Learning

Can we learn in our sleep? (p. 5-33)
How do trainers get animals to do cute tricks like dancing or water skiing? (p. 5-21)

Does watching violence on TV really teach children to become violent? (p. 5-27)

How do phobias develop? (p. 5-11)

Do different people have different learning styles that work best for them? (p. 5-34)
Before reading further, try your hand at the following four items.

(1) Ivan Pavlov, the discoverer of classical conditioning, was well known as a
   (a) slow eater.
   (b) fast walker.
   (c) terrible cook.
   (d) I have no idea.

(2) John B. Watson, the founder of behaviorism, was tossed out of Johns Hopkins
   University for
   (a) plagiarizing a journal article.
   (b) stabbing one of his faculty colleagues.
   (c) having an affair with his graduate student.
   (d) I have no idea.

(3) Watson believed that parents should do which of the following to their children
   before bedtime?
   (a) spank them
   (b) kiss them on the cheek
   (c) shake their hands
   (d) I have no idea.

(4) As a college student, B. F. Skinner, the founder of radical behaviorism, once spread a
   false rumor that which of the following individuals was coming to campus?
   (a) silent movie comedian Charlie Chaplin
   (b) psychoanalyst Sigmund Freud
   (c) President Theodore Roosevelt
   (d) I have no idea.

Now, read the following paragraph.

The three most famous figures in the psychology of learning were each colorful
characters in their own way. The discoverer of classical conditioning, Ivan Pavlov,
was a notoriously compulsive fellow. He ate lunch every day at precisely 12 noon,
got to bed at exactly the same time every night, and departed St. Petersburg, Russia,
for vacation the same day every year. Pavlov was also such a rapid walker that
his wife frequently had to run frantically to keep up with him. The life of the
founder of behaviorism, John B. Watson, was rocked with scandal. Despite becom-
ing one of the world’s most famous psychologists, he was unceremoniously booted
out of Johns Hopkins University for having an affair with his graduate student,
Rosalie Rayner. Watson also had rather unusual ideas about parenting; for example,
he believed that all parents should shake hands with their children before bedtime.
B. F. Skinner, the founder of radical behaviorism, was something of a prankster in
his undergraduate years at Hamilton College in New York. He and a friend once
spread a false rumor that comedian Charlie Chaplin was coming to campus. This
rumor nearly provoked a riot when Chaplin didn’t materialize as expected.

Now go back and try again to answer the four questions at the beginning of
this chapter.

If you got more questions right the second time than the first—and odds are
you did—then you’ve experienced something we all take for granted:
learning. (The answers, by the way, are b, c, c, and a.) By learning, we mean
a change in an organism’s behavior or thought as a result of experience. As we
discovered in Chapter 3, when we learn our brains change along with our be-
behaviors. Remarkably, your brain is physically different now than it was just a few minutes ago, because it underwent chemical changes that allowed you to learn novel facts.

Learning lies at the heart of just about every domain of psychology. Virtually all behaviors are a complex stew of genetic predispositions and learning. Without learning, we’d be unable to do much; we couldn’t walk, talk, or read an introductory psychology textbook chapter about learning.

Psychologists have long debated how many distinct types of learning there are. We’re not going to try to settle this controversy here. Instead, we’ll review several types of learning that psychologists have studied in depth, starting with the most basic.

Before we do, place your brain on pause, put down your pen or highlighter, close your eyes, and attend to several things that you almost never notice: the soft buzzing of the lights in the room, the feel of your clothing against your skin, the sensation of your tongue on your teeth or lips. Unless someone draws our attention to these stimuli, we don’t even realize they’re there because we’ve learned to ignore them. Habituation is the process by which we respond less strongly over time to repeated stimuli. It helps explain why loud snorers can sleep peacefully through the night while keeping their irritated roommates wide awake. Chronic snorers have become so accustomed to the sound of their own snoring that they no longer notice it.

Habituation is the simplest form of learning. We can find it even in the lowly single-celled amoeba that we see under our microscope. Shine a light on an amoeba, and it will contract into a ball. But keep shining the light, and soon it will resume its normal activities, like busily swimming around on our microscope slide. Habituation is probably the earliest form of learning to emerge in humans. Unborn fetuses as young as 32 weeks display habituation when we apply a gentle vibrator to the mother’s stomach. At first, the fetus jerks around in response to the stimulus, but after repeated vibrations it stops moving (Morokuma et al., 2004). What was first a shock to the fetus’s system later became a mere annoyance that it could safely ignore.

Habituation makes good adaptive sense. We wouldn’t want to attend to every tiny sensation that comes across our mental radar screens because most pose no threat. Yet we wouldn’t want to habituate to stimuli that might be dangerous. Fortunately, not all repeated stimuli lead to habituation; only those that we deem safe or worth ignoring do. We typically don’t habituate to powerful stimuli, like extremely loud tones or painful electric shocks.

**Classical Conditioning**

The story of habituation could hardly be more straightforward. We experience a stimulus, respond to it, and then stop responding after repeated exposure. We’ve learned something significant, but we haven’t learned to forge connections between two stimuli. Yet a great deal of learning depends on associating one thing with another. If we never learned to connect one stimulus, like the appearance of an apple, with another stimulus, like its taste, our world would be what William James (1890) called a “blooming, buzzing confusion”—a world of disconnected sensory experiences.

