nothing there. According to the principles of operant conditioning, the first group would learn the maze better than the second group—which was, indeed, what happened. But when Tolman took some of the rats from the second, unreinforced group and gave them food at the goal box, almost immediately they started running the maze as well as the rats in the first group (see Figure 5–9). He explained these dramatic findings by noting that the unrewarded rats had actually learned a great deal about the maze as they wandered around inside it but their learning was latent—stored internally in some way but not yet reflected in their behavior. When they were given a good reason (a food reward) to run the maze quickly, they put their latent learning to use.

In response to Tolman’s theory of latent learning, Thorndike proposed an experiment to test whether a rat could learn to run a maze and store an image or cognitive map of the maze without experiencing the maze firsthand. He envisioned researchers carrying each rat through the maze in a
Insight and Learning Sets

Another phenomenon that highlights the importance of cognitive processing in learning is **insight**, the sudden “coming together” of the elements of a situation so that the most efficient path is instantly clear or the solution to a problem suddenly strikes the learner. In this case, learning does not progress slowly and gradually on a smooth curve as a result of practice but suddenly shoots up from unsuccessful trial and error to instant success.

**Insight** Learning that occurs rapidly as a result of understanding all the elements of a problem.
During World War I, the German Gestalt psychologist Wolfgang Köhler conducted a series of experiments on insightful learning. He placed a chimpanzee in a cage with a banana on the ground just outside the cage, but not within reach. When the animal realized that it couldn’t reach the banana by stretching out its arms, it initially reacted with frustration. After a while, the chimp started looking at what was in the cage, including a stick left there by the experimenters. Sometimes quite suddenly, the chimp would grab the stick, poke it through the bars of the cage, and drag the banana within reach. The same kind of sudden insight occurred when the banana was hung from the roof of the cage, just out of the chimp's grasp. This time, inside the cage were some boxes, which the chimp quickly learned to move to the spot under the banana and stack up high enough so it could climb up to snatch the food.

Human Insight

Insightful learning is particularly important in humans, who must learn not only where to obtain food and how to escape from predators but also such complex ethical and cultural ideas as the value of hard work, helping others, overcoming addictions, or dealing with a life crisis. In Chapter 7 (Cognition and Language), we will explore the role of insight in creative problem solving. As we will see, there are times when all other problem-solving techniques fail to produce a solution; in such cases, it is not unusual for the solution to suddenly “pop up” in a moment of insight (Novick & Sherman, 2003). Moreover, to the extent that people gain insight into their own behavior, they should be capable of changing significantly over the course of their lives (Bornstein & Masling, 1998). Indeed, as we will see in Chapter 14 (Therapies), the common goal of the various insight therapies, such as psychoanalysis, is to give people a better awareness and understanding of their feelings, motivations, and actions in the hope that this will lead to better adjustment (Pine, 1998).

Are the complex cognitive processes that produce insight limited to higher animals such as apes and humans? In a classic 1984 study, four Harvard University psychologists presented the banana-and-box problem to a small group of pigeons to see if they, too, were capable of insight learning (R. Epstein, Kirshnit, Lanza, & Rubin, 1984). Because moving boxes around is not as natural a behavior for pigeons as it is for chimps, the researchers first conditioned the pigeons, through standard shaping procedures, to push a box toward a particular target—a green spot on the wall of the training cage. On separate occasions, the pigeons were also taught to climb onto a box that was stuck to the floor and to peck at a small picture of a banana to receive a food reward. The question then was: Could the pigeons put the two new behaviors together to solve the problem of the banana and the box? When the pigeons were presented with an out-of-reach hanging picture of a banana and with a box, Epstein and his coworkers reported that each pigeon initially showed confusion and, just like Köhler's chimps, looked for a while from the hanging picture to the box. Then, fairly suddenly, each pigeon began to push the box toward the picture, stopping now and then to sight the picture and to check the direction in which to push the box. When the box was underneath the picture of the banana, each of the pigeons then climbed on top and pecked at the picture to receive its reward.

Previous learning can also be used to speed up new learning, a process demonstrated clearly in a series of studies by Harry Harlow with rhesus monkeys (Harlow,
Learning set  The ability to become increasingly more effective in solving problems as more problems are solved.

