6 :: LEARNING

6.1 Classical Conditioning
- Pavlov’s Dogs: Classical Conditioning of Salivation p. 196
- Processes of Classical Conditioning p. 198
- Applications of Classical Conditioning p. 200
- Working the Scientific Literacy Model: Conditioning and Advertising p. 203
- Learning Without Awareness p. 205
- Module Summary p. 208

6.2 Operant Conditioning
- Processes of Operant Conditioning p. 210
- Applications of Operant Conditioning p. 215
- Working the Scientific Literacy Model: Reinforcement and Superstition p. 217
- Module Summary p. 220

6.3 Cognitive and Observational Learning
- Cognitive Perspectives on Learning p. 222
- Observational Learning p. 225
- Working the Scientific Literacy Model: Linking Media Exposure to Behavior p. 228
- Module Summary p. 231

Chapter In Focus p. 232
- Chapter Quiz p. 233
- Work the Scientific Literacy Model p. 234
Classical Conditioning: Learning by Association

**Focus Questions**

1. Which types of behaviors can be learned?
2. Do all instances of classical conditioning go undetected by the individual?

Learning is a process by which behavior or knowledge changes as a result of experience. Learning from experience plays a major role in enabling us to do many things that we clearly were not born to do, from the simplest tasks, such as flipping a light switch, to the more complex, such as playing a musical instrument.

To many people, the term “learning” signifies the activities that students do—reading, listening, and taking tests in order to acquire...
new information. This process, which is known as cognitive learning, is just one type of learning, however. Another way that we learn is by associative learning, which is the focus of this module. You probably associate certain holidays with specific sights, sounds, and smells, or foods with specific flavors and textures. We are not the only species with this skill—even the simplest animals such as the earthworm can learn by association. Here we will explore the processes that account for how these associations form. Research on associative learning has a long history in psychology, dating back to Ivan Pavlov (1849–1936), a Russian physiologist and the 1904 Nobel laureate in medicine.

**Pavlov’s Dogs: Classical Conditioning of Salivation**

Pavlov studied digestion, using dogs as a model species for his experiments. As a part of his normal research procedure, he collected saliva and other gastric secretions from the dogs when they were presented with meat powder. Pavlov and his assistants noticed that as they prepared dogs for procedures, even before any meat powder was presented, the dogs would start salivating. This curious observation led Pavlov to consider the possibility that digestive responses were more than just simple reflexes in response to food. If dogs salivate in anticipation of food, then perhaps the salivary response can also be learned (Pavlov’s lab assistants referred to them as “psychic secretions”). Pavlov began conducting experiments in which he first presented a sound from a metronome, a device that produces ticking sounds at set intervals, and then presented meat powder to the dogs. After pairing the sound with the food several times, Pavlov discovered that the metronome by itself could elicit salivation (see Figure 6.1).

Pavlov’s discovery began a long tradition of inquiry into what is now called classical conditioning—learning that occurs when a neutral stimulus elicits a response that was originally caused by another stimulus. In Pavlov’s experiments, the neutral stimulus was the sound of the tone, which was paired with meat powder that could by itself elicit salivation (Figure 6.2). After repeated pairings, the dogs learned that the tone predicted meat powder; eventually, just hearing the tone alone could elicit salivation. Classical conditioning, also referred to as Pavlovian conditioning, influences many other responses as well and occurs in a variety of settings.

You can think about classical conditioning in mechanical terms—that is, one event causes another. A stimulus is an external event or cue that elicits a response. Stimuli (plural), such as food, water, pain, or sexual contact, elicit different types of responses. An unconditioned stimulus (US) is a stimulus that elicits a reflexive response without learning. In this context, the terms “conditioning” and “learning” are synonymous. Thus the “unconditioned” part of the unconditioned stimulus refers to the fact that it can elicit a response in the absence of any learning. An unconditioned response (UR) is a reflexive, unlearned
reaction to an unconditioned stimulus. In Pavlov’s experiment, meat powder elicited unconditioned salivation in his dogs (see the top panel of Figure 6.2). The link between the US and the UR is, by definition, unlearned. In addition to food eliciting salivation, other unconditioned stimulus and response relationships include flinching (a UR) in response to a loud sound (US), and blinking (UR) in response to a puff of air to the eye (US).

Recall that a defining characteristic of classical conditioning is that a neutral stimulus comes to elicit a response. It does so because the neutral stimulus is paired with, and therefore predicts, an unconditioned stimulus. In Pavlov’s experiment, the tone was originally a neutral stimulus because it did not elicit a response, least of all salivation (see Figure 6.2). A conditioned stimulus (CS) is a once neutral stimulus that elicits a conditioned response because it has a history of being paired with an unconditioned stimulus. A conditioned response (CR) is the learned response that occurs to the conditioned stimulus. After being repeatedly paired with the US, the once neutral tone in Pavlov’s experiment became a conditioned stimulus (CS) because it elicited the conditioned response of...
salivation. To establish that conditioning has taken place, the tone (CS) must elicit salivation in the absence of food (US; see the bottom panel of Figure 6.2).

A common point of confusion is the difference between a conditioned response and an unconditioned response—in Pavlov’s experiment, they are both salivation. What distinguishes the two is the stimulus that elicits them. Salivation is a UR if it occurs in response to a US (food). Salivation is a CR if it occurs in response to a CS (the tone). A CS can have this effect only if it becomes associated with a US.

**Quick Quiz 6.1a**

**Pavlov’s Dogs: Classical Conditioning of Salivation**

1. The learned response that occurs to the conditioned stimulus is known as the ______.
   - A. unconditioned response
   - B. conditioned stimulus
   - C. conditioned response
   - D. unconditioned response

2. A once neutral stimulus that elicits a conditioned response because it has a history of being paired with an unconditioned stimulus is known as a(n) ______.
   - A. unconditioned response
   - B. conditioned stimulus
   - C. conditioned response
   - D. unconditioned response

3. A dental drill can become an unpleasant stimulus, especially for people who may have experienced pain while one was used on their teeth. In this case, the pain elicited by the drill is a(n) ______.
   - A. conditioned response
   - B. unconditioned stimulus
   - C. conditioned stimulus
   - D. unconditioned response

4. Sylvia used to play with balloons. When she tried to blow up a balloon last week, it popped in her face and gave her quite a scare. Now, blowing up a balloon is so scary that Sylvia will not try it. In this example, the pop is a(n) ______ and the balloon is a(n) ______.
   - A. conditioned stimulus; unconditioned stimulus
   - B. unconditioned stimulus; conditioned stimulus
   - C. unconditioned response; conditioned response
   - D. conditioned response, unconditioned response

Answers can be found on page ANS-2.

**Processes of Classical Conditioning**

Classically conditioned responses typically involve reflexive actions, but they are still quite flexible. Conditioned responses may be very strong and reliable, which is likely if the CS and the US have a long history of being paired together. Conditioned responding may diminish over time, or it may occur with new stimuli with which the response has never been paired. We now turn to some processes that account for the flexibility of classically conditioned responses.

**ACQUISITION, EXTINCTION, AND SPONTANEOUS RECOVERY**

Learning involves a change in behavior due to experience, which can include acquiring a new response. **Acquisition** is the initial phase of learning in which a response is established; thus, in classical conditioning, acquisition is the phase in which a neutral stimulus is repeatedly paired with the US. In Pavlov’s experiment, the conditioned salivary response was acquired with numerous tone–food pairings (see Figure 6.3). A critical part of acquisition is the predictability with which the CS and the US occur together. In Pavlov’s experiment, conditioning either would not occur or would be very weak if food was delivered only sometimes (i.e., inconsistently) when the tone was sounded. Even once a response is fully acquired, there is no guarantee it will persist forever.

Both in natural situations and in the laboratory, the CS and the US may not always occur together. **Extinction** is the loss or weakening of a conditioned response when a conditioned stimulus and unconditioned stimulus no longer occur together. For the dogs in Pavlov’s experiment, if a tone is presented repeatedly and no food follows, then salivation should occur less and less, until eventually it may not occur at all (Figure 6.3). This trend probably makes sense from a biological perspective: If the tone is no longer a reliable predictor of food, then salivation becomes unnecessary. However, even after extinction occurs, a once established conditioned response can return.

**Spontaneous recovery** is the reoccurrence of a previously extinguished conditioned response, typically after some time has passed since extinction. Pavlov and his assistants studied the phenomenon of extinction—but also noticed that salivation would reappear when the dogs were later returned to the experimental testing room where acquisition and extinction trials had been conducted. The dogs would also salivate again in response to a tone, albeit less so than at the end of acquisition (Figure 6.3). Why would salivation spontaneously return after the response had supposedly extinguished? Psychologists are not fully sure why, but the fact that
responses can be spontaneously recovered suggests that extinction does not result in “forgetting.” Rather, the opposite seems to be occurring—namely, extinction involves learning something new (Bouton, 1994). In Pavlov’s experiment, for example, the dogs learned that in the experimental setting, the tone was no longer a reliable stimulus for predicting food.

Extinction and spontaneous recovery are evidence that classically conditioned responses can change once they are acquired. Further evidence of flexibility of conditioned responding can be seen in some other processes of classical conditioning, including generalization and discrimination learning.

**STIMULUS GENERALIZATION AND DISCRIMINATION** Stimulus generalization is a process in which a response that originally occurs to a specific stimulus also occurs to different, though similar stimuli. In Pavlov’s experiment, dogs salivated not just to the original tone (CS), but also to very similar tones (see Figure 6.4). Generalization allows for flexibility in learned behaviors, although it is certainly possible for behavior to be too flexible. Salivating in response to any sound would be wasteful because not every sound correctly predicts food. Thus Pavlov’s dogs also showed discrimination, which occurs when an organism learns to respond to one original stimulus but not to new stimuli that may be similar to the original stimulus. In salivary conditioning, the CS might be a 1,200-hertz tone, which is the only sound that is paired with food. The experimenter might produce tones of 1,100 or 1,300 hertz as well, but not pair these with food. Stimulus discrimination is said to occur when salivation occurs to the target 1,200-hertz tone, but much less so, if at all, to other tones (Figure 6.4).

![Stimulus Generalization and Discrimination](image)
CONDITIONED EMOTIONAL RESPONSES

Psychologists dating back to John Watson in the 1920s recognized that our emotional responses could be influenced by classical conditioning (Paul & Blumenthal, 1989; Watson & Rayner, 1920). These conditioned emotional responses consist of emotional and physiological responses that develop to a specific object or situation. Watson and Rayner conducted one of their first studies with an 11-month-old child known as Albert B. (also referred to as “Little Albert”). When they presented Albert with a white rat, he showed no fear at first, and even reached out for the animal. Then, while Albert was in the vicinity of the rat, they startled him by striking a steel bar with a hammer. Watson and Rayner reported that Albert quickly associated the rat with the startling sound; the child soon showed a conditioned emotional response just to the rat. (For the record, ethical standards in modern-day psychological research would not allow this type of experiment to take place.)

The Watson and Rayner procedure may seem artificial because it took place in a laboratory, but here is a more naturalistic example. Consider a boy who sees his neighbor’s cat. Not having a cat of his own, the child is very eager to pet the animal—perhaps a little too eager, because the cat reacts defensively and scratches his hand. The cat may become a CS for the boy, which elicits a fear response. Further, if generalization occurs, the boy might be afraid of all cats. Now imagine if this reaction becomes a very intense fear: Conditioned emotional responses like these offer a possible explanation for phobias, which are intense, irrational fears of specific objects or situations (discussed in detail in Module 15.2).

Applications of Classical Conditioning

Now that you are familiar with the basic processes of classical conditioning, we can begin to explore its many applications. Classical conditioning is a common phenomenon that applies to many different situations, including emotional learning, advertising, aversions to certain foods, and sexual responses.