**PAVLLOV’S DISCOVERIES**

The history of science teaches us that many discoveries arise from serendipity, or accident. Yet it takes a great scientist to capitalize on serendipitous observations that others regard as meaningless flukes. As French microbiologist Louis Pasteur, who discovered the process of pasteurizing milk, observed, “Chance favors the prepared mind.” So it was with the discoveries of Russian scientist Ivan Pavlov. His landmark understanding of classical
conditioning emerged from a set of unforeseen observations that were unrelated to his main research interests.

Pavlov’s primary research was digestion in dogs—in fact, his discoveries concerning digestion, not classical conditioning, earned him the Nobel Prize in 1904. Pavlov placed dogs in a harness and inserted a cannula, or collection tube, into their salivary glands to study their salivary responses to meat powder. In doing so, he observed something unexpected: He found that dogs began salivating not only to the meat powder itself but to previously neutral stimuli that had become associated with it, such as research assistants who brought the powder. Indeed, the dogs even salivated to the sound of these assistants’ footsteps as they approached the laboratory. The dogs seemed to be anticipating the meat powder and responding to stimuli that signaled its arrival.

We call this process of association classical conditioning (or Pavlovian or respondent conditioning): a form of learning in which animals come to respond to a previously neutral stimulus that had been paired with another stimulus that elicits an automatic response. Yet Pavlov’s initial observations were merely anecdotal, so like any good scientist he put his informal observations to a more rigorous test.

**THE CLASSICAL CONDITIONING PHENOMENON**

Here’s how Pavlov first demonstrated classical conditioning systematically (see Figure 5.1):

1. He started with an initially neutral stimulus, called the conditioned stimulus (CS). In this case, Pavlov used a metronome, a clicking pendulum that keeps time (in other studies, Pavlov used a tuning fork or whistle; contrary to popular belief, Pavlov didn’t use a bell). This stimulus doesn’t elicit much, if any, response from the dogs. Interestingly, the term conditioned stimulus is apparently a mistranslation from the original Russian. Pavlov actually referred to it as the conditional stimulus, because the animal’s response to it is conditional—that is, dependent—on learning.

2. He then paired the CS again and again with an unconditioned stimulus (UCS). (This term was unconditional stimulus in the original Russian, because the animal responds to it unconditionally, that is, all of the time or automatically.) In the case of Pavlov’s dogs, the UCS was the meat powder. The UCS elicits an automatic, reflexive response called the unconditioned response (UCR), in this case salivation. The key point is that the animal doesn’t need to learn to respond to the UCS with the UCR. It produces the UCR without any training at all, because the response is a product of biology, not experience.

3. Pavlov repeatedly paired the CS and UCS—and observed something remarkable. If he now presented the CS (the metronome) alone, it elicited a response, namely, salivation. This new response is the conditioned response (CR): a response previously associated with a nonneutral stimulus that comes to be elicited by a neutral stimulus. Lo and behold, learning has occurred. [LEARNING OBJECTIVE 5.1] The dog, which previously did nothing when it heard the metronome except perhaps turn its head toward it, now salivates when it hears the metronome. The CR, in contrast to the UCR, is a product of experience, not biology.

In most cases, the CR is similar to the UCR, but it’s rarely identical to it. For example, Pavlov found that dogs salivated less in response to the metronome (the CS) than to the meat powder (the UCS).

Few findings in psychology are as replicable as classical conditioning. We can apply the classical conditioning paradigm to just about any animal with an intact nervous system and demonstrate it repeatedly without fail. If only all psychological findings were so dependable!

**AVERSIVE CONDITIONING**

We can classically condition organisms not only to positive UCSs, like food, but to negative UCSs, like stimuli inducing pain or nausea. If you were allergic to daisies and sneezed...
uncontrollably whenever you were near them—whether you saw them or not—you’d probably develop an automatic avoidance response, like shying away from a bouquet even before you realized why you were doing it. This type of avoidance response reflects aversive conditioning: classical conditioning to an unpleasant UCS (Emmelkamp & Kamphuis, 2005). Stanley Kubrick’s 1971 film *A Clockwork Orange* provides an unforgettable example of aversive conditioning involving the main character, Alexander de Large, portrayed by actor Malcolm McDowell. De Large’s prison captors, who hoped to eradicate his bloodthirsty lust for violence, forced him to watch film clips of aggressive individuals, like the members of Hitler’s army marching in unison, while experiencing nausea induced by injections of a serum. The aversive conditioning worked—but only for a while.