Social learning theory  A view of learning that emphasizes the ability to learn by observing a model or receiving instructions, without firsthand experience by the learner.

Observational (or vicarious) learning  Learning by observing other people’s behavior.

Harlow presented each monkey with two boxes—say, a round green box on the left side of a tray and a square red box on the right side. A morsel of food was put under one of the boxes. The monkey was permitted to lift just one box; if it chose the correct box, it got the food. On the next trial, the food was put under the same box (which had been moved to a new position), and the monkey again got to choose just one box. Each monkey had six trials to figure out which box covered the food no matter where that box was located. Then the monkeys were given a new set of choices—say, between a blue triangular box and an orange pentagonal one—and another six trials, and so on with other shapes and colors of boxes.

How long did it take for the monkeys to figure out that in any set of six trials, food was always under the same box? Initially, the monkeys chose boxes randomly, by trial and error; sometimes they would find food, but just as often they would not. However, after a while their behavior changed: In just one or two trials, they would find the correct box, which they chose consistently thereafter until the experimenter supplied new boxes. They seemed to have learned the underlying principle—“food is always under the same box”—and they used that learning to solve almost instantly each new set of choices presented by the experimenter.

Harlow concluded that the monkeys had “learned how to learn”; in other words, that they had established learning sets. With practice, they became more effective at solving a problem, so that, within the limited range of choices available, they discovered how to tell which box would give them what they wanted. By extension, Köhler’s chimps could be said to have established learning sets for various ways of obtaining food that was just out of reach. When presented with the familiar problem of reaching the banana, the chimps simply called up the appropriate learning sets and solved the problem. Epstein’s pigeons, however, first had to be taught the appropriate learning sets, and then they, too, were able to solve the problem. In all these cases, the animals seemed to have learned more than just specific behaviors—they apparently learned how to learn. Whether this means that animals can think is an issue that is still being studied and debated. We will explore the question of cognitive learning in animals later in this chapter; then, in Chapter 7 (Cognition and Language), we will look more closely at the question of whether animals can think.

Learning by Observing

We have seen how cognitive psychologists came to challenge the idea that most or all human learning stems from conditioning. Another group of psychologists, social learning theorists, also challenged this idea. Social learning theory focuses on the extent to which we learn not just from firsthand experience, the kind of learning explained by classical and operant conditioning, but also from watching what happens to other people or by hearing about something. In fact, we can learn new behaviors without ever actually performing them or being reinforced for them. For example, the first time you drive a car, you tend to drive carefully because you have been told to do so, you have been warned about driving carelessly, you have watched people drive carefully, and you’ve seen what happens when people drive carelessly. In other words, you learned a great deal about driving before you ever got behind the wheel of a car.

This kind of observational (or vicarious) learning is quite common (Blackmore, 1999). But we do not imitate everything that other people do. Social learning theory accounts for this in several ways (Bandura, 1977, 1986). First, you must not only see but also pay attention to what the model does; this is more likely if the model commands attention (as does a famous or attractive person or an expert). Second, you must remember what the model did. Third, you have to convert what you learned into action: You may learn a great deal from watching a model but have no particular reason to display what you have learned as behavior. This distinction

In observational or vicarious learning, we learn by watching a model perform a particular action and then trying to imitate that action correctly. Some actions would be very difficult to master without observational learning.

between learning and performance is crucial to social learning theorists: They stress that learning can occur without any change in outward or overt behavior. Finally, the extent to which we display behaviors that have been learned through observation can be affected by vicarious reinforcement and vicarious punishment. That is, our willingness to perform acts that we learn by observation depends in part on what happens to the people we are watching. So, when children watching TV or movies see people using drugs or behaving violently, we have cause for concern about whether the plot punishes the actors for their behavior.

The foremost proponent of social learning theory is Albert Bandura, who refers to his learning theory as a social cognitive theory (Bandura, 1986). In a classic experiment, Bandura (1965) demonstrated that people can learn a behavior without being reinforced for doing so and that learning a behavior and performing it are not the same thing. Three groups of nursery-school children watched a film in which an adult model walked up to an adult-size plastic doll and ordered it to move out of the way. When the doll failed to obey, the model became aggressive, pushing the doll on its side, punching it in the nose, hitting it with a rubber mallet, kicking it around the room, and throwing rubber balls at it.