Quick Quiz 6.1b

Processes of Classical Conditioning

1. What is the recurrence of a previously extinguished conditioned response, typically after some time has passed since extinction?
   A. Extinction  
   B. Spontaneous recovery  
   C. Acquisition  
   D. Discrimination

2. In classical conditioning, the process during which a neutral stimulus becomes a conditioned stimulus is known as _______.
   A. extinction  
   B. spontaneous recovery  
   C. acquisition  
   D. discrimination

3. Your dog barks every time a stranger’s car pulls into the driveway, but not when you come home. Reacting to your car differently is a sign of _______.
   A. discrimination  
   B. generalization  
   C. spontaneous recovery  
   D. acquisition

Answers can be found on page ANS-2.

Watson and Rayner generalized Albert’s fear of white rats to other furry, white objects. Shown here, Watson tests Albert’s reaction to a Santa Claus mask. Click on this image in your eText to see video footage of Little Albert.
have happened is that participants acquired a negative emotional reaction (the CR) to the faces, but this particular sample did not react this way. Instead, these individuals showed very little physiological arousal, their emotional brain centers remained quiet, and overall they did not seem to mind looking at pictures of faces that had been paired with pain (see Figure 6.5;

Some commonly feared objects and situations. Psychologists are finding that we are predisposed to fear specific objects that have posed threats over our evolutionary history.

Fear conditioning procedures have frequently been used in the laboratory to address clinical issues beyond phobias. For example, scientists have conducted some fascinating experiments on people diagnosed with psychopathy (the diagnosis of “psychopathy” is very similar to antisocial personality disorder, a topic we expand upon in Module 13.2). People with this disorder are notorious for disregarding the feelings of others. In one study, a sample of people diagnosed with psychopathy looked at brief presentations of human faces (the CS) followed by a painful stimulus (the US). What should
Birbaumer et al., 2005). People who showed no signs of psychopathy did not enjoy this experience. In fact, following several pairings between CS and US, the control group showed increased physiological arousal and activity of the emotion centers of the brain, and understandably reported disliking the experience of the experiment.

A healthy fear response is important for survival, but not all situations or objects are equally dangerous. Snakes and heights should probably elicit more fear and caution than butterflies or freshly mowed grass. In fact, fearing snakes is very common, which makes it tempting to conclude that we have an instinct to fear them. In reality, young primates (both human children and young monkeys, for example) tend to be quite curious about, or at least indifferent, to snakes, so this fear is most likely the product of learning rather than instinct.

Psychologists have conducted some ingenious experiments to address how learning is involved in snake fear. For instance, photographs of snakes (the CS) were paired with a mild electric shock (the US). One unconditioned response that a shock elicits is increased palm sweat—known as the skin conductance response. This reaction occurs when our bodies are aroused by a threatening or uncomfortable stimulus. Following several pairings between snake photos and shock in an experimental setting, the snake photos alone (the CS) elicited a strong increase in skin conductance response (the CR). For comparison, participants were also shown nonthreatening pictures of flowers, paired with the shock. Much less intense conditioned responding developed in response to pictures of flowers, even though the pictures had been paired with the shock an equal number of times as the snakes and shock (Figure 6.6; Öhman & Mineka, 2001). Thus it appears we are predisposed to acquire a fear of snakes, but not flowers.

This finding may not be too surprising, but what about other potentially dangerous objects such as guns? In modern times, guns are far more often associated with death or injury than snakes, and certainly flowers. When the researchers paired pictures of guns (the CS) with the shock (US), they found that conditioned arousal to guns among participants was less than that to snake photos, and comparable to that of harmless flowers. In addition, the conditioned arousal to snake photos proved longer lasting and slower to extinguish than the conditioned responding to pictures of guns or flowers (Öhman & Mineka, 2001).

Given that guns and snakes both have the potential to be dangerous, why is it so much easier to learn a fear of snakes than a fear of guns? The term preparedness refers to the biological predisposition to rapidly learn a response to a particular class of stimuli (Seligman, 1971), such as the finding that we learn to fear snakes more readily than either flowers or guns. Preparedness helps make sense of these research findings from an evolutionary perspective. Over time, humans have evolved a strong predisposition to fear an animal that has a long history of causing severe injury or death (Cook et al., 1986; Ohman & Mineka, 2001). The survival advantage has gone to those who were quick to learn to avoid animals such as snakes. The same is not true for flowers (which do not attack humans) or guns (which are relatively new in our species’ history).

**Conditioned Taste Aversions**

Another example of how biological factors influence classical conditioning comes from food aversions. Chances are there is a food that you cannot stand to even look at because it once made you ill. A conditioned taste aversion is the acquired dislike or disgust of a food or drink because it was paired with illness (Garcia et al., 1966). In these situations, a taste (the CS) causes the illness (the US). Getting sick is the UR. The CR is the nausea and other signs of disgust in response to the CS (Figure 6.7).

Taste aversions may develop in a variety of ways, such as through illness associated with food poisoning, the flu, medical procedures, or excessive intoxication. Also, as is the case with fear conditioning, only certain types of stimuli are amenable to the development of conditioned taste aversions. When we develop an
aversion to a particular food, the relationship typically involves the flavor of the food and nausea, rather than the food and any stimulus that may have been present during conditioning. For example, if you were listening to a particular song while you got sick from eating tainted spinach, your aversion would develop to the sight, thought, and most definitely taste of spinach, but not to the song that was playing. Thus humans are biologically prepared to associate food, but not sound, with illness (Garcia et al., 1966).

Several unique characteristics are associated with conditioned taste aversions, such as the relatively long delay between tasting the food or beverage (the CS) and sickness (the US). The onset of symptoms from food poisoning may not occur until several hours have passed after the tainted food or beverage was consumed. As a consequence, the interval between tasting the food (CS) and feeling sick (US) may be a matter of hours, whereas most conditioning happens only if the CS and the US occur very closely to each other in time. Another peculiarity is that taste aversions are learned very quickly—a single CS-US pairing is typically sufficient. These special characteristics of taste aversions are extremely important for survival. The flexibility offered by a long window of time separating CS and US, as well as the requirement for only a single exposure, raises the chances of acquiring an important aversion to the offending substance.

Usually, a conditioned taste aversion develops to something we have ingested that has an unfamiliar flavor. If you have eaten the same ham and Swiss cheese sandwich at lunch for years, and you become ill one afternoon after eating it, you will be less prone to develop a conditioned taste aversion. This scenario can be explained by latent inhibition, which occurs when frequent experience with a stimulus before it is paired with a US makes it less likely that conditioning will occur after a single episode of illness. Latent inhibition applies to many instances where classical conditioning can occur—not just to conditioned taste aversions. For example, a child who is clawed by the family cat after years of otherwise friendly interactions is less likely to develop a fear of cats than a child who is scratched during her very first encounter with a cat.

[FIG. 6.7] Conditioned Taste Aversions Classical conditioning can account for the development of taste aversions. Falling ill after eating a particular food can result in conditioned feelings of nausea in response to the taste, smell, or texture of the food.
situation). This example alone does not provide scientific confirmation that classical conditioning accounts for why people might be inclined to buy this product. Psychologists, however, have studied this phenomenon in the laboratory to unravel the mysteries of advertisers' appeals. In one study, researchers created a fictitious product they called “Brand L toothpaste.” This CS appeared in a slide show several times, along with attractive visual scenery (the US). The participants who experienced the CS and US paired together had positive evaluations of Brand L compared to participants from a control group who viewed the same slides but in an unpaired fashion (Stuart et al., 1987). Recent studies show that both positive and negative evaluations of stimuli can be conditioned in laboratory conditions that mimic what people experience in everyday exposure to advertisements (Stahl et al., 2009).

Can we critically evaluate this information?

Are companies being sneaky and deceitful when they use classical conditioning as a strategy to influence consumer behavior? As discussed in Module 4.1, the effects of subliminal advertising are greatly exaggerated. In reality, images flashed on a screen for a fraction of second can go undetected, yet still elicit subtle emotional and physiological responses. However, this effect is not likely powerful enough to control spending behavior. The imagery in advertisements, by comparison, is presented for longer than a fraction of second, giving viewers time to consciously perceive it. The effect is
that you might choose a particular shampoo or body spray because you remember liking the advertisements. Therefore, although classical conditioning in advertisement affects emotional responding, it is not causing us to blindly follow suggestions to purchase products (Stahl et al., 2009).

**Why is this relevant?**
Advertisements are often perceived as being geared toward instilling and retaining consumer loyalty to products. Another view, of course, is that ads seek to part you and your money. As a thoughtful consumer, you should take a moment to at least ask why you are drawn toward a given product. Our emotional responses are not necessarily good guides for decision making. When it comes to deciding whether to make a purchase, you might ask yourself whether the sexy or humorous advertisement for the product is influencing your decision. Alternatively, is your purchase driven by the true value of the product and an actual need for it? Likewise, when you see political advertisements, consider their positive or negative emotional content. Making a reasoned decision about a candidate is preferable to making an emotion-based one.

**Quick Quiz 6.1c**

**Applications of Classical Conditioning**

1. Conditioning a response can take longer if the subject experiences the conditioned stimulus repeatedly before it is actually paired with a US. This phenomenon is known as _______.

   - A. preparedness
   - B. extinction
   - C. latent inhibition
   - D. acquisition

2. Why are humans biologically prepared to fear snakes and not guns?

   - A. Guns kill fewer people than do snakes.
   - B. Guns are a more recent addition to our evolutionary history.
   - C. Snakes are more predictable than guns.
   - D. Guns are not a natural phenomenon, whereas snakes do occur in nature.

**Learning Without Awareness**

Common sense might lead us to believe that learning is something we actively do, not something that happens to us without our knowledge. In reality, classical conditioning affects very subtle physiological responses, so in some cases we are completely unaware that it is happening. Classical conditioning is involved in physiological reactions that occur during drug taking, sexual arousal and, as we will see, it likely accounts for why diet beverages are seemingly ineffective at promoting weight loss.

**DRUG USE AND TOLERANCE**

Classical conditioning accounts for some drug-related phenomena, such as cravings and tolerance (see Module 5.3). Cues that accompany drug use can become conditioned stimuli that elicit cravings (Sinha, 2009). For example, a cigarette lighter, the smell of tobacco smoke, or the presence of another smoker can elicit cravings in people who smoke.

Many drugs also have the potential for tolerance, meaning that a decreased reaction occurs with repeated use of the drug. This trend, in turn, leads users to increase their dosage. *Conditioned drug tolerance*, which

Physiological reactions to drugs are influenced by stimuli that are associated with administration of the drug.
involves physiological responses in preparation for drug administration, appears to underlie this process. It happens when the cues that are associated with drug administration become conditioned stimuli. For example, a heroin user may use the drug in a certain room with a specific set of paraphernalia and rituals for injection. Here, the unconditioned stimulus is the drug. Conditioned drug tolerance develops as the body begins associating environmental cues that accompany drug use with the drug itself. The conditioned responses involve an increase in the physiological processes that metabolize the drug—adaptive responses that prepare the body for something potentially dangerous. Over time, more of the drug is needed to override these preparatory responses so that the desired effect can be obtained.

This phenomenon can have fatal consequences for drug abusers. Psychologist Shepard Siegel (1984) conducted interviews with patients who were hospitalized for overdosing on heroin. Over the course of his interviews a pattern among the patients emerged. Several individuals reported that they were in situations unlike those that typically preceded their heroin injections—for example, in a different environment or even using an injection site that differed from the usual ritual. As a result of these differences, the CSs that were normally paired with delivery of the drug changed, leaving their bodies unprepared for delivery of the drug. Without a conditioned preparatory response, delivery of even a normal dose of the drug can be lethal. This finding has been confirmed in animal studies: Siegel and his associates (1982) found that conditioned drug tolerance and overdosing can also occur with rats. When rats received heroin in an environment different from where they experienced the drug previously, mortality was double that in control rats that received the same dose of heroin in their normal surroundings (64% versus 32%).

**SEXUAL AROUSAL** Sexual arousal and reproductive physiology can also be influenced by classical conditioning. For example, Domjan and colleagues (2004) have studied conditioned sexual responses in Japanese quail. Males of this species will vigorously copulate with an artificial model (the CS) that has a history of being paired with a female quail (the US). These birds become highly persistent when it comes to copulating with these models—they continue to do so even when actual sexual opportunities have long since vanished. That is, the responses resist the process of extinction described previously. Some have argued that this persistent copulation with an inanimate object mirrors the sexual fetishism found in some humans (Köksal et al., 2004).