**ADAPTIVE VALUE OF CLASSICAL CONDITIONING**

Without classical conditioning, we couldn’t develop physiological associations to stimuli that signal biologically important events, like things we want to eat—or that want to eat us. Many of the physiological responses we display in classical conditioning contribute to

**GLOSSARY**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>classical (Pavlovian or respondent) conditioning</td>
<td>form of learning in which animals come to respond to a previously neutral stimulus that had been paired with another stimulus that elicits an automatic response</td>
</tr>
<tr>
<td>conditioned stimulus (CS)</td>
<td>initially neutral stimulus</td>
</tr>
<tr>
<td>unconditioned stimulus (UCS)</td>
<td>stimulus that elicits an automatic response</td>
</tr>
<tr>
<td>unconditioned response (UCR)</td>
<td>automatic response to a nonneutral stimulus that does not need to be learned</td>
</tr>
<tr>
<td>conditioned response (CR)</td>
<td>response previously associated with a nonneutral stimulus that is elicited by a neutral stimulus through conditioning</td>
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</table>
our survival. Salivation, for instance, helps us to digest food. Moreover, without classical conditioning, we couldn’t learn many important associations that help us survive, such as the connection between a car horn and the risk of being hit by a large metal object.

**ACQUISITION, EXTINCTION, AND SPONTANEOUS RECOVERY**

Pavlov noted, and many others have confirmed, that classical conditioning occurs in three phases—acquisition, extinction, and spontaneous recovery.

**Acquisition.** In acquisition, we gradually learn—or acquire—the CR. If we look at Figure 5.2a, we’ll see that, as the CS and UCS are paired over and over again, the CR increases progressively in strength. The steepness of this curve varies somewhat depending on how close together in time the CS and UCS are presented. In general, the closer in time the pairing of CS and UCS, the faster learning occurs, with about a half-second delay typically being the optimal pairing for learning. [LEARNING OBJECTIVE 5.2] Longer delays usually decrease the speed and strength of the organism’s response.

**Extinction.** In a process called extinction, the CR decreases in magnitude and eventually disappears when the CS is repeatedly presented alone, that is, without the UCS (see Figure 5.2b). After numerous presentations of the metronome without meat powder, Pavlov’s dogs eventually stopped salivating. Most psychologists once believed that extinction was similar to forgetting: The CR fades away over repeated trials, just as many memories gradually decay (see Chapter 6). Yet the truth is more complicated and interesting than that. Extinction is an active, rather than passive, process. During extinction a new response, which in the case of Pavlov’s dogs was the absence of salivation, gradually “writes over” or inhibits the CR, namely, salivation. The extinguished CR doesn’t vanish completely; it’s merely overshadowed by the new behavior. This contrasts with most forms of traditional forgetting, in which the memory itself disappears. Interestingly, Pavlov had proposed this hypothesis in his writings, although few people believed him at the time. How do we know he was right? Read on.

**Spontaneous Recovery.** In a phenomenon called spontaneous recovery, a seemingly extinct CR reappears (often in somewhat weaker form) if the CS is presented again. It’s as though the CR were lurking in the background, waiting to appear following another presentation of the CS. In a classic study, Pavlov (1927) presented the CS (tone from a metronome) alone again and again and extinguished the CR (salivation) because there was no UCS (mouthwatering meat powder) following it. Two hours later, he presented the CS again, and the CR returned. The animal hadn’t really forgotten the CR, just suppressed it.

**WHAT DO you THINK?**

You are a veteran of the Vietnam War who suffered emotional trauma for several years following your combat experience. You are currently re-experiencing symptoms of trauma after viewing coverage of the current conflicts in Iraq and Afghanistan. How could spontaneous recovery help explain the return of your symptoms?
STIMULUS GENERALIZATION AND DISCRIMINATION

As much as classical conditioning helps us adapt to and learn new things, it would be virtually useless if we couldn’t apply it to new situations. As Greek philosopher Heraclitus observed, “We never step into the same river twice.” No two stimuli are identical; even our friends and family look a tiny bit different every time we see them. We need to learn to respond to stimuli that differ somewhat from those we originally encountered during conditioning. By the same token, we don’t want to go around shouting “Mom!” at every woman who has the same height and hair style as our mothers.

Stimulus Generalization. Pavlov found that, following classical conditioning, his dogs salivated not merely to the original metronome sound but to sounds similar to it. This phenomenon is stimulus generalization: the process by which CSs that are similar, but not identical, to the original CS elicit a CR. Stimulus generalization occurs along a generalization gradient: The more similar to the original CS the new CS is, the stronger the CR will be (see Figure 5.3). Pavlov found that his dogs showed their largest amount of salivation to the original sound, with progressively less salivation to sounds that were less and less similar to it in pitch. Stimulus generalization allows us to transfer what we’ve learned to new things.

Stimulus Discrimination. Stimulus discrimination is the flip side of the coin to stimulus generalization; it occurs when we exhibit a less pronounced CR to CSs that differ from the original CS. Stimulus discrimination helps us understand why we can enjoy scary movies. Although we may hyperventilate a bit while watching sharks circle the divers in the movie Open Water, we’d respond much more strongly if a shark chased us around in a tank at the aquarium. We’ve learned to discriminate between a motion picture stimulus and the real-world version of it and to modify our response as a result.