The film ended differently for children in each of the three groups, however. Children in the model-rewarded condition saw the model showered with candies, soft drinks, and praise by a second adult—an example of vicarious reinforcement. Those in the model-punished condition witnessed the second adult shaking a finger at the model, scolding, and spanking him—an example of vicarious punishment. Youngsters in the no-consequences condition saw a version of the film that ended with the scene of aggression—no second adult appeared, so there were no consequences for the model.

Immediately after seeing the film, the children were individually escorted into another room where they found a doll, rubber balls, a mallet, and many other toys. As a child played alone for ten minutes, observers recorded the youngster’s behavior from behind a one-way mirror. Every time a child spontaneously repeated any of the aggressive acts seen in the film, that child was coded as performing the behavior. After ten minutes, an experimenter entered the room and offered the child treats in return for imitating or repeating things the model had done or said to the doll. Bandura used the number of successfully imitated behaviors as a measure of how much the child had learned by watching the model (see Figure 5–10).

Analysis of the data revealed that (1) children who had observed the model being rewarded were especially likely to perform the model’s behavior spontaneously; but (2) children in all three groups had learned to imitate the model’s behavior equally well, and quite accurately at that (see Figure 5–11).

The children in this study learned aggressive behavior without being reinforced for it and without seeing the model reinforced for it. Seeing a model reinforced or punished simply provides useful information about what is likely to happen to us if we imitate the model. By drawing attention to the importance of modeling, social learning theory also points out how not to teach something unintentionally. For example, suppose you want to teach a child not to hit other children. You might think that slapping the child as punishment would change the behavior. But social learning theory maintains that slapping the child as punishment would change the behavior. You and the child would both be better off if your actions reflected a less aggressive way of dealing with other people (Bandura, 1973, 1977).

Bandura and more recently others (Efklides, Niemivirta, & Yamauchi, 2002; Ommundsen, 2003) stress that human beings are also capable of setting performance standards for themselves and then rewarding (or punishing) themselves for achieving or failing to achieve those standards as a way to regulate their own behavior (see Applying Psychology: Modifying Your Own Behavior, on page 204). Thus, vicarious reinforcement and vicarious punishment Reinforcement or punishment experienced by models that affects the willingness of others to perform the behaviors they learned by observing those models.
human beings use the powers of sight as well as insight, hindsight, and foresight to interpret their own experiences and those of others (Bandura, 1962).

Cognitive Learning in Nonhumans

We have seen that contemporary approaches to conditioning emphasize that conditioned stimuli, reinforcers, and punishers provide information about the environment. Classical and operant conditioning are not viewed as purely mechanical processes that can proceed without at least some cognitive activity. Moreover, animals are capable of latent learning, learning cognitive maps, and insight, all of which involve cognitive processes. Thus, because all animals can be conditioned, we might reasonably conclude that all animals are capable of at least minimal cognitive processing of information. Do nonhuman animals also exhibit other evidence of cognitive learning? The answer seems to be a qualified yes.

For example, rats that watch other rats try a novel or unfamiliar food without negative consequences show an increased tendency to eat the new food (Galef, 1993). In a different experiment, one group of rats watched another group experience extinction; as a result, the observer rats themselves extinguished faster than if they had not watched the model rats (Heyes, Jaldow, & Dawson, 1993). This experiment provides evidence that rats can learn from the experiences of others through observation and imitation.

**THINKING CRITICALLY**

**Media Violence and Aggressive Behavior**

In 2000, Congress held hearings on the subject of violent movies and TV programs, claiming that such media provided bad examples to young people. Comstock and Scharrer (1999) concluded that “TV violence frightens some children and excites others, but its foremost effect is to increase aggressive behavior that sometimes spills over into seriously harmful antisocial behavior.”

1. If Comstock and Scharrer were present, what questions would you ask them to decide whether to have confidence in their conclusions?
2. Do you agree or disagree with their conclusions? Why, or why not? What research evidence would be required to change your opinion?
1993). Apparently, the observer rats learned something about the absence of reward simply by seeing what happened to the other rats. These surprising results, along with reports that animals as diverse as chickens and octopi learn by watching others, further support the notion that nonhuman animals do indeed learn in ways that reflect the cognitive theory of learning. In Chapter 7 (Cognition and Language) we will revisit this topic, examining in more detail some of the intriguing new procedures scientists have used to explore the cognitive abilities of other animals (e.g., Boysen & Himes, 1999).