A fetish involves sexual attraction and fixation on an object. Some common fetishes involve leather, lace, shoes, boots, and undergarments, none of which elicit unconditioned sexual responses (Lalumiere & Quinsey, 1998). A conditioned sexual fetish can form if there is an association between the object (the CS) and sexual encounters (the US). As you can probably imagine, this phenomenon is not often studied in the laboratory. In one rare study, however, male volunteers were conditioned to experience sexual arousal when shown photos of shoes alone after such photos had been paired with sexually explicit photos (Rachman, 1996). Several explanations have been proposed for how sexual fetishes might develop, and classical conditioning certainly appears to play a role (Lowenstein, 2002). Nevertheless, in the case of sexual fetishism (and unlike in the case of the Japanese quail), the conditioning does not seem to function in a way that is conducive to actual reproductive success, given that the fixation on the desired object detracts many affected individuals from normal sexual functioning.

As you can see, the conditioned physiological changes associated with drug tolerance and sexual responses can occur below the level of awareness. It appears that certain types of conditioning involve relatively basic, if not minimal, brain functioning.

**CONDITIONING AND TRAUMATIC BRAIN INJURY** Researchers have shown that people who have minimal brain function can still be conditioned. A convincing case comes from work with patients who are comatose or in a persistent vegetative state (see Module 5.3). Patients who have experienced severe brain trauma and are nonresponsive or minimally responsive to outside stimulation can learn to associate a CS and a US (Bekinschtein et al., 2009). Because of their diminished consciousness or nonconscious states, however, these patients cannot report anything about

Classically conditioned sexual behavior in a male quail. After this object (the CS) is paired with a live female quail (the US), the male quail will direct its sexual responses to the CS alone.
the conditioning experience to the researchers. What demonstrates that they are making an association is a simple conditioned eye blink response that is elicited by the sound of a tone (see Figure 6.9).

**THE PARADOX OF “DIET” BEVERAGES** As shown in Figure 6.10, consumption of diet beverages has risen over the last several decades, but so has obesity. Classical conditioning may help explain why diet drinks are seemingly ineffective in helping people lose weight, as described at the beginning of this module (Swithers et al., 2009; Swithers & Davidson, 2005).

Through neural mechanisms linking the brain and digestive system, humans actually become conditioned to the foods and drinks that they consume, including those that contain real sugar. Sweet tastes send a message to the body that a high dose of calories is on the way. For example, the taste of a candy bar is a conditioned stimulus (CS) that tells the body that a large amount of calories (the US) is soon to arrive in the gut. This relationship is an important one for the body to learn, as it helps maintain an energy balance—eventually your body tells you it is time to stop eating sweets and switch to something else, perhaps with fewer calories. Artificially sweetened beverages disrupt this relationship between the sugary sweet CS and high-calorie food US. The artificially sweetened taste of a diet soda is not followed by a high dose of calories that your body “expects.” So how does the body respond? It continues to send out hunger messages: Your gut “tells” you to make up for the calories by opening up a bag of cookies or potato chips. This linkage may very well help explain why, overall, artificially sweetened beverages do not promote weight loss.

![Figure 6.10](image-url)  
**Figure 6.10**  
*Diet Soda Consumption’s Association with Increased (Not Decreased) Prevalence of Obesity*

**Quick Quiz 6.1d**

**Learning Without Awareness**

1. When a heroin user develops a routine, the needle can become the ________, whereas the body’s preparation for the drug in response to the presence of the needle is the ________.
   
   ![Diagram showing the transition from neutral stimulus to conditioned stimulus and response](image-url)  
   **Figure 6.9**  
   *Conditioned Eye Blink Responding*  
   Patients who show no signs of consciousness learn to associate a tone (NS) with a puff of air to the eye (US). After several trials this tone alone elicits eye blinking (the CR).

   **[ANS.2]**  
   **A** CS; CR  
   **B** US; CR  
   **C** US; CR  
   **D** CS; US

2. Which is the best explanation for why diet beverages do not prevent people from gaining weight?
   
   ![Diagram showing the relationship between diet beverage consumption and increased obesity](image-url)  
   **[ANS.2]**  
   **A** Diet beverages actually have more calories than regular beverages.  
   **B** The artificially sweetened beverages seem to stimulate hunger for high-calorie foods.  
   **C** People who drink diet beverages typically eat more food than those who drink only water.  
   **D** Diet drinks elicit conditioned emotional reactions that lead people to overeat.

   **[ANS.2]**  
   **A** Diet beverages actually have more calories than regular beverages.  
   **B** The artificially sweetened beverages seem to stimulate hunger for high-calorie foods.  
   **C** People who drink diet beverages typically eat more food than those who drink only water.  
   **D** Diet drinks elicit conditioned emotional reactions that lead people to overeat.

   **Answers can be found on page ANS-2.**
Module 6.1
Classical Conditioning: Learning by Association

Now that you have read this module you should:

KNOW ...

- The key terminology involved in classical conditioning:
  - acquisition (p. 198)
  - classical conditioning (p. 196)
  - conditioned emotional response (p. 200)
  - conditioned response (p. 197)
  - conditioned stimulus (p. 197)
  - conditioned taste aversion (p. 202)
  - discrimination (p. 199)
  - extinction (p. 198)
  - generalization (p. 199)
  - learning (p. 195)
  - preparedness (p. 202)
  - spontaneous recovery (p. 198)
  - unconditioned response (p. 196)
  - unconditioned stimulus (p. 196)

UNDERSTAND ...

- How responses learned through classical conditioning can be acquired and lost. Acquisition of a conditioned response occurs with repeated pairings of the CS and the US. Once a response is acquired, it can be extinguished if the CS and the US no longer occur together. During extinction, the CR diminishes, although it may reappear under some circumstances. For example, if enough time passes following extinction, the CR may spontaneously recover when the organism encounters the CS again.

- The role of biological and evolutionary factors in classical conditioning. Not all stimuli have the same potential to become a strong CS. Responses to biologically relevant stimuli, such as snakes, are more easily conditioned than are responses to stimuli such as flowers or guns, for example. Similarly, avoidance of potentially harmful foods is critical to survival, so organisms can develop a conditioned taste aversion quickly (in a single trial) and even when ingestion and illness are separated by a relatively long time interval.

APPLY ...

- The concepts and terms of classical conditioning to new examples. Read the three scenarios that follow and identify the conditioned stimulus (CS), the unconditioned stimulus (US), the conditioned response (CR), and the unconditioned response (UR) in each case. [Hint: When you apply the terms CS, US, CR, and UR, a good strategy is to identify whether something is a stimulus (something that elicits) or a response (a behavior). Next, identify whether the stimulus automatically elicits a response (the US) or does so only after being paired with a US (a CS). Finally, identify whether the response occurs in response to the US alone (the UR) or the CS alone (the CR).] Check your answers on page ANS-2.

  1. Cameron and Tia went to the prom together, and during their last slow dance the DJ played the theme song for the event. During the song, the couple kissed. Now, several years later, whenever Cameron and Tia hear the song, they feel a rush of excitement.

  2. Harry has visited his eye doctor several times due to problems with his vision. One test involves blowing a puff of air into his eye. After repeated visits to the eye doctor, Harry starts blinking as soon as the instrument is being applied.

  3. Sarah went to a new restaurant and experienced the most delicious meal she has ever tasted. The restaurant starts advertising on the radio, and now every time an ad comes on, Sarah finds herself craving the meal she had enjoyed so much.

ANALYZE ...

- Claims that artificially sweetened beverages are a healthier choice. Because of classical conditioning, the digestive system responds to the flavor of the artificially sweetened (CS) beverage as though a high-calorie food source (the US) is on the way. When the low-calorie beverage reaches the digestive system, the gut has already prepared itself for something high in calories (the CR). As a consequence, hunger messages continue to be sent to the brain. Because the “diet” beverage does not deliver on the promise of high calories, the person experiences an increased level of hunger.
Cash and grades are two very strong motivators for college students. Hundreds of students each year spend hours pursuing these valuable rewards through hard work and studying. Recently, a website called Ultrinsic combined these two motivators by enticing students to gamble on their grades. The site, based in New York, allows students at more than 30 colleges and universities in the United States to upload their schedules and authorize access to their academic records through their university. Imagine a student places a wager of $25 that she will earn an A in her general chemistry course. Ultrinsic calculates the odds of this outcome based on course difficulty and the betting student's previous academic record and offers a contribution of perhaps $43. If the student receives any grade less than an A, the $25 is lost. If she earns an A, $68 is paid out to the student.

Gambling among college students is relatively common. In one survey, 42% of college students admitted to gambling within the previous year (see Barnes et al., 2010). Sites like Ultrinsic create additional chances for students to gamble on their grades. Ultrinsic certainly has its rightful share of critics who disagree with the idea of students gambling on their grades. Given the myriad problems associated with gambling, its approach is certainly controversial. College students who use the site might argue that the gambling motivates them and brings immediate consequences to their studying, or lack thereof.

**Focus Questions**

1. How do the consequences of our actions—such as winning or losing a bet—affect subsequent behavior?
2. Many behaviors, including gambling, are reinforced only part of the time. How do the odds of being reinforced affect how often a behavior occurs?

We tend to repeat the actions that bring rewards, and avoid those that lead to punishment. This is about as straightforward a statement about behavior as one can make, but might oversimplify the complex dynamics that occur among our environment, behavior, and consequences. Operant conditioning is a type of learning in which behavior is influenced by consequences. The term operant is used because the individual operates on the environment before consequences...
can occur. In contrast to classical conditioning, which typically affects reflexive responses, operant conditioning involves voluntary actions such as speaking or listening, starting and stopping an activity, and moving toward or away from something. Whether and when we engage in these types of behaviors depend on our own unique histories with consequences.

Initially the difference between classical and operant conditioning may seem unclear. One useful way of telling the difference is that in classical conditioning a response is not required for a reward (or unconditioned stimulus) to be presented; to return to Pavlov’s dogs, meat powder is presented regardless of whether salivation occurs. Learning has taken place if a conditioned response develops following pairings between the conditioned stimulus and the unconditioned stimulus. Notice that in this situation that the subject is not required to respond to anything—the dog does not have to salivate to receive food. In operant conditioning, a response and a consequence are required for learning to take place. Without a response of some kind, there can be no consequences (see Table 6.1 for a summary of differences between operant and classical conditioning).

**Processes of Operant Conditioning**

The concept of *contingency* is important to understanding operant conditioning; it simply means that a consequence depends upon an action. Earning good grades is generally contingent upon studying effectively. Excelling at athletics is contingent upon training and practice. The consequences of a particular behavior can be either reinforcing or punishing (see Figure 6.11).

**REINFORCEMENT AND PUNISHMENT**

Reinforcement is a process in which an event or reward that follows a response increases the likelihood of that response occurring again. We can trace the scientific study of reinforcement’s effects on behavior to Edward Thorndike, who conducted experiments in which he measured the time it took cats to learn how to escape from puzzle boxes (see Figure 6.12). Thorndike observed that over repeated trials, cats were able to escape more rapidly because they learned which responses worked (such as pressing a pedal on the floor of the box). From his experiments, Thorndike proposed the law of effect—the idea that responses followed by satisfaction will occur again, and those that are not followed by satisfaction become less likely. Within a few decades after the publication of Thorndike’s work, the famous behaviorist, B. F. Skinner, began conducting his own studies on the systematic relationship between reinforcement and behavior. As was the case with Thorndike, much of Skinner’s work took place in the laboratory using nonhuman subjects.