HIGHER-ORDER CONDITIONING

Taking conditioning a step further, organisms learn to develop conditioned associations to CSs that are associated with the original CS. If after we condition a dog to salivate to a tone we pair a picture of a circle with the tone, the dog eventually salivates to the circle as well as to the tone. This finding demonstrates higher-order conditioning: the process by which organisms develop classically conditioned responses to CSs associated with the original CS (Gewirtz & Davis, 2000). As we might expect, second-order conditioning—in which a new CS is paired with the original CS—tends to be weaker than garden-variety classical conditioning, and third-order conditioning—in which a third CS is paired with the second-order CS—is even weaker. Fourth-order conditioning and beyond is typically difficult or impossible.

Higher-order conditioning also helps to explain how some people develop addictions to cigarettes, heroin, and other drugs. Many addictions are shaped in part by higher-order conditioning, with the context in which people take the drugs serving as a higher-order CS. People who don’t generally smoke cigarettes may find themselves craving one at a party because they’ve smoked occasionally at previous parties with their friends who smoke. Behaviorists refer to these higher-order CSs as occasion setters, because they refer to the setting in which the CS occurs.

APPLICATIONS OF CLASSICAL CONDITIONING TO DAILY LIFE

Classical conditioning applies to myriad domains of everyday life. We’ll consider four here: advertising and the acquisition of fears, phobias, and fetishes.
Classical Conditioning and Advertising. Few people grasp the principles of classical conditioning, especially higher-order conditioning, better than advertisers. By repeatedly pairing the sights and sounds of products with photographs of handsome hunks and scantily clad beauties, marketing whizzes try to establish classically conditioned connections between their brands and positive emotions. [LEARNING OBJECTIVE 5.3] They do so for a good reason: It works.

One researcher (Gorn, 1982) paired slides of either blue or beige pens (the CSs) with music that participants had rated as either enjoyable or not enjoyable (the UCSs). Then he gave participants the opportunity to select a pen as they left the lab. Whereas 79 percent of participants who heard music they liked picked the pen that had been paired with music, only 30 percent of those who heard music they disliked picked the pen that had been paired with music.

Nevertheless, not all researchers who’ve paired products with pleasurable stimuli have succeeded in demonstrating classical conditioning effects (Smith, 2001). Two researchers (Gresham & Shimp, 1985) paired various products, like Coke, Colgate toothpaste, and Grape-Nuts cereal, with television commercials that previous subjects had rated as generating pleasant, unpleasant, or neutral emotions. They found little evidence that these pairings affected participants’ preferences for the ads. Nevertheless, their negative findings are open to a rival explanation: latent inhibition. Latent inhibition refers to the fact that when we’ve experienced a CS alone many times, it’s difficult to classically condition it to another stimulus (Vaitl & Lipp, 1997). Because the investigators relied on brands with which participants were already familiar, their negative findings may be attributable to latent inhibition. Indeed, when researchers have used novel brands, they’ve generally been able to show classical conditioning effects (Stuart, Shimp, & Engle, 1987).

The Acquisition of Fears: The Strange Tale of Little Albert. Can classical conditioning help explain how we come to fear or avoid stimuli? John B. Watson, the founder of behaviorism, answered this question in 1920 when he and his graduate student, Rosalie Rayner, performed what must be regarded as one of the most ethically questionable studies in the history of psychology. Here’s what they did.

Watson and Rayner (1920) set out in part to falsify the Freudian view (see Chapter 12) that phobias stem from deep-seated conflicts buried in the unconscious. They recruited a 9-month-old infant who’ll be forever known in the psychological literature as Little Albert. Little Albert was fond of furry little creatures, like white rats. But Watson and Rayner were about to change that.

Watson and Raynor first allowed Little Albert to play with a rat. But only seconds afterward, Watson snuck up behind Little Albert and struck a gong with a steel hammer, creating an earsplitting noise and startling him out of his wits. After seven such pairings of CS (rat) and UCS (loud sound from gong), Little Albert displayed a CR (fear) to the rat alone. This fear was still present when Watson and Rayner exposed Little Albert to the rat five days later. Little Albert also displayed stimulus generalization, coming to fear not merely rats, but also a rabbit, a dog, a furry coat, and, to a lesser extent, a Santa Claus mask and John B. Watson’s hair. Fortunately, Little Albert also demonstrated at least some stimulus discrimination, as he didn’t display much fear toward cotton balls or the hair of Dr. Watson’s research assistants.

Watson and Rayner’s demonstration is only a case study. As we saw in Chapter 2, case studies are limited in the conclusions they allow; for example, we can’t generalize from Little Albert’s case to the development of fears in other children. But the Little Albert case provides an existence proof (see Chapter 2) that classical conditioning can produce fears in humans. Although not everyone has successfully replicated Watson and Rayner’s
findings (Harris, 1979; Jones, 1930), Watson and Rayner were probably right that Little Albert’s fears arose in part from classical conditioning. Nevertheless, these replication failures may imply that there’s more to fear reactions than classical conditioning alone; we’ll come back to this point later in the chapter.

Incidentally, no one knows what became of poor Little Albert. His mother withdrew him from the study about a month after it began, never to be heard from again. Needless to say, because inducing prolonged fear responses in an infant raises a host of serious ethical questions, Watson and Rayner’s Little Albert study would never get past a modern-day college or university IRB (see Chapter 2).