**Check Your Understanding**

1. Match the following terms with the appropriate definitions.
   - latent learning
   - insight
   - observational learning
   
   a. new, suddenly occurring idea to solve a problem
   b. learning by watching a model
   c. learning that has not been demonstrated in behavior

2. An ape examines a problem and the tools available for solving it. Suddenly the animal leaps up and executes a successful solution. This is an example of
   
   a. trial-and-error learning
   b. classical conditioning
   c. operant conditioning
   d. insight

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**Figure 5–11**

As the graph shows, even though all the children in Bandura’s study of imitative aggression learned the model’s behavior, they performed differently depending on whether the model they saw was rewarded or punished.

Source: Albert Bandura, *Journal of Personality and Social Psychology* 1965, 1, 589–595, Fig. 1. Copyright © 1965 by the American Psychological Association. Reprinted by permission.

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3. According to social learning theorists, we can learn new behaviors without ever actually performing them or being reinforced for them. This is called
   ___a. observational learning
   ___b. vicarious learning
   ___c. a and b

Answers: 1. latent learning—c; insight—a; observational learning—b; 2.d, 3.c

Summary

This chapter concentrates on learning, the process by which experience or practice produces a relatively permanent change in behavior or potential behavior. The basic form of learning is known as conditioning.

Classical Conditioning

In classical (or Pavlovian) conditioning, a response naturally elicited by one stimulus comes to be elicited by a different, formerly neutral stimulus. Russian psychologist Ivan Pavlov hit upon classical (or Pavlovian) conditioning almost by accident when studying digestive processes. He trained a dog to salivate at the sound of a bell by presenting the sound just before food was brought into the room. Eventually, the dog began to salivate at the sound of the bell alone.

Elements of Classical Conditioning Classical conditioning involves pairing a response naturally caused by one stimulus with another, previously neutral stimulus. There are four basic elements to this transfer: The unconditioned stimulus (US), often food, invariably causes an organism to respond in a specific way. The unconditioned response (UR) is the reaction (such as salivation) that always results from the unconditioned stimulus. The conditioned stimulus (CS) is a stimulus (such as a bell) that does not initially bring about the desired response; over the course of conditioning, however, the CS comes to produce the desired response when presented alone. Finally, the conditioned response (CR) is the behavior that the organism learns to exhibit in the presence of a conditioned stimulus.

Classical Conditioning in Humans Humans also learn to associate certain sights or sounds with other stimuli. John Watson and Rosalie Rayner conditioned a little boy, Albert, to fear white rats by making a loud, frightening noise every time the boy was shown a rat. Using much the same principle, Mary Cover Jones developed a method for unlearning fears. She paired the sight of a caged rat, at gradually decreasing distances, with a child’s pleasant experience of eating candy. This method evolved into desensitization therapy, a conditioning technique designed to gradually reduce anxiety about a particular object or situation. Recently, scientists have discovered that the immune system may respond to classical conditioning techniques, thus allowing doctors to use fewer drugs in treating certain disorders.

Classical Conditioning Is Selective Some kinds of conditioning are accomplished very easily, whereas other kinds may never occur.

Operant Conditioning

Classical conditioning focuses on a behavior that invariably follows a particular event, whereas operant (or instrumental) conditioning concerns the learning of behavior that operates on the environment: The person or animal behaves in a particular way to gain something desired or avoid something unpleasant. This behavior is initially emitted rather than elicited—you wave your hand to flag down a taxi, dogs beg at the dinner table to get food. Such actions are called operant behaviors.

Elements of Operant Conditioning Psychologist Edward Lee Thorndike, the first researcher to study operant behavior systematically, used a “puzzle box” to determine how cats learn. His work still stands as a landmark in our understanding of the effects of both reinforcers and punishers. In operant conditioning, reinforcement (such as food) is used to increase the probability that a particular response will occur in the future. To decrease the probability that a particular response will recur, punishers (such as scolding) are used. Thorndike proposed the law of effect, which states that behavior that is consistently rewarded will become “stamped in” as learned behavior and behavior that is consistently punished will be “stamped out.”

Types of Reinforcement There are several kinds of reinforcers; all of them strengthen behavior just as steel rods reinforce or strengthen concrete.