Although operant conditioning is very much a part of our everyday behavior, many of its basic principles stem from laboratory studies conducted on nonhuman species such as pigeons or rats, which were typically placed in an apparatus such as the one pictured in Figure 6.13. Operant chambers, sometimes referred to as Skinner boxes, include a lever or key that the subject can manipulate. Pushing the lever may result in the delivery of a reinforcer such as food. In operant conditioning terms, a reinforcer is a stimulus that

<table>
<thead>
<tr>
<th>Behavior mostly depends on …</th>
<th>Reflexive and physiological responses</th>
<th>Skeletal muscles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target response is …</td>
<td>Automatic</td>
<td>Voluntary</td>
</tr>
<tr>
<td>Reinforcement is …</td>
<td>Present regardless of whether a response occurs</td>
<td>A consequence of the behavior</td>
</tr>
</tbody>
</table>

**Table 6.1 :: Major Differences Between Classical and Operant Conditioning**

**Reinforcement increases behavior.**
- Behavior: Try the new café on 2nd Avenue.
- Consequence: The meal and service were fantastic!
- Effect: The behavior is reinforced. You’ll go there again.

**Punishment decreases behavior.**
- Behavior: Try listening to the new radio station in town.
- Consequence: The music is terrible!
- Effect: You won’t listen to that station again.

[FIG. 6.11] Reinforcement and Punishment. The key distinction between reinforcement and punishment is that reinforcers, no matter what they are, increase behavior. Punishment involves a decrease in behavior, regardless of what the specific punisher may be. Thus both reinforcement and punishment are defined based on their effects on behavior. Click on this figure in your eText to see more details.
is contingent upon a response, and that increases the probability of that response occurring again. Using operant chambers, researchers record the animal’s rate of responding over time (a measure of learning), and typically set a criterion for the number of responses that must be made before a reinforcer becomes available. As we will discuss later in this module, animals and humans are quite sensitive to how many responses they must make, or how long they must wait, before they will receive a reward.

After studying Figure 6.13, you might wonder whether observations made with this apparatus could possibly apply to real-world situations. In fact, similar machinery can be found in all sorts of nonlaboratory settings. People pull levers on slot machines, press buttons on vending machines, and punch keys on telephones. Researchers use machinery such as operant chambers to help them control and quantify learning, but the general principles of operant conditioning apply to life outside and away from such machines.

Reinforcement involves increased responding, but decreased responding is also a possible outcome of an encounter with a stimulus. Punishment is a process that decreases the future probability of a response. Thus a punisher is a stimulus that is contingent upon a response, and that results in a decrease in behavior. Like reinforcers, punishers are defined not based on the stimuli themselves, but rather in terms of their effects on behavior. We will explore some topics related to punishment in this module, but because reinforcement is more central to the topic of operant conditioning, we will elaborate on it more extensively. One key characteristic of reinforcement learning is that it is motivated by the satisfaction of various types of drives.

**PRIMARY AND SECONDARY REINFORCERS**

Reinforcement can come in many different forms. On the one hand, it may consist of stimuli that are inherently reinforcing, such as food, water, shelter, and sexual contact.
Animals pressing levers in operant chambers to receive rewards may seem artificial. However, if you look around you will see that our environment is full of devices that influence our operant responses.

These **primary reinforcers** consist of reinforcing stimuli that satisfy basic motivational needs. On the other hand, many stimuli that we find reinforcing, such as money or grades, are reinforcing only after we first learn that they have value. **Secondary reinforcers** consist of reinforcing stimuli that acquire their value through learning. Think about how you would react if you were handed a $1,000 check to spend as you please, versus how an infant would respond if given the same document. The baby might try to mouth the check before abandoning it for a shiny rattle or something else more reinforcing to her, because she has not learned why it might be reinforcing.

Both primary and secondary reinforcers satisfy our drives, but what underlies the motivation to seek these reinforcers? The answer is complex, but research points to a specific brain circuit including a structure called the **nucleus accumbens** (see Figure 6.14). The nucleus accumbens becomes activated during the processing of all kinds of rewards, including primary ones such as eating and having sex, as well as “artificial” rewards such as using cocaine and smoking a cigarette. Variations in this area might also account for why individuals differ so much in their drive for reinforcers. For example, scientists have discovered that people who are prone to risky behaviors such as gambling and alcohol abuse are more likely to have inherited particular copies of genes that code for dopamine and other reward-based chemicals of the brain (Comings & Blum, 2000). Perhaps the reward centers of gamblers and others who engage in high-risk behaviors are not sufficiently stimulated by natural rewards, making them more likely to engage in behaviors that will give them the rush that they crave.

Secondary reinforcers can be powerful motivators as well, as can be seen in **token economies** (Hackenberg, 2009). Token economies are often used in residential treatment settings to encourage appropriate behaviors while discouraging inappropriate ones. With this approach, caretakers establish a reinforcement system in which tokens serve as secondary reinforcers. A resident can earn tokens through good behavior, which can then be exchanged for something else reinforcing, such as candy or special privileges. Conversely, misbehavior can cost tokens, so these tokens can play a role in punishment as well.

**POSITIVE AND NEGATIVE REINFORCEMENT AND PUNISHMENT**

Behavior can be reinforced in several different ways. A response can be strengthened because it brings a reward or, alternatively, because it results in the removal of something unpleasant.
Negative reinforcement is a concept that students frequently find confusing because it seems unusual that something aversive could be involved in the context of reinforcement. Recall that reinforcement (whether positive or negative) always involves an increase in the strength or frequency of responding. The term “positive” in this context simply means that a stimulus is introduced or increased, whereas the term “negative” means that a stimulus has been reduced or avoided.

Negative reinforcement can be further classified into two subcategories. Avoidance learning is a specific type of negative reinforcement that removes the possibility that a stimulus will occur. Examples of avoidance learning include taking a detour to avoid traffic congestion on a particular road, and paying bills on time to avoid late fees. In these cases, negative situations are avoided. In contrast, escape learning occurs if a response removes a stimulus that is already present. Covering your ears upon hearing overwhelmingly loud music is one example. You cannot avoid the music, because it is already present, so you escape the aversive stimulus. The responses of taking a detour and covering your ears both increase in frequency because they have effectively removed the offending stimuli. In the laboratory, operant chambers such as the one pictured in Figure 6.13 often come equipped with a grid metal floor that can be used to deliver a mild electric shock; responses that remove (escape learning) or prevent (avoidance learning) the shock are negatively reinforced.

As with reinforcement, various types of punishment are possible. Positive punishment is a process in which a behavior decreases because it adds or increases a particular stimulus (Table 6.2). For example, some cat owners use a spray bottle to squirt water when the cat hops on the kitchen counter or scratches the furniture. Remember that the

Table 6.2 :: Distinguishing Types of Reinforcement and Punishment

<table>
<thead>
<tr>
<th></th>
<th>CONSEQUENCE</th>
<th>EFFECT ON BEHAVIOR</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive reinforcement</td>
<td>Stimulus is added or</td>
<td>Increases the response</td>
<td>A child gets an allowance for making her bed, so she is likely to do it again in the future.</td>
</tr>
<tr>
<td></td>
<td>increased.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative reinforcement</td>
<td>Stimulus is removed or</td>
<td>Increases the response</td>
<td>The rain no longer falls on you after opening your umbrella, so you are likely to do it again in the future.</td>
</tr>
<tr>
<td></td>
<td>decreased.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive punishment</td>
<td>Stimulus is added or</td>
<td>Decreases the response</td>
<td>A pet owner scolds his dog for jumping up on a house guest, and now the dog is less likely to do it again.</td>
</tr>
<tr>
<td></td>
<td>increased.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative punishment</td>
<td>Stimulus is removed or</td>
<td>Decreases the response</td>
<td>A parent takes away TV privileges to stop the children from fighting.</td>
</tr>
<tr>
<td></td>
<td>decreased.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Avoidance and escape learning. Getting caught in road construction is typically an aversive event. Avoidance learning might involve taking precautionary measures, such as starting the trip on an alternative route so you do not encounter the construction at all. Escape responses, such as pulling out of the traffic jam to take a shortcut, occur after the stimulus is already encountered. Either response would be negatively reinforced, as it removes the aversive stimulus of being caught.

The term "positive" simply means that a stimulus is added to the situation—in these cases, the stimuli are punishers because they decrease the frequency of a behavior.

Behavior may also decrease as a result of the removal of a stimulus. **Negative punishment** occurs when a behavior decreases because it removes or diminishes a particular stimulus (Table 6.2). Withholding someone’s privileges as a result of an undesirable behavior is an example of negative punishment. A parent who “grounds” a child does so because this action removes something of value to the child. If effective, the outcome of the grounding will be to decrease the behavior that got the child into trouble.

**EXTINCTION, STIMULUS CONTROL, GENERALIZATION, AND DISCRIMINATION** If you read Module 6.1, you know how extinction, generalization, and discrimination apply to classical conditioning. Similar phenomena occur with operant conditioning. In operant conditioning, **extinction** refers to the weakening of an operant response when reinforcement is no longer available.

If you lose your Internet connection for example, you will probably stop trying to refresh your web browser because there is no reinforcement for doing so—the behavior will be extinguished.

Once a response has been learned, the organism may soon learn that reinforcement is available under only certain conditions and circumstances. A pigeon in an operant chamber may learn that pecking is reinforced only when the chamber’s light is switched on, so there is no need to continue pecking when the light is turned off. This illustrates the concept of a **discriminative stimulus**—a cue or event that indicates that a response, if made, will be reinforced. A behavior—in this case, pecking—is under **stimulus control** when a discriminative stimulus reliably elicits a specific response. As with the pigeon in the operant chamber, much of human behavior is under stimulus control. Before we pour a cup of coffee, we might check whether the light on the coffee pot is on—a discriminative stimulus that tells us the beverage will be hot and, presumably, reinforcing.

The processes of generalization and discrimination influence whether organisms respond to discriminative stimuli. Generalization is observed in operant conditioning just as in classical conditioning, albeit with some important differences. In operant conditioning, **generalization** occurs when an operant response takes place to a new stimulus that is similar to the stimulus present during original learning. Children who have a history of being reinforced by their parents for tying their shoes, for example, are likely to demonstrate this same behavior when a teacher or other adult asks them to do so. **Discrimination** occurs when an operant response is made to one stimulus but not to another, even similar stimulus. Perhaps you have learned that reinforcement is associated with only specific behaviors. For example, your behavior of stopping in response to a red traffic light has been reinforced in the past. You would not expect the same reinforcement for stopping at a green traffic light, even though these stimuli are often located closely to each other, and are often the same shape, brightness, and size.

Table 6.3 differentiates among the processes of extinction, generalization, and discrimination in classical and operant conditioning.

<table>
<thead>
<tr>
<th>PROCESS</th>
<th>CLASSICAL CONDITIONING</th>
<th>OPERANT CONDITIONING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extinction</td>
<td>A CS is presented without a US until the CR no longer occurs.</td>
<td>Responding gradually ceases if reinforcement is no longer available.</td>
</tr>
<tr>
<td>Generalization</td>
<td>A different CS that resembles the original CS used during acquisition elicits a CR.</td>
<td>Responding occurs to a stimulus that resembles the original discriminative stimulus used during learning.</td>
</tr>
<tr>
<td>Discrimination</td>
<td>A CR does not occur in response to a different CS that resembles the original CS.</td>
<td>There is no response to a stimulus that resembles the original discriminative stimulus used during learning.</td>
</tr>
</tbody>
</table>
Applications of Operant Conditioning

Now that we have reviewed the basic processes of operant conditioning, you should have a sense of how much our behavior is influenced by rewards and punishment. In this section, we focus on some specific applications of operant conditioning.

SHAPING Rats placed in operant chambers do not automatically go straight for the lever and begin pressing it to obtain food rewards. Instead, they must first learn that lever pressing accomplishes something. Getting a rat to press a lever can be done by reinforcing behaviors that approximate lever pressing, such as standing up, facing the lever, standing while facing the lever, placing paws upon the lever, and pressing downward. Shaping is a procedure in which a specific operant response is created by reinforcing successive approximations of that response. Shaping is done in step-by-step fashion until the desired response—in this case, lever pressing—is learned. Skilled behavioral psychologists can string together long sequences of behavior using shaping techniques. Shaping has some broad applications—a particularly important one is in helping people develop specific skill sets.