Phobias. Do you suffer from paraskavedekatriaphobia? If so, don’t be concerned, because you aren’t the only person who’s afraid of Friday the 13th.

Higher-order conditioning allows our learning to be remarkably flexible. We can develop fears of many stimuli, although certain phobias, such as those of snakes, spiders, heights, water, and blood, are considerably more widespread than others (American Psychiatric Association, 2000). Other, more exotic phobias, like fear of being tickled by feathers (pterophonphobia), fear of clowns (coulrophobia), fear of flutes (aulophobia), and fear of bald people (peladophobia), are exceedingly rare.

The good news is that classical conditioning can contribute not only to the acquisition of phobias but also to their elimination. Mary Cover Jones, a student of Watson, treated a 3-year-old named Little Peter, who had a phobia of rabbits. Jones (1924) treated Peter’s fear successfully by gradually introducing him to a white rabbit while giving him a piece of his favorite candy. As she moved the rabbit increasingly closer to him, the sight of the rabbit eventually came to elicit a new CR: pleasure rather than fear. Modern-day psychotherapists, although rarely feeding their clients candy, use similar practices to eliminate phobias. They may pair feared stimuli with relaxation or other pleasurable stimuli (Wolpe, 1990; see Chapter 14).

Fetishes. There’s also good reason to believe that fetishism—sexual attraction to nonliving things—often arises in part from classical conditioning (Akins, 2004). Like phobias, fetishes come in a bewildering variety of forms: People can become attached to shoes, stockings, and just about anything else.

Although the origins of human fetishes are controversial, Michael Domjan and his colleagues were successful in classically conditioning fetishes in male Japanese quails. In one study, they presented male quails with a cylindrical object made of terrycloth, followed by a female quail with which they happily mated. After 30 such pairings, about half of the male quails attempted to mate with the cylindrical object when it appeared alone (Köksal et al., 2004). Although the generalizability of these findings to humans is unclear, there’s good evidence that at least some people develop fetishes by the repeated pairing of neutral objects with sexual activity (Rachman & Hodgson, 1968; Weinberg, Williams, & Calhan, 1995).

myth CONCEPTIONS

ARE WE WHAT WE EAT?

Many of us have heard that “we are what we eat,” but in the 1950s, psychologist James McConnell took this proverb quite literally. McConnell became convinced he’d discovered a means of chemically transferring learning from one animal to another. Indeed, for many years psychology textbooks informed undergraduates that scientists could chemically transfer learning across animals.

James McConnell and his colleagues paired a light with an electric shock, which caused the planaria worm to contract reflexively.
McConnell's animal of choice was the planaria, a flatworm a few inches long. Using classical conditioning, McConnell and his colleagues exposed planaria to a light, which served as the CS, while pairing it with a 1-second electric shock, which served as the UCS. When planaria receive an electric shock, they contract reflexively. After numerous pairings between light and shock, the light itself causes planaria to contract (Thompson & McConnell, 1955).

McConnell wanted to find out whether he could chemically transfer the memory of this classical conditioning experience to another planaria. His approach was brutally simple. Relying on the fact that many planaria are miniature cannibals, he chopped up the trained planaria and fed them to their fellow worms. Remarkably, McConnell (1962) reported that planaria who’d gobbled up classically conditioned planaria acquired classically conditioned reactions to the light more quickly than planaria who hadn’t.

Understandably, McConnell's memory transfer studies generated enormous excitement. Imagine if McConnell were right! You could sign up for your introductory psychology class, swallow a pill containing all of the psychological knowledge you’d need to get an A, and . . . voilà, you’re now an expert psychologist. Indeed, McConnell went directly to the general public with his findings, proclaiming in *Time*, *Newsweek*, and other popular magazines that scientists were on the verge of developing a “memory pill” (Rilling, 1996).

Yet it wasn’t long before the wind went out of McConnell’s scientific sails: Scientists couldn’t replicate his findings. Eventually, after years of intense debate and failed replications, the scientific community concluded that McConnell had fooled himself into seeing something that was never there. His planaria lab closed its doors in 1971.

Strange as it was, McConnell’s story had an even stranger twist. On November 15, 1985, he went to his mailbox to open an innocent-looking package. When he did, it exploded. Fortunately, McConnell wasn’t seriously injured, although he suffered permanent hearing loss. The package had been mailed by a man named Theodore Kaczynski, better known as the “Unabomber.” Kaczynski, a former mathematics professor later diagnosed with paranoid schizophrenia, had sent bombs to several individuals around the country who were ardent proponents of technological innovation. Apparently Kaczynski had read McConnell’s popular articles about the possibility of using memory pills and other revolutionary behavior change techniques for transforming society and identified him as a target (Rilling, 1996).

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**Quiz**

1. Habituation to meaningless stimuli is generally adaptive.  
   - [ ] TRUE  
   - [ ] FALSE  

2. In classical conditioning, the conditioned stimulus (CS) initially yields a reflexive, automatic response.  
   - [ ] TRUE  
   - [ ] FALSE

3. Conditioning is most effective when the CS precedes the UCS by a short period of time.  
   - [ ] TRUE  
   - [ ] FALSE

4. Extinction is produced by the gradual “decay” of the CR over time.  
   - [ ] TRUE  
   - [ ] FALSE

Answers: (1) T (p. 5-5); (2) F (p. 5-6); (3) T (p. 5-8); (4) F (p. 5-8)
Operant Conditioning

What do the following four examples have in common?