The presence of positive reinforcers (such as food) adds to or increases the likelihood that a behavior will recur. Negative reinforcers (such as terminating electric shocks) also increase the likelihood that a behavior will recur, but they do so by reducing or eliminating something unpleasant from the environment.
Punishment Although all reinforcers (both positive and negative) increase the likelihood that a behavior will occur again, punishment is any event whose presence decreases the likelihood that ongoing behavior will recur. Reinforcement always strengthens behavior; punishment weakens it. Avoidance training involves learning a desirable behavior that prevents an unpleasant condition, such as punishment, from occurring.

Operant Conditioning Is Selective Studies have revealed that in operant conditioning the behaviors that are easiest to condition are those that animals typically would perform in the training situation. These behaviors vary from species to species and put significant constraints on both classical and operant conditioning.

Superstitious Behavior When something we do is followed closely by a reinforcer, we tend to repeat that behavior, even if it was not actually responsible for producing the reinforcement. Such behaviors are called superstitious. Nonhumans as well as humans exhibit superstitious behaviors.

Learned Helplessness The failure to avoid or escape from an unpleasant or aversive stimulus that occurs as a result of previous exposure to unavoidable painful stimuli is referred to as learned helplessness. Learned helplessness, which has been demonstrated in both animals and humans, is associated with many of the symptoms characteristic of depression.

Shaping Behavioral Change Through Biofeedback When operant conditioning is used to control certain biological functions, such as blood pressure, skin temperature, or heart rate, it is referred to as biofeedback. Neurofeedback is biofeedback used to monitor and control brain waves. Biofeedback and neurofeedback are used to treat a number of medical problems, giving patients control of their treatment.

Comparing Classical and Operant Conditioning

A number of phenomena characterize both classical conditioning and operant conditioning, and there are several terms and concepts common to both kinds of learning.

Response Acquisition In classical conditioning, responses occur naturally and automatically in the presence of the unconditional stimulus. During the phase of the learning process called response acquisition, these naturally occurring responses are attached to the conditioned stimulus by pairing that stimulus with the unconditioned stimulus. Intermittent pairing reduces both the rate of learning and the final level of learning achieved.

In operant conditioning, response acquisition refers to the phase of the learning process in which desired responses are followed by reinforcers. A Skinner box is often used to limit the range of available responses and thus increase the likelihood that the desired response will occur. To speed up this process and make the occurrence of a desired response more likely, motivation may be increased by letting the animal become hungry; the number of potential responses may also be reduced by restricting the animal's environment.

For behaviors outside the laboratory, which cannot be controlled so conveniently, the process of shaping is often useful: Reinforcement is given for successive approximations to the desired behavior. However, there are differences among species in what behaviors can be learned and the circumstances under which learning will take hold.

Extinction and Spontaneous Recovery If the unconditioned stimulus and the conditioned stimulus are no longer paired, extinction occurs, meaning the strength and/or frequency of the learned response diminishes. When Pavlov's dogs received no food after repeatedly hearing the bell, they ceased to salivate at the sound of the bell. However, after a while, this extinguished response may reappear without retraining in a process called spontaneous recovery. Extinction is complete when the subject no longer produces the conditioned response.

Extinction occurs in operant conditioning when reinforcement is withheld. However, the ease with which a behavior is extinguished varies according to several factors: the strength of the original learning, the variety of settings in which learning takes place, and the schedule of reinforcement used during conditioning. Especially hard to extinguish is behavior learned through punishment rather than reinforcement.

Generalization and Discrimination In classical conditioning, situations or stimuli may resemble each other enough that the learners will react to one the way they have learned to react to the other through a process called stimulus generalization. On the other hand, the process of stimulus discrimination enables learners to perceive differences among stimuli so that not all loud sounds, for example, provoke fear.

Just as in classical conditioning, responses learned through operant conditioning can generalize from one stimulus to other, similar stimuli. Response generalization occurs when the same stimulus leads to different but similar responses. Discrimination in operant conditioning is taught by reinforcing a response only in the presence of certain stimuli.

New Learning Based on Original Learning In both classical and operant conditioning, original learning serves as a building block for new learning.