PSYCH @ The Special Needs Classroom

Operant conditioning is the basis for an educational method called applied behavior analysis (ABA), which involves using close observation, prompting, and reinforcement to teach behaviors, often to people who experience difficulties and challenges owing to a developmental condition such as autism (Granpeesheh et al., 2009). People with autism are typically nonresponsive to normal social cues from a very early age. This impairment can lead to a deficit in developing many skills, ranging from basic, everyday ones as well as complex skills such as language. For example, explaining how to clear dishes from the dinner table to a child with autism could prove difficult. Psychologists who specialize in ABA often shape the desired behavior using prompts (such as asking the child to stand up, gather silverware, stack plates, and so on) and verbal rewards as each step is completed. These and more elaborate ABA techniques can be used to shape a remarkable variety of behaviors to improve the independence and quality of life for people with autism.
SCHEDULES OF REINFORCEMENT  Typically, behavior is rewarded according to some kind of schedule. Skinner and his colleagues (Ferster & Skinner, 1957) recognized the importance of schedules of reinforcement—rules that determine when reinforcement is available. Reinforcement may be available at highly predictable or very irregular times. Also, reinforcement may be based on how often someone engages in a behavior, or on the passage of time.

Vending machines should deliver a snack every time the correct amount of money is deposited. With such continuous reinforcement, every response made results in reinforcement, and learning initially occurs rapidly.

Other reinforcers we work to achieve do not come with such regularity; we also encounter situations where reinforcement is available only some of the time. Telephoning a friend may not always get you an actual person on the other end of the call. In this kind of partial (intermittent) reinforcement, only a certain number of responses are rewarded, or a certain amount of time must pass before reinforcement is available. Four types of partial reinforcement schedules are possible (see Figure 6.15), which have different effects on rates of responding.

Ratio schedules of reinforcement are based on the amount of responding. In a fixed-ratio schedule, reinforcement is delivered after a specific number of responses have been completed. For example, a rat may be required to press a lever 10 times to receive food. Similarly, an employee working on commission may receive a bonus only after selling a specific number of items.

In a variable-ratio schedule, the number of responses required to receive reinforcement varies according to an average. Slot machines at casinos operate on variable-ratio reinforcement schedules. The odds are that the slot machine will not give anything back, but sometimes a player will get a modest winning. Of course, hitting the jackpot is very infrequent. The variable nature of the reward structure for playing slot machines helps explain why responding on this schedule can be vigorous and persistent. Slot machines and other games of chance hold out the possibility that at some point players will be rewarded, but the unpredictable reward structure tends to promote strong response levels—in other words, a lot of money deposited into the machine.

In contrast to ratio schedules, interval schedules are based on the passage of time, not the number of responses. A fixed-interval schedule reinforces the first response occurring after a set amount of time passes. If your psychology professor gives you an exam every three weeks, your reinforcement for studying is on a fixed-interval schedule. In Figure 6.15, notice how the fixed-interval schedule shows that responding drops off after each reinforcement is delivered (as indicated by the tick marks). However, responding increases because reinforcement is soon available again. This schedule may reflect how you devote time to studying for your next exam—studying time tends to decrease after an exam, and then builds up again as another test looms.

A slightly different schedule is the variable-interval schedule, in which the first response is reinforced following a variable amount of time. The time interval varies around an
average. For example, if you were watching the nighttime sky during a meteor shower, you would be rewarded for looking upward at irregular times. A meteor may fall on average every 5 minutes, but there will be times of inactivity for a minute, 10 minutes, 8 minutes, and so on.

As you can see from Figure 6.15, ratio schedules tend to generate relatively high rates of responding. This outcome makes sense in light of the fact that in ratio schedules, reinforcement is based on how often you engage in the behavior (something you have some control over) versus how much time has passed (something you do not control). For example, looking up with greater frequency does not cause more meteor activity because a variable-interval schedule is in effect. In contrast, a salesperson is on a variable-ratio schedule because approaching more customers increases the chances of making a sale.

One general characteristic of schedules of reinforcement is that partially reinforced responses tend to be very persistent. For example, although people are only intermittently reinforced for putting money into a slot machine, a high rate of responding is maintained and may not decrease until after a great many losses in a row (or the individual runs out of money). The effect of partial reinforcement on responding is especially evident during extinction. Being partially reinforced can lead to very persistent responding even if, unbeknownst to the organism, reinforcement is no longer available. The partial reinforcement effect refers to a phenomenon in which organisms that have been conditioned under partial reinforcement resist extinction longer than those conditioned under continuous reinforcement.

WORKING THE SCIENTIFIC LITERACY MODEL
Reinforcement and Superstition

It is clear that reinforcement can appear in multiple forms and according to various schedules. What all forms have in common is the notion that the behavior that brought about the reinforcement will be strengthened. But what happens if the organism is mistaken about what caused the reinforcement to occur—will it experience reinforcement anyway? This raises the topic of superstition.

What do we know about superstition and reinforcement?

Reinforcement is often systematic and predictable. If it is not, then behavior is eventually extinguished. In some cases, however, it is not perfectly clear what brings about the reinforcement. Imagine a baseball player who tries to be consistent in how he pitches. After a short losing streak, the pitcher suddenly wins a big game. If he is playing the same way, then what happened to change his luck? Did an alteration in his pre-game ritual lead to the victory? Humans the world over are prone to believing that some ritual or luck charm will somehow improve their chances of success or survival. Psychologists believe these superstitions can be explained by operant conditioning.

How can science explain superstition?

Decades ago, B. F. Skinner (1948) attempted to create superstitious behavior in pigeons. Food was delivered every 15 seconds, regardless of what the pigeons were doing. Over time, the birds started engaging in “superstitious” behaviors. The pigeons repeated the behavior occurring just before reinforcement, even if the behavior was scratching, head-bobbing, or standing on one foot. A pigeon that happened to be turning in a counterclockwise direction when reinforcement was delivered repeated this seemingly senseless behavior.

In a laboratory study involving humans, psychologists constructed a doll that could spit marbles (Wagner & Morris, 1987). Children were told that the doll would sometimes spit marbles at them and that these marbles could be collected and traded for toys. The marbles were ejected at random intervals, leading several of the children to develop superstitious behaviors such as sucking their thumbs or kissing the doll on the nose.

Psychologists have conducted controlled studies to see whether superstitious behaviors have any effect on performance outcomes. In one investigation, college students, 80% of whom believed in the idea of “good luck,” were asked to participate in a golf putting contest in which members of one group were told they were playing with “the lucky ball,” and others were told they would be using “the ball everyone has used so far.” Those who were told they were using the lucky ball performed significantly better than those who used the ball that was not blessed with good luck (Damisch et al., 2010). These effects also occurred in other tasks, such as memory and anagram games, and participants also showed better performance at tasks if allowed to bring a good luck charm.

Can we critically evaluate these findings?

Superstitious beliefs, though irrational on the surface, may enhance individuals’ belief that they can perform successfully at a task. Sometimes these beliefs can even enhance performance, as the golf putting experiment revealed. These
findings, however, are best applied to situations where the participant has some control over an outcome, such as taking an exam or playing a sport. People who spend a lot of time and money gambling are known to be quite superstitious, but it is important to distinguish between games of chance versus skill in this setting. “Success” at most gambling games is due entirely, or predominantly, to chance. Thus the outcomes are immune to the superstitious beliefs of the players.

Why is this relevant?

Between Skinner’s original work with pigeons, and more contemporary experiments with people, it appears that operant conditioning plays a role in the development of some superstitions. Superstitious behavior is frequently displayed by professional athletes, who wear specific (sometimes unwashed) clothing or go through rituals as they prepare to perform. One of the more bizarre rituals was practiced by former Cleveland Indians outfielder Kevin Rhomberg, who believed that if someone touched him he would have bad luck unless he touched that person back. This quirk may have been accepted by his teammates, but it also included the opposing players. Thus, if Rhomberg was tagged out while running bases, he could be seen pursuing the player in order to touch him as the teams switched sides (his professional career was short—just 41 games).

Perhaps you have a good-luck charm or a ritual you must complete before a game or even before taking a test. Think about what brings you luck, and then try to identify why you believe in this relationship. Can you identify a specific instance when you were first reinforced for this behavior?

APPLYING PUNISHMENT

People tend to be more sensitive to the unpleasantness of punishment than they are to the pleasures of reward. Psychologists have demonstrated this asymmetry in laboratory studies with college students who play a computerized game where they can choose a response that can bring either a monetary reward or a monetary loss. It turns out that the participants found losing money to be about three times as punishing as being rewarded with money was pleasurable. In other words, losing $100 is three times more punishing than gaining $100 is reinforcing (Rasmussen & Newland, 2008).

The use of punishment raises some ethical concerns—especially when it comes to physical means. A major issue that is debated all over the world is whether corporal punishment (e.g., spanking) is acceptable to use with children. In fact, more than 20 countries, including Sweden, Austria, Finland, Denmark, and Israel, have banned the practice. Interestingly, very few people in the United States publicly advocate spanking. This is certainly the case among psychologists. Even so, spanking remains a very common practice. In one recent study, for example, approximately two-thirds of participating families reported spanking their three-year-old child at least once in the past month (Taylor et al., 2010). Parents often use this tactic because it works: Spanking is generally a very effective punisher when it is used for immediately stopping a behavior (Gershoff, 2002). However, one reason why so few psychologists advocate spanking is because it is associated with some major side effects. In multiple studies, spanking has been associated with poorer parent–child relationships, poorer mental health for both adults and children, delinquency in children, and increased chances of children becoming victims or perpetrators of physical abuse in adulthood (Gershoff, 2002; Gershoff & Bitensky, 2007).

Do these findings suggest that corporal punishment should be abandoned altogether? Although few psychologists recommend spanking altogether, further research has shown that the negative side effects are more likely if punishment is particularly severe, such as slapping children in the face. Other research indicates that less harsh forms of corporal punishment, such as light spanking, are effective and unlikely to bring about other negative side effects (Kazdin & Benjet, 2003). In addition, punishment may suppress an unwanted behavior temporarily, but by itself it does not teach which behaviors are appropriate. As a general rule, punishment of any kind is most effective when combined with reinforcement of an alternative, suitable response. Table 6.4 offers some general guidelines for maximizing the effects of punishment and minimizing negative side effects.
Operant Conditioning: Learning Through Consequences :: Module 6.2 :: 219

Table 6.4 :: Punishment Tends to Be Most Effective When Certain Principles Are Followed

<table>
<thead>
<tr>
<th>PRINCIPLE</th>
<th>DESCRIPTION AND EXPLANATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severity</td>
<td>Should be proportional to offense. A small fine is suitable for parking illegally or littering, but inappropriate for someone who commits assault.</td>
</tr>
<tr>
<td>Initial punishment level</td>
<td>The initial level of punishment needs to be sufficiently strong to reduce the likelihood of the offense occurring again.</td>
</tr>
<tr>
<td>Contiguity</td>
<td>Punishment is most effective when it occurs immediately after the behavior. Many convicted criminals are not sentenced until many months after they have committed an offense. Children are given detention that may not begin until hours later. Long delays in punishment are known to reduce its effectiveness.</td>
</tr>
<tr>
<td>Consistency</td>
<td>Punishment should be administered consistently. A parent who only occasionally punishes a teenager for breaking her curfew will probably have less success in curbing the behavior than a parent who uses punishment consistently.</td>
</tr>
<tr>
<td>Show alternatives</td>
<td>Punishment is more successful, and side effects are reduced, if the individual is clear on how reinforcement can be obtained by engaging in appropriate behaviors.</td>
</tr>
</tbody>
</table>

Quick Quiz 6.2b :: Applications of Operant Conditioning

1. Shaping is the process of:
   A. reinforcing a series of responses that approximate the desired behavior.
   B. decreasing the likelihood of a behavior.
   C. reinforcing the basic motivational needs of a subject.
   D. punishing a series of responses that you want to increase.

2. Pete cannot seem to stop checking the change slots of vending machines. Although he usually does not find any money, occasionally he finds a quarter. Despite the low levels of reinforcement, this behavior is likely to persist due to ________.
   A. escape learning
   B. the partial reinforcement effect
   C. positive punishment
   D. generalization

3. Frederick trained his parrot to open the door to his cage by pecking at a lever three times. Frederick used a ________ schedule of reinforcement to encourage the desired behavior.
   A. variable interval
   B. variable-ratio
   C. fixed interval
   D. fixed-ratio

4. A friend regularly spanks his children to decrease their misbehavior. Which statement is most accurate in regard to this type of corporal punishment?
   A. Spanking is an effective method of punishment and should always be used.
   B. Spanking can be an effective method of punishment but carries risks of additional negative outcomes.
   C. Spanking is not an effective method of punishment, so it should never be used.
   D. The effects of spanking have not been well researched, so it should not be used.

Answers can be found on page ANS-2.
Now that you have read this module you should:

**KNOW ...**

- The key terminology associated with operant conditioning:
  - avoidance learning (p. 213)
  - continuous reinforcement (p. 216)
  - discriminative stimulus (p. 214)
  - escape learning (p. 213)
  - extinction (p. 214)
  - fixed-interval schedule (p. 216)
  - fixed-ratio schedule (p. 216)
  - negative punishment (p. 214)
  - negative reinforcement (p. 213)
  - operant conditioning (p. 209)
  - partial (intermittent) reinforcement (p. 216)
  - partial reinforcement effect (p. 217)
  - positive punishment (p. 213)
  - positive reinforcement (p. 213)
  - primary reinforcer (p. 212)
  - punisher (p. 211)
  - punishment (p. 211)
  - reinforcement (p. 210)
  - reinfocer (p. 210)
  - schedules of reinforcement (p. 216)
  - secondary reinforcer (p. 212)
  - shaping (p. 215)
  - variable-interval schedule (p. 216)
  - variable-ratio schedule (p. 216)

**UNDERSTAND ...**

- The role that consequences play in increasing or decreasing behavior. Positive and negative reinforcement increase the likelihood of a behavior, whereas positive and negative punishment decrease the likelihood of a behavior. Positive reinforcement and punishment involve adding a stimulus to the situation, whereas negative reinforcement and punishment involve removal of a stimulus.

- How schedules of reinforcement affect behavior. Schedules of reinforcement can be fixed or variable, and can be based on intervals (time) or ratios (the number of responses). In contrast to continuous reinforcement, intermittent schedules tend to elicit vigorous responding. Our tendency to link our behavior to reinforcement is particularly evident when it comes to superstition—where a ritual is believed to bring about reinforcement, regardless of whether it actually does.

**APPLY ...**

- Your knowledge of operant conditioning to examples. The concepts of positive and negative reinforcement and punishment are often the most challenging when it comes to this material. Read the following scenarios and determine whether positive reinforcement, negative reinforcement, positive punishment, or negative punishment explains the change in behavior. Check your answers on page ANS-2.
  1. Steven is caught for cheating on multiple examinations. As a consequence, the school principal suspends him for a three-day period. Steven likes being at school and, when he returns from his suspension, he no longer cheats on exams. Which process explains the change in Steven’s behavior? Why?

- Ericka earns As in all of her math classes. Throughout her schooling, she finds that the personal and social rewards for excelling at math continue to motivate her. She eventually completes a graduate degree and teaches math. Which process explains her passion for math? Why?

- Automobile makers install sound equipment that produces annoying sounds when a door is not shut properly, lights are left on, or a seat belt is not fastened. The purpose is to increase proper door shutting, turning off of lights, and seat belt fastening behavior. Which process explains the behavioral change these sounds are attempting to make?

- Hernan bites his fingernails and cuticles to the point of bleeding and discomfort. To reduce this behavior, he applies a terrible-tasting topical lotion to his fingertips; the behavior stops. Which process explains Hernan’s behavioral change?

**ANALYZE ...**

- The effectiveness of punishment on changing behavior. Many psychologists recommend that people rely on reinforcement to teach new or appropriate behaviors. The issue here is not that punishment does not work, but rather that there are some notable drawbacks to using punishment as a means to change behavior. For example, punishment may teach individuals to engage in avoidance or aggression, rather than developing an appropriate alternative behavior that can be reinforced.
Are you smarter than a chimpanzee? For years psychologists have asked this question, but in a more nuanced way. More specifically, they have tested the problem-solving and imitative abilities of chimpanzees and humans to help us better understand what sets us apart, and what makes us similar to other animals. Chimps and humans both acquire many behaviors from observing others, but imagine if you pitted a typical human preschooler against a chimpanzee. Who do you think would be the best at learning a new skill just by watching someone else perform it? Researchers Victoria Horner and Andrew Whiten asked this question by showing 3- and 4-year-old children how to retrieve a treat by opening a puzzle box, and then they demonstrated the task to chimpanzees as well. But there was one trick thrown in: As they demonstrated the process, the researchers added in some steps that were unnecessary to opening the box. The children and chimps both figured out how to open it, but the children imitated all the steps—even the unnecessary ones—while the chimps skipped the useless steps and went straight for the treat (Horner & Whiten, 2005).

What can we conclude from these results? Maybe it is true that both humans and chimps are excellent imitators, although it appears the children imitated a little too well, while the chimps imitated in a smarter manner. Clearly, we both share a motivation to imitate—which is a complex cognitive ability.

Focus Questions

1. What role do cognitive factors play in learning?
2. Which processes are required for imitation to occur?

The first two modules of this chapter focused on relatively basic ways of learning. Classical conditioning occurs through the formation of associations (Module 6.1), and in operant conditioning behavior changes as a result of rewarding or punishing consequences (Module 6.2). In both modules, we emphasized relationships between stimuli and responses, and avoided making reference to an organism that was doing the thinking part of the learning process.
When John Watson, B. F. Skinner, and other behavioral psychologists of the time were conducting their research, they assumed that “thought” was unnecessary for a scientific account of how stimuli and responses are related. However, since the 1950s and continuing today, psychologists have recognized that cognitive processes such as thinking and remembering are useful to theories and explanations for how we learn.

Cognitive Perspectives on Learning

Cognitive psychologists have contributed a great deal to psychology’s understanding of learning. In some cases, they have presented a very different view from behaviorism by addressing unobservable mental phenomena. In other cases, their work has simply complemented behaviorism by integrating cognitive accounts into even the seemingly simplest of learned behaviors, such as classical conditioning.

THE PAST PREDICTS THE FUTURE: COGNITIVE PROCESSES AND CONDITIONING

Pavlov’s experiments illustrated how classical conditioning involves pairing a conditioned stimulus such as a tone with an unconditioned stimulus of food, resulting in the conditioned response of salivation to the tone alone (Module 6.1). When it comes to the real world, however, learning is rarely so simple. Tones might occur in the absence of food, and food might be available with or without tones. Classical conditioning can take place only if an organism recognizes that there is a consistent relationship between the two stimuli. In other words, an association can form if the conditioned stimulus is a reliable predictor of the unconditioned stimulus (Rescorla & Wagner, 1972). It seems that humans are sensitive to the degree to which stimuli are associated and respond only if there is consistency in their relationship. The same is true for rats. Rats that experience tones and shocks occurring together 100% of the time show more fear in response to a tone than do rats that experience the same number of tones and shocks, but for which the stimuli actually occur together only 50% of the time (see Figure 6.16).

LATENT LEARNING

Much of human learning involves absorbing information and then demonstrating what we have learned through a performance task, such as a quiz or exam. Learning, and reinforcement for learning, may not be expressed until there is an opportunity to do so.

Psychologist Edward Tolman proposed that humans, and even rats, express latent learning—learning that is not immediately expressed by a response until the organism is reinforced for doing so. Tolman and Honzik (1930) demonstrated latent learning in rats running a maze (see Figure 6.17). The first group of rats could obtain food if they navigated the correct route through the maze. They were given 10 trials to figure out an efficient route to the end of the maze, where food was always waiting. A second group was allowed to explore the maze, but did not have food available at the other end until the 11th trial. A third group (a control) never received any food while in the maze. It might seem that only the first group—the one that was reinforced on all trials—would learn how to best shuttle from the start of the maze to the end. After all, it was the only group that was consistently reinforced. This is, in fact, what happened—at least for
If you put yourself in the rat’s shoes—or perhaps paws would be more appropriate—you will realize that humans experience latent learning as well. Consider a familiar path you take to work or school. There is probably a spot along that route that you have never visited, simply because there is no reason—perhaps it is a vacant storefront. But imagine you discover one day that a fantastic and inexpensive new restaurant opened up in that spot. You would have no trouble finding it in the future because you have an understanding of the general area. Tolman and Honzik assumed that this process held true for their rats, and they further hypothesized that rats possess a cognitive map of their environment, much like our own cognitive map of our surroundings. This classic study is important because it illustrates that humans (and rats) acquire information in the absence of immediate reinforcement and that we can use that information when circumstances allow.

Humans and rats may have latent learning in common, but one characteristic that is unique to human learning is the ability to think about and reflect on strengths and weaknesses in how we learn. Specifically, we can identify what works and what does not work when it comes to learning, and adjust our strategies accordingly.

SUCCESSFUL LONG-TERM LEARNING AND DESIRABLE DIFFICULTIES

Humans are highly attuned to our own learning and states of knowledge. When we are sufficiently motivated to learn new information, we tend to share certain goals, including (1) a long-lasting change in behavior and knowledge and (2) the ability to apply new knowledge and skills across a variety of unique situations. All too often, however, we work in ways that provide only short-term effects, and very little improvement over time (Schmidt & Bjork, 1992). There are at least three habits people fall into when trying to learn new behaviors:

- We want clarity about what to learn or do.
- We want very noticeable results.
- We want it all to happen very fast.
Thus, if you were learning vocabulary for a foreign language class, chances are you are likely to cram. In doing so, you might use a study guide with material for the exam and read through the items repeatedly, testing yourself as you go. As you do so, you might notice that you learned the first few items easily; in turn, you will move on to the next topic as soon as you get the words right. This approach might get you through a quiz in your German course in a few hours, but it probably will not help you in actual conversation if you were to fly to Germany next week.

We like these techniques because they are easy and quick, and they seem to be effective. In reality, though, they merely trick us into thinking that we have learned more—or better—than we have. In other words, getting results fast usually causes us to overestimate how well we will remember things in the long run. To really remember and understand something, learning should be a little more difficult—but it should be the right kind of difficult (Schimdt & Bjork, 1992). Desirable difficulties are situations that make acquiring new knowledge more challenging and with benefits that are less obvious in the short term. At the same time, desirable difficulties promote long-term learning and the ability to apply the information to new and unique situations. Next, we will discuss two applications of desirable difficulties.

**Organization Versus Rearrangement** If you have taken other college courses before this one, you have probably filled out instructor evaluation forms at the end of the term. Evaluations almost always ask whether the professor was clear. This seems like an obvious question, because students tend to like course material laid out in a clear and logical manner. But is clarity always a good thing? In one study, half of the students in a college course received lecture outlines that fit the lecture perfectly, whereas the other half of the students received outlines that were scrambled. After the lecture, students were quizzed on their retention for the material. On recognition and cued-recall tests, the students with the organized notes did better. So does that mean students are right in wanting perfect clarity? Not necessarily. On the hard questions—which required inferring the meaning of material or solving problems—the students with the scrambled lecture notes performed better. In other words, the scrambled notes led to more effortful studying and, therefore, more meaningful learning (Mannes & Kintsch, 1987).

**Total Time Versus Distributed Practice** Students are invariably busy people, and most probably engage in some degree of procrastination. The result is often the need to cram for a final the night before the exam or to write a 15-page paper in one day. Consider this question: Which is better—studying 4 hours the night before an exam or studying in four 1-hour sessions in the days leading up to the exam? Research suggests that the answer is clear. In nearly 200 scientific articles describing more than 300 experiments, distributing 4 hours of study over four separate 1-hour sessions has been proven much better than cramming for the same amount of time (Cepeda et al., 2006). There is not a clear consensus among psychologists as to why this is so, but spreading out study sessions across time seems to provide more opportunities to link concepts together and helps to reinforce memory formation.

**Creating Desirable Difficulties** These studies and dozens of others provide compelling evidence that we would be better off creating desirable difficulties for ourselves, rather than trying to make studying as quick and easy as possible.

Before closing this section, it is important to recognize the limits of creating difficulties. There is a
reason researchers included the word “desirable” in the term **desirable difficulty**: If professors were to speak unintelligibly in front of your class, or to give extremely vague assignments with no criteria to work toward or models to follow, you would be right to criticize your instructors—“difficult” does not necessarily equal “desirable.”

That leaves us with the most important questions of all: How do we create desirable difficulties for ourselves? And how do we know when a difficulty is desirable? Table 6.5 summarizes what seems to work best. As you can see, learning can be greatly enhanced through awareness and monitoring of your own experiences.

**Table 6.5 :: Three Tips for Creating Desirable Difficulties to Promote Learning**

| Determine the purpose of learning. | On the one hand, if you are learning a three-item grocery list, there is no need to make it difficult. On the other hand, if you are learning a skill for a hobby (e.g., playing guitar) or if you need to remember information for your job (e.g., rules for filing reports), then you will probably want to achieve a thorough understanding. |
| Consider changing the order. | If you are learning a song on an instrument, do not start at the beginning every time—start halfway through, or one-fourth of the way. If you are learning vocabulary through flashcards, shuffle the order of the words. To learn about more complex ideas—perhaps how nerve cells work—approach the process from a different order each time. |
| Distribute your learning. | Practicing or studying for four hours can produce varying results, depending on how you spend those four hours. Longer-lasting learning will result if your learning is distributed over a few short study sessions, rather than cramming all at once. Also, you might try the spacing effect: gradually increase the intervals between learning sessions, but start with short ones. |

**Observational Learning**

The first two modules in this chapter focused on aspects of learning that require direct experience. Pavlov’s dogs experienced the tone and the food one right after the other, and learning occurred. Rats in an operant chamber experienced the reinforcing consequences of pressing a lever, and learning occurred. However, not all learning requires direct experience, and this is a good thing. Can you imagine if surgeons had to learn by trial and error? Who on earth would volunteer to be the first patient?

**Observational learning involves changes in behavior and knowledge that result from watching others.** Humans have elaborate cultural customs and rituals that spread through observation. The cultural differences we find in dietary preferences, clothing styles, athletic events, holiday rituals, music tastes, and so many other customs exist because of observational learning. Socially transmitting behavior is an efficient approach; indeed, it is the primary way that adaptive behavior spreads so rapidly within a population, even in nonhuman species (Heyes & Galef, 1996). Before setting off in search of food, rats smell the breath of other rats. They will then search preferentially for food that matches the odor of their fellow rats’ breath. To humans, this practice may not seem very appealing—but for rats, using breath as a source of information about food may help them survive. By definition, a breathing rat is a living rat, so clearly the food the animal ate did not kill it. Living rats are worth copying. Human children are also very sensitive to social cues about what they should avoid. Curious as they may be, even young children will avoid food if they witness their parents reacting with disgust toward it (Stevenson et al., 2010).

For observational learning to occur, some key processes need to be in place if the behavior is to be successfully transmitted from one person to the next.
PROCESSES SUPPORTING OBSERVATIONAL LEARNING  Albert Bandura identified four processes involved in observational learning: attention to the act or behavior, memory for it, the ability to reproduce it, and the motivation to do so (see Figure 6.18). Without any one of these processes, observational learning would be unlikely—or at least would result in a poor rendition.

First, consider the importance of attention. Seeing someone react with a classically conditioned fear to snakes or spiders can result in acquiring a similar fear—even in the absence of any direct experience with snakes or spiders (LoBue et al., 2010). Also, paying attention to others who are being rewarded or punished, as in operant conditioning, can result in learning by the observer. Observing someone being rewarded for a behavior facilitates imitation of the same behaviors that bring about rewards.

Second, memory is an important facet of observational learning. When we learn a new behavior, there is often a delay before the opportunity to perform it arises. If you tuned into a cooking show, for example, you will need to recreate the steps and processes required to prepare the dish at a later time. Memory for how to reproduce a behavior or skill can be found at a very early age. Infants just nine months of age can reproduce a new behavior, even if there is a 24-hour delay between observing the act and having the opportunity to do so.

Third, observational learning requires that the observer can actually reproduce the behavior. This can be very challenging, depending on the task. Unless an individual has a physical impairment, learning an everyday task—such as operating a can opener—is not difficult. By comparison, hitting a baseball thrown by a professional pitcher requires a very specialized skill set. Research indicates that observational learning is most effective when we first observe, practice immediately, and continue practicing soon after acquiring the response. For example, one study found that the optimal way to develop and maintain motor skills is by repeated observation before and during the initial stages of practicing (Weeks & Anderson, 2000). It appears that watching someone else helps us practice effectively, and allows us to see how errors are made. When we see a model making a mistake, we know to examine our own behavior for similar mistakes (Blandin & Proteau, 2000).

Finally, motivation is clearly an important component of observational learning. On the one hand, being hungry or thirsty will motivate an individual to find out where others are going to find food and drink. On the other hand, a child who has no aspirations to ever play the piano will be less motivated to observe his teacher during lessons.
Observational punishment is also possible, but appears to be less effective at changing behavior than reinforcement. Witnessing others experience negative consequences may decrease your chances of copying someone else’s behavior. Even so, we are sometimes surprisingly bad at learning from observational punishment. Seeing the consequences of smoking, drug abuse, and other risky behaviors does not seem to prevent many people from engaging in the same activities.

**MYTHS IN MIND**

**Teaching Is Uniquely Human**

Teaching is a significant component of human culture and a primary means by which information is learned in classrooms, at home, and many other settings. But are humans the only species with the ability to teach others? Some intriguing examples of teaching-like behavior have been observed in nonhuman species (Thornton & Raihani, 2010). Prepare to be humbled.

Teaching behavior was recently discovered in ants (Franks & Richardson, 2006)—probably the last species we might suspect would demonstrate this complex ability. For example, a “teacher” ant gives a “pupil” ant feedback on how to locate a source of food.

Field researchers studying primates discovered the rapid spread of potato washing behavior in Japanese macaque monkeys (Kawai, 1965). Imo—perhaps one of the more ingenious monkeys of the troop—discovered that potatoes could be washed in salt water, which also may have given them a more appealing taste. Potato washing behavior subsequently spread through the population, especially among the monkeys that observed the behavior in Imo and her followers.

Transmission of new and unique behaviors typically occurs between mothers and their young (Huffman, 1996). Chimpanzee mothers, for example, actively demonstrate to their young the special skills required to crack nuts open (Boesch, 1991). Also, mother killer whales appear to show their offspring how to beach themselves (Rendell & Whitehead, 2001), a behavior that is needed for the type of killer whale that feeds on seals that congregate along the shoreline.

In each of these examples, it is possible that the observer animals are imitating the individual who is demonstrating a behavior. These observations raise the possibility that teaching may not be a uniquely human endeavor.

**IMITATION AND OBSERVATIONAL LEARNING**

One of the primary mechanisms that allows observational learning to take place is imitation—recreating a motor behavior or expression, often to accomplish a specific goal. From a very young age, infants imitate the facial expressions of adults (Meltzoff & Moore, 1977). Later, as they mature physically, children readily imitate motor acts produced by a model, such as a parent, teacher, or friend. This ability seems to be something very common among humans.

At the beginning of this module, we raised the topic of human imitation—namely, how children, in contrast to chimpanzees, may imitate beyond what is necessary. Psychologists have found that both children from industrialized regions of Australia and children from remote non-industrialized communities in Africa over-imitate the actions of adults who model how to open a contraption using a variety of sticks, switches, and knobs. The adult demonstrating the actions involved in opening the box added irrelevant steps to the
process—many of which the children were compelled to imitate (Nielsen & Tomaselli, 2010). Perhaps humans are so wired and motivated to learn from others that evolution has given us, but not nonhumans, the tendency to over-imitate.

**WORKING THE SCIENTIFIC LITERACY MODEL**

**Linking Media Exposure to Behavior**

Observational learning occurs during our face-to-face interactions with others, but what about all the time people spend observing others through television, movies, the Internet, and even video games?

**What do we know about media effects on behavior?**

In some cases, learning from the media involves direct imitation; in other cases, what we observe shapes what we view as normal or acceptable behavior. Either way, the actions people observe in the media can raise concerns, especially when children are watching. Given that American children now spend an average of five hours per day interacting with electronic media, it is no wonder that one of the most discussed and researched topics in observational learning is the role of media violence in developing aggressive behaviors and desensitizing individuals to the effects of violence (Anderson et al., 2003). So how have researchers tackled the issue?

One of the first experimental attempts to test whether exposure to violence begets violent behavior in children was made by Albert Bandura and colleagues (1961, 1963). In a series of studies, groups of children watched an adult or cartoon character attack a “Bobo” doll, while another group of children watched adults who did not attack the doll. Children who watched adults attack the doll did likewise when given the opportunity, in some cases even imitating the specific attack methods used by the adults. The other children did not attack the doll. This provided initial evidence that viewing aggression makes children at least temporarily more prone to committing aggressive acts toward an inanimate object. Decades of research has since confirmed that viewing aggression is associated with increased aggression and desensitization to violence (Bushman & Anderson, 2007).

Exposure to violence can come in many forms, including music. Several genres of popular music tend to have violent lyrical content accompanying aggressive, loud music. Does listening to violent music also increase aggression? Experiments indicate that it can. In one study, undergraduate students listened to either soft music (e.g., classical), heavy metal, or no music while they participated in a laboratory experiment. All of the students completed a self-report on their mood.

In Albert Bandura’s experiment, children who watched adults behave violently toward the Bobo doll were aggressive toward the same doll when given the chance—often imitating specific acts that they viewed. Click on this image in your eText to watch video footage of this experiment.
at the beginning and then wrote a short essay while listen-
ing to the music. Their essay was then taken into another
room, where an experimenter provided feedback that was
either positive or negative, regardless of the actual content
or quality of what they wrote. The purpose of the negative
feedback was to provoke aggression in students from each
group. After the students received this feedback, their anger
and mood levels were measured with a questionnaire. The
students who listened to heavy metal music during their par-
ticipation reported greater feelings of anger in response to
negative feedback than those who listened to pleasant music.
Also, their overall mood levels declined from the time they
started the experiment (Krahé & Bieneck, in press).

Can we critically evaluate this research?
Exposure to violent media and ag-
gressive behavior and thinking are
certainly related to each other. How-
ever, at least two very important
questions remain. First, does expo-
sure to violence cause violent behavior or desensitization to
violence? Second, does early exposure to violence turn children
into violent adolescents or adults? Unfortunately, there are no
simple answers to either question, due in large part to investiga-
tors’ reliance on correlational designs, which are typically used
for studying long-term effects. Recall that correlational studies
can establish only that variables are related, but cannot deter-
mine that one variable (media) causes another one (violent be-
behavior). What is very clear from decades of research is that a
positive correlation exists between exposure to violent media
and aggressive behavior in individuals, and that this correlation
is stronger than those between aggression and peer influence,
abusive parenting, or intelligence (Bushman & Anderson, 2007;

Why is this relevant?
Despite problems establishing
a cause-and-effect relationship,
we know that, at the very least,
media violence is a significant
risk factor for future aggressiveness. Many organizations have
stepped in to help parents make decisions about which type
of media their children will be exposed to. The Motion Picture
Association of America has been rating movies, with violence
as a criterion, since 1968. Violence on television was being
monitored and debated even before the film industry took
this step. Since the 1980s, parental advisory stickers have been
appearing on music with lyrics that are sexually explicit, refer-
ence drug use, or depict violence. Even more recently, due to
a drastic upsurge in their popularity and sophistication, video
games have been labeled with parental advisory stickers.

Graphic violence in video games has become commonplace.
Can pixilated, fictional characters controlled by your own hands make you more aggressive or even violent? Adolescents, college students, and even a lot of older adults play hours of video games each day, many of which are very violent. Also, because video games are becoming so widespread, concerns have been raised about whether the correlations between media violence and aggression are found across different cultures. What do you think: Do these games increase aggression and violent acts by players? First, test your knowledge and assumptions and then see what research tells us.

**Quick Quiz 6.3b**

**Observational Learning**

1. Observational learning:  
   - **A** is the same thing as teaching.  
   - **B** involves a change in behavior as a result of watching others.  
   - **C** is limited to humans.  
   - **D** is not effective for long term retention.

2. _______ is the replication of a motor behavior or expression, often to accomplish a specific goal.  
   - **A** Observational learning  
   - **B** Latent learning  
   - **C** Imitation  
   - **D** Cognitive mapping

3. Nancy is trying to learn a new yoga pose. To obtain the optimal results, research indicates she should:  
   - **A** observe, practice immediately, and continue to practice.  
   - **B** observe and practice one time.  
   - **C** just closely observe the behavior.  
   - **D** observe the behavior just one time and then practice on her own.

4. Which is the most accurate conclusion from the large body of research that exists on the effects of viewing media violence?  
   - **A** Viewing aggression directly causes increased aggression and desensitization to violence.  
   - **B** Viewing aggression does not cause increased aggression and desensitization to violence.  
   - **C** Viewing aggression is related to increased aggression and desensitization to violence.  
   - **D** Viewing aggression is not related to increased aggression and desensitization to violence.

(These data are from Anderson et al., 2010; Carnagey et al., 2007; and Fischer et al., 2010).
Now that you have read this module you should:

**KNOW ...**

- The key terminology associated with cognitive and observational learning:
  - imitation (p. 227)
  - observational learning (p. 225)
  - latent learning (p. 222)

**UNDERSTAND ...**

- The concept of latent learning and its relevance to cognitive aspects of learning. Without being able to observe learning directly, it might seem as if no learning occurs. However, Tolman and Honzik showed that rats can form "cognitive maps" of their environment. They found that even when no immediate reward was available, rats still learned about their environment.

**APPLY ...**

- Principles of learning to make your own learning experiences more effective. Increasing the effectiveness of learning experiences does not mean making your study time easier—in fact, you may need to incorporate some study habits to make learning more difficult so that you have a better understanding and longer-lasting results.

Use the tips in Table 6.5 (p. 225) in considering each of the following scenarios (check your answers on page ANS-2):

1. John forgot that he had an upcoming major examination until 48 hours before the test. Given that it is so close to the examination and he can spend only 12 of the next 48 hours on studying, what is John’s best course of action?

2. Janet is struggling to understand how observational learning involves the four processes of attention, memory, motor reproduction of behavior, and motivation. In class, her professor gave examples that always presented the processes in the exact same order. How might Janet rethink this approach to better understand the concept?

3. Memorizing schedules of reinforcement seems like something that is relevant only to what goes on in an operant chamber. To Darius, this task seems like busy work. How might he change his mindset to give meaning to this task?
Focus Questions:

1. **Which types of behaviors can be learned?** Conditioning can involve observable behaviors as well as physiological responses of which we may or may not be aware. Many of our basic reflexes and physiological processes are influenced by classical conditioning. Also, we are particularly good at learning about stimuli associated with food and other biologically important events, such as threats to survival, and the sexual behavior that makes life possible in the first place. Module 6.2 and Module 6.3 described additional types of behaviors that can be learned.

2. **Do all instances of classical conditioning go undetected by the individual?** Clearly, some classical conditioning goes undetected. Conditioning occurs to drugs and cues that accompany drug use. Sexual arousal and physiological responses can be conditioned as well. Drug-related and sexual conditioning often go undetected, but people can become aware that they are responding to cues that are associated with sexual arousal or drug use. The observation that people in vegetative states can be conditioned makes a strong case that awareness is not required for conditioning to occur. Certainly, conditioning that takes place to artificial sweeteners goes undetected—the learning takes place at a very basic physiological level.

3. **How do the consequences of our actions—such as winning or losing a bet—affect subsequent behavior?** The answer to this question may initially seem obvious: If the consequences are rewarding and we win the bet, we are likely to repeat our behavior. Although that is often the case, consequences are actually somewhat more complex. Consider the concepts of primary and secondary reinforcement. Primary reinforcers satisfy basic biological needs. In contrast, the cash from a bet is a secondary reinforcer, whose value is something we learn. Also, everyone who gambles sometimes wins and sometimes loses, which leads us to the next question.

4. **Many behaviors, including gambling, are reinforced only part of the time. How do the odds of being reinforced affect how often a behavior occurs?** Operant behavior is largely influenced by reinforcement schedules. Some responses are reinforced on a continuous schedule. At other times, reinforcement is not available until a certain number of responses has occurred, or a scheduled amount of time has passed. This kind of intermittent reinforcement can result in vigorous responding. In gambling, rewards are typically obtained only after a gambler has placed many bets that went unrewarded. In the mind of the gambler, the next big reward may be just around the corner—a belief that serves to encourage vigorous, and risky, responding.

Focus Questions:

1. **What role do cognitive factors play in learning?** Even something as seemingly basic as classical conditioning can have a cognitive component. For example, humans and animals both judge the degree to which one stimulus, such as a tone, reliably predicts whether another stimulus, such as food, will be available. In research studies, responding to the tone is strongest when it is consistently followed by food, and animals (including humans) are highly sensitive to changes in this relationship. The concept of desirable difficulties shows that effective learning involves mental organization, rearrangement of information, and awareness of good strategies for learning. Thus one cognitive factor involved in our learning is an awareness of what we know and do not know; we need this ability to use strategies to improve learning.

2. **Which processes are required for imitation to occur?** Imitation, at the very least, requires that the individual pay attention to another individual, that the person remember what was observed, and that the individual has both the motor abilities required for the task and the motivation to learn it. Humans have extraordinary capabilities when it comes to imitation. Indeed, both imitation and “over-imitation” occur at a very young age in humans. This tendency might occur because following cultural conventions is such a strong motivating force for our species—so much so that the motivation to imitate can be stronger than the motivation to solve a problem.
1. In classical conditioning, a(n) ________ becomes a(n) ________, which elicits a response.
   - A neutral stimulus; conditioned stimulus
   - B neutral stimulus; unconditioned stimulus
   - C unconditioned stimulus; conditioned stimulus
   - D unconditioned stimulus; neutral stimulus

2. Most mornings, Becky listens to her favorite song as she gets ready for work, including putting in her contacts. One afternoon, Becky hears her favorite song playing, and her eyes start watering—something that usually happens only when she put her contacts in. If this is an example of classical conditioning, what is the unconditioned stimulus?
   - A Eye watering
   - B Becky’s contacts
   - C The song
   - D Getting ready for work

3. How would John B. Watson have explained why many people have a phobia of flying on airplanes?
   - A Flying is unnatural for human beings.
   - B The brain has difficulty understanding how something heavy can fly.
   - C Extensive news coverage of airplane crashes cause people to associate airplanes with danger.
   - D People with a flying phobia are actually afraid of being trapped in small spaces.

4. An important distinction between classical and operant conditioning is that:
   - A classical conditioning involves voluntary responding, while operant conditioning involves involuntary responding.
   - B classical conditioning involves reinforcement, while operant conditioning involves punishment.
   - C classical conditioning involves cognitive learning, while operant conditioning involves associative learning.
   - D responding does not affect the presentation of stimuli in classical conditioning, but in operant conditioning responding has consequences.

5. The word “negative” in the term negative reinforcement refers to:
   - A the removal of a stimulus.
   - B an unwanted conditioned behavior.
   - C the use of punishment.
   - D the use of inappropriate stimuli.

6. A rat is conditioned to press a lever for food. One day a food pellet jams in the automatic feeder and the rat no longer receives food after pressing the lever. After a few minutes, the rat eventually stops pressing the lever. This is an example of:
   - A negative reinforcement.
   - B extinction.
   - C classical conditioning.
   - D avoidance learning.

7. All other things being equal, an animal trained on which of the following schedules of reinforcement should experience extinction most quickly when the reinforcement is removed?
   - A Fixed-interval schedule
   - B Continuous schedule
   - C Variable-ratio schedule
   - D Variable-interval schedule

8. Learning that occurs, but is not expressed until later, is called ________.
   - A observational learning
   - B classical conditioning
   - C latent learning
   - D discriminative learning

9. In general, studying is more effective when:
   - A desirable difficulties are present.
   - B the information is organized in outlines that can quickly be reviewed several times.
   - C the total amount of studying time is short.
   - D all of the studying occurs in one long session.

10. Which of the following statements best describes our current understanding of the relationship between exposure to media violence and future aggression?
    - A There is no relationship between media violence and aggression.
    - B Media violence clearly causes aggression.
    - C There is a positive correlation between media violence and aggression.
    - D There is a negative correlation between media violence and aggression.
Work the Scientific Literacy Model :: Understanding Reinforcement and Punishment

What do we know about reinforcement and punishment?
Review Figure 6.11 on page 210 for a summary of operant conditioning, and turn back to Table 6.2 on page 213 for help distinguishing between reinforcement and punishment. As you review this material, think about how you could mentally organize these concepts. If you are positively reinforced, then some external incentive is given to you. If you are negatively reinforced, then your behavior has resulted in something aversive being removed. For example, the child in line at the grocery store who whines until his dad gives him candy is positively reinforced for whining: He receives something he wants (candy), so the next time the child is at the store, his behavior (whining) is likely to increase. The father is negatively reinforced, because he gives his son the candy and the whining (something he finds aversive) stops. Both father and son were reinforced because each is likely to repeat the behavior that got them what they wanted.

While the father was negatively reinforced in this scenario, no one was punished. If you are confused about the difference between negative reinforcement and punishment, consider this: most people find the outcome of negative reinforcement to be desirable but are upset about being punished.

Why is this relevant?
Watch the accompanying video excerpt on operant conditioning. You can access the video at MyPsychLab or by clicking the play button in the center of your eText. If your instructor assigns this video as a homework activity, you will find additional content to help you at MyPsychLab. You can also view the video by using your smartphone and the QR code below, or you can go to the YouTube link provided.

After you have read this chapter and watched the video, imagine that you are asked by a roommate to help him devise a weight-loss program to increase his chances of making the football team. Create a one-month behavior modification program based on the principles of operant conditioning which will help him get started towards his goal.

How can science help explain how reinforcement and punishment work?
Page 210 included a discussion of how early research with animal subjects proved that systematic reinforcement can shape behaviors in both animals and humans. Also, on page 212, we mentioned how modern researchers have identified a specific region of the brain, the nucleus accumbens, that becomes activated during the processing of rewarding activities such as eating (see Figure 6.14). Individual differences in this area of the brain might account for why some people can easily modify their behavior through reinforcement or punishment, whereas others struggle to do so. Research has also revealed that people tend to react more strongly to the unpleasantness of punishment than they do to the pleasures of reward, which raises questions about the effectiveness of punishment versus reinforcement. For example, parents who spank their children often see short-term results when a child stops her undesirable behavior, but studies have found that spanking has several negative side effects. Research also suggests that the negative side effects increase or decrease depending on the severity of the physical punishment.

Can we critically evaluate claims about reinforcement and punishment?
Do these findings suggest that all punishment is ineffective and that reinforcement is the only way to successfully modify behavior? The discussion of punishment on pages 213–214 explained that while punishment may temporarily stop an unwanted behavior, it does not teach appropriate behaviors. For example, if the latest fad diet severely restricts the amount and kind of food you can eat, you may lose pounds in the short term, but once the diet is over, you will probably go back to your unhealthy ways and gain back the weight. Generally, punishment of any kind is most effective when it is combined with reinforcing alternative responses. See the guidelines in Table 6.4 on page 219 for tips on using punishment and minimizing its negative side effects.