- Using bird feed as a reward, a behavioral psychologist teaches a pigeon to distinguish paintings by Monet from paintings by Picasso. By the end of the training, the pigeon is a veritable art expert.
- Using fish as a treat, a trainer teaches a dolphin to jump out of the water, spin three times, splash in the water, and propel itself through a hoop.
- In his initial attempt at playing tennis, a frustrated 12-year-old hits his opponent’s serve into the net the first 15 times. After two hours of practice, he returns his opponent’s serve successfully more than half the time.

The answer: All are examples of operant conditioning. The first, incidentally, comes from an actual study (Watanabe, Sakamoto, & Wakita, 1995). **Operant conditioning** is learning controlled by the consequences of the organism’s behavior. In each of these examples, superficially different as they are, the organism’s behavior is shaped by what comes after it, namely, reward. Psychologists also refer to operant conditioning as **instrumental conditioning**, because the organism’s response serves an instrumental function. That is, the organism “gets something” out of the response, like food, sex, attention, or avoiding something unpleasant. **[LEARNING OBJECTIVE 5.4]**

Behaviorists refer to the behaviors emitted by the animal to receive a reward as **operants**, because the animal “operates” on its environment to get what it wants. Dropping 75 cents into a soda machine is an operant, as is asking out an attractive classmate. In the first case, our reward is a refreshing drink and, in the second, a hot date—if we’re lucky.

**OPERANT CONDITIONING: WHAT IT IS AND HOW IT DIFFERS FROM CLASSICAL CONDITIONING**

Operant conditioning differs from classical conditioning in three important ways, which we’ve highlighted in Table 5.1. **[LEARNING OBJECTIVE 5.5]**

1. In classical conditioning, the organism’s response is **elicited**, that is, “pulled out” of the organism by the UCS and later the CS. Remember that in classical conditioning the UCR is an automatic response that doesn’t require training. In operant conditioning, the organism’s response is **emitted**, that is, generated by the organism in a seemingly voluntary fashion.

2. In classical conditioning, the animal’s reward is independent of what it does. Pavlov gave his dogs meat powder regardless of whether, or how much, they salivated. In operant conditioning, the animal’s reward is contingent—that is, dependent—on what it does. If the animal doesn’t emit a response in an operant conditioning paradigm, it comes out empty handed (or in the case of a dog, empty pawed).

3. In classical conditioning, the organism’s responses depend primarily on the autonomic nervous system (see Chapter 3). In operant conditioning, the organism’s responses depend primarily on the skeletal muscles. That is, in contrast to classical conditioning, in which learning involves changes in heart rate, breathing, perspiration, and other bodily systems, in operant conditioning learning involves changes in voluntary motor behavior.

**Table 5.1** Key Differences between Operant and Classical Conditioning.

<table>
<thead>
<tr>
<th></th>
<th>Classical Conditioning</th>
<th>Operant Conditioning</th>
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<tbody>
<tr>
<td>Target behavior</td>
<td>Elicited automatically</td>
<td>Emitted voluntarily</td>
</tr>
<tr>
<td>Reward</td>
<td>Provided unconditionally</td>
<td>Contingent on behavior</td>
</tr>
<tr>
<td>Behavior</td>
<td>Autonomic nervous system</td>
<td>Skeletal muscles</td>
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**GLOSSARY**

**operant conditioning**

learning controlled by the consequences of the organism’s behavior
**THE LAW OF EFFECT**

Generations of introductory psychology students have learned to reframe the famous **law of effect**, put forth by psychologist E. L. Thorndike. The law of effect is the first and most important commandment of operant conditioning: *If a response, in the presence of a stimulus, is followed by a satisfying state of affairs, the bond between stimulus and response will be strengthened.*

This statement means simply that if something we do in response to a stimulus is followed by a reward, we’re more likely to repeat the behavior in response to that stimulus in the future. Psychologists sometimes refer to early forms of behaviorism as **S-R psychology** (S stands for *stimulus*, R for *response*). According to S-R theorists, most of our complex behaviors reflect the accumulation of associations between stimuli and responses: the sight of a close friend and the behavior of saying hello or the smell of a delicious hamburger and reaching for it on our plate. S-R theorists maintain that almost everything we do voluntarily—driving a car, eating a sandwich, or planting a kiss on someone’s lips—results from the gradual buildup of S-R bonds due to the law of effect. Thorndike (1898) discovered the law of effect in a classic study of cats and puzzle boxes. Here’s what he did.

Thorndike placed a hungry cat in a box and put a tantalizing piece of fish just outside. To escape from the box, the cat needed to hit upon (literally) the right solution, which was pressing on a lever or pulling on a string inside the box (see **Figure 5.4**). When Thorndike first placed the cat in the puzzle box, it typically flailed around aimlessly in a frantic effort to escape. Then, by sheer accident, the cat eventually found the correct solution, scurried out of the box, and gobbled up its delectable treat. Thorndike wanted to find out what would happen to the cat’s behavior over time. Once it figured out the solution to the puzzle, would it then get it right every time?

Thorndike found that the cat’s time to escape from the puzzle box decreased **gradually** over 60 trials. There was no point at which the cat abruptly realized what it needed to do to escape. According to Thorndike, his cats were learning by trial and error through the steady buildup of associations. Indeed, Thorndike and many other S-R theorists went so far as to conclude that all learning, including all human learning, occurs by trial and error.

These findings, Thorndike concluded, provide a crushing blow to the hypothesis that cats learn by **insight**, that is, by grasping the nature of the problem. Had his cats possessed insight into the nature of the problem, the results presumably would have looked like what we see in **Figure 5.5**. This figure illustrates what psychologists term the **aha reaction**: “Aha—I got it!” Once the animal solves the problem, it gets it correct just about every time after that. Yet Thorndike never found an Aha! moment: The time to a correct solution decreased only gradually.

There’s good evidence that humans solve many problems through insight (Dawes, 1994). Many researchers didn’t initially recognize this phenomenon, because they were fooled by their own graphs. If we look at **Figure 5.6**, we’ll see the results of a typical investigation of problem solving. On each trial, participants receive feedback from the experimenter about whether they’re right or wrong. The dotted line in Figure 5.6 shows the results averaged across many participants. This line seems to provide evidence of gradual, trial-and-error learning, doesn’t it?

But appearances can be deceiving. If we look at the pattern of learning **within each subject** in Figure 5.6, we can see that individuals are actually learning by insight. Each subject figures out the answer suddenly and then almost always gets it right after that, but different people are achieving this insight at different times. By lumping together the results across all subjects, the dotted line in the graph misleadingly suggests a gradual rather than sudden decline (Restle, 1962; Trabasso & Bower, 1963). So people often do learn through insight; they just do so at different rates.
B. F. SKINNER AND REINFORCEMENT

Thorndike’s pioneering discoveries laid the groundwork for research on operant conditioning. B. F. Skinner then kicked it up a notch using electronic technology.

Skinner found Thorndike’s experimental setup unwieldy because the researcher had to stick around to place the unhappy cat back into the puzzle box following each trial. This limitation made it difficult to study the buildup of associations in ongoing operant behavior over hours, days, or weeks. So he developed what came to be known as a **Skinner box** (more formally, an operant chamber), which electronically records an animal’s responses and prints out a *cumulative record*, or graph, of the animal’s activity. A Skinner box typically contains a bar that delivers food when pressed, a food dispenser, and often a light that signals when reward is forthcoming (see Figure 5.7). With this setup, Skinner studied the operant behavior of rats, pigeons, and other animals and mapped out their responses to reward. By allowing a device to record behavior without any direct human observation, Skinner ran the risk of missing some important behaviors that the box wasn’t designed to record. Nonetheless, his discoveries forever altered the landscape of psychology.

TERMINOLOGY OF OPERANT CONDITIONING

To understand Skinner’s research, you need to learn a bit of psychological jargon. There are three key concepts in Skinnerian psychology: reinforcement, punishment, and discriminant stimulus.

![Skinner Box and Electronic Device](image)
Reinforcement. Up to this point, we’ve used the term reward to refer to any pleasant consequence that makes a behavior more likely to occur. But Skinner found this term imprecise. He preferred the term reinforcement, meaning any outcome that strengthens the probability of a response (Skinner, 1953, 1971).

Skinner distinguished positive reinforcement, when we administer a stimulus, from negative reinforcement, when we take away a stimulus. Positive reinforcement could be giving a child a Hershey’s Kiss when he picks up his toys; negative reinforcement could be ending a child’s time-out for bad behavior once she’s stopped whining. [LEARNING OBJECTIVE 5.6] In both cases, the outcome for the organism is satisfying.

Hundreds of psychology students over the years have demonstrated the power of reinforcement using an unconventional participant: their professor. In the game Condition Your Professor (Vyse, 1997), a class of introductory psychology students agrees to provide positive reinforcement—such as smiling or nodding their heads—to their professor whenever he or she moves in a particular direction, such as to the far left side of the room. Your authors know of one famous introductory psychology teacher who spent almost all of his time lecturing from behind his podium. During one class, his students smiled profusely and nodded their heads whenever he ventured out from behind the podium. Sure enough, by the end of class the professor was spending most of his time away from the podium. You and your classmates might want to attempt a similar stunt with your introductory psychology professor; just don’t mention we suggested it.

Punishment. We shouldn’t confuse negative reinforcement with punishment, which is any outcome that weakens the probability of a response. Punishment typically involves administering an unpleasant stimulus, such as a physical shock or a spanking, or an unpleasant social outcome, like laughing at someone. It can also involve the removal of a positive stimulus, such as a favorite toy or article of clothing.

We also shouldn’t confuse punishment with the disciplinary practices often associated with it. Skinner, who insisted on precision in language, argued that certain actions that might superficially appear to be punishments are actually reinforcements. He defined reinforcements and punishments solely in terms of their consequences. Consider this scenario: A mother rushes into her 3-year-old son’s bedroom and yells “Stop that!” each time she hears him kicking the wall. Is she punishing the child’s demanding behavior? There’s no way to tell without knowing the consequences. If the bad behavior increases following the scolding, then perhaps the child is kicking the wall to get attention. If so, the mother is reinforcing, rather than punishing, his angry demands. Reinforcement strengthens the probability of a response. In contrast, punishment weakens it (see Table 5.2). [LEARNING OBJECTIVE 5.7]

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Table 5.2 Distinguishing Reinforcement from Punishment.

<table>
<thead>
<tr>
<th></th>
<th>Procedure</th>
<th>Effect on Behavior</th>
<th>Typical Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Reinforcement</td>
<td>Presenting a desirable stimulus</td>
<td>Increases target behavior</td>
<td>Gold star on homework</td>
</tr>
<tr>
<td>Negative Reinforcement</td>
<td>Removing an undesirable stimulus</td>
<td>Increases target behavior</td>
<td>Static on phone that subsides when you move to a different spot in your room</td>
</tr>
<tr>
<td>Punishment</td>
<td>Presenting an undesirable stimulus or removing a desirable one</td>
<td>Decreases target behavior</td>
<td>Scolding by parents or confiscating a favorite toy</td>
</tr>
</tbody>
</table>

Try labeling each of the following examples as an instance of either negative reinforcement or punishment and explain why (you can find the answers written upside-down in the margin at the bottom of the next page):
(1) A boy keeps making noise in the back of a classroom despite a teacher’s repeated warnings. The teacher finally sends him to the principal’s office. When he returns two hours later, he’s much quieter.

(2) A woman with adult onset diabetes works hard to control her blood sugar through diet and exercise. As a result, her doctor allows her to discontinue administering her unpleasant daily insulin shots, which increases her attempts to eat healthily and exercise.

Does punishment work in the long run? Popular wisdom tells us that it usually does. Yet Skinner (1953) and most of his followers argued against the routine use of punishment to change behavior. They believed that reinforcement alone could shape most human behaviors for the better.

According to Skinner and others (Azrin & Holz, 1966), punishment has several disadvantages:

(1) Punishment tells the organism only what not to do, not what to do. A child who’s punished for throwing a tantrum won’t learn how to deal with frustration more constructively.

(2) Punishment often creates anxiety, which in turn interferes with future learning.

(3) Punishment may encourage subversive behavior, prompting people to become sneakier about finding ways to display forbidden behavior.

(4) Punishment from parents may provide a model for children’s aggressive behavior (Straus, Sugarman, & Giles-Sims, 1997). A child whose parents slap him when he misbehaves may "get the message" that slapping is acceptable.

Numerous researchers have reported that the use of physical punishment by parents is positively correlated with aggressive behavior in children (Fang & Corso, 2007; Gershoff, 2002). Across many studies, Murray Strauss and his colleagues (1998) found that physical punishment is associated with more behavioral problems in children.

Yet we must remember that these studies are correlational and don’t demonstrate causality. Other interpretations are possible. For example, because children share half of their genes with each parent, and because aggression is partly heritable (Krueger, Hicks, & McGue, 2001), the correlation between parents’ physical punishment and their children’s aggression may be due to the fact that parents who respond to adverse situations physically pass on this genetic predisposition to their children (DiLalla & Gottesman, 1991). It’s also conceivable that the causal arrow is reversed: Children who are aggressive may be difficult to control and therefore elicit physical responses from their parents.

The association between physical punishment and childhood behavior problems may depend on race and culture. Spanking and other forms of physical discipline result in more childhood behavior problems in Caucasian families but fewer in African American families (Lansford et al., 2004). Moreover, spanking tends to be more predictive of higher levels of childhood aggression and anxiety in countries in which spanking is rare, like China or Thailand, than in countries in which it’s common, like Kenya or India (Lansford et al., 2005). The reasons for this difference aren’t clear, although children who are spanked in countries in which spanking is more culturally accepted may feel less stigmatized than children in countries in which it’s culturally condemned.

Still, that’s not to say that we should never use punishment, only that we should use it sparingly. Most research suggests that punishment works best when it’s delivered consistently and follows the undesired behavior promptly (Brennan & Mednick, 1994). In particular, immediate punishment sometimes tends to be effective, whereas delayed punishment is often useless (Church, 1969; McCord, 2006; Moffitt, 1983). Punishment of an undesired behavior also works best when we simultaneously reinforce a desired behavior (Azrin & Holz, 1966).
Discriminant Stimulus. The final critical term in operant conditioning lingo is **discriminant stimulus**, typically abbreviated simply as $S_d$. A discriminant stimulus is any stimulus that signals the presence of reinforcement. When we snap our fingers at a dog in the hopes of having it come over to us, the dog may approach us to get a much-appreciated petting. For the dog, our finger snapping is an $S_d$: It’s a signal that if it comes near us, it will receive reinforcement. According to behaviorists, we’re responding to $S_d$s virtually