Higher-order conditioning in classical conditioning uses an earlier conditioned stimulus as an unconditioned stimulus for further training. For example, Pavlov used the bell to condition his dogs to salivate at the sight of a black square. This sort of conditioning is difficult to achieve because of extinction: Unless the first unconditioned stimulus is presented occasionally, the initial conditioned response will be extinguished.

In operant conditioning, neutral stimuli can become reinforcers by being paired or associated with other reinforcers. A primary reinforcer is one that, like food and water, is rewarding in and of itself. A secondary reinforcer is one whose value is learned through its association with primary reinforcers or with other secondary reinforcers. Money is an example of a secondary reinforcer—in and of itself, it is not rewarding; it is valuable only for what it can buy.

Contingencies The “if-then” relationship between conditioned stimuli and unconditioned stimuli in classical conditioning or between responses and reinforcers (or punishers) in operant conditioning is called a contingency.

Robert Rescorla has demonstrated that classical conditioning requires more than merely presenting an unconditioned stimulus and a conditioned stimulus together in time. His work shows that for conditioning to occur, a conditioned stimulus must provide...
information about the unconditioned stimulus—that is, there must be a CS–US contingency. Blocking can occur when prior conditioning prevents conditioning to a second stimulus, even when the two stimuli are presented simultaneously.

In operant conditioning, response contingencies are usually referred to as schedules of reinforcement. Partial reinforcement—in which rewards are given for some correct responses but not for every one—results in behavior that persists longer than that learned by continuous reinforcement. Whenever partial reinforcement is given, the rule for determining when and how often reinforcers will be delivered is the schedule of reinforcement. Schedules are either fixed or variable, and may be based on either the number of correct responses or the elapsed time between correct responses.

A fixed-interval schedule provides reinforcement of the first correct response after a fixed, unchanging period of time. A variable-interval schedule reinforces the learner for the first correct response that occurs after various periods of time, so the subject never knows exactly when a reward is going to be delivered. In a fixed-ratio schedule, behavior is rewarded each time a fixed number of correct responses is given; in a variable-ratio schedule, reinforcement follows a varying number of correct responses.

Summing Up Despite their differences, classical and operant conditioning share many similarities; both involve associations between stimuli and responses; both are subject to extinction and spontaneous recovery as well as generalization and discrimination. In fact, many psychologists now question whether classical and operant conditioning are not simply two ways of bringing about the same kind of learning.

Cognitive Learning

Both human and nonhuman animals also demonstrate cognitive learning, learning that is not tied to immediate experience by stimuli and reinforcers.

Latent Learning and Cognitive Maps Early experiments by Tolman and other psychologists demonstrated that learning takes place even before the subject reaches the goal and occurs whether or not the learner is reinforced. Tolman proposed the concept of latent learning, which maintains that subjects store up knowledge even if this knowledge is not reflected in their current behavior because it is not elicited by reinforcers. Later research suggested that latent learning is stored as a mental image, or cognitive map. When the proper time comes, the learner calls up this map and puts it to use.

Insight and Learning Sets One phenomenon that highlights the importance of cognitive processing in learning is insight, in which learning seems to occur in a “flash.” Through insight learning, human and some nonhuman animals suddenly discover whole patterns of behavior or solutions to problems. Learning sets refer to the increasing effectiveness at problem solving that comes about as more problems are solved.

Learning by Observing Social learning theory argues that we learn not just from firsthand experience, but also from watching others or by hearing about something. Albert Bandura contends that observational (or vicarious) learning accounts for many aspects of human learning. His highly influential theory of learning holds that although reinforcement is unrelated to learning itself, reinforcement may influence whether learned behavior is actually displayed. Such observational learning stresses the importance of models in our lives. To imitate a model’s behavior, we must (1) pay attention to what the model does; (2) remember what the model did; and (3) convert what we learned from the model into action. The extent to which we display behaviors that have been learned through observation can be affected by vicarious reinforcement and vicarious punishment. Social cognitive theory emphasizes that learning a behavior from observing others does not necessarily lead to performing that behavior. We are more likely to imitate behaviors we have seen rewarded.

Cognitive Learning in Nonhumans Research has demonstrated that nonhuman animals can be classically conditioned, that they can be taught to perform whole patterns of operant behaviors, and that they are capable of latent learning. All this evidence lends support to the argument that nonhuman animals use cognitive processing in learning.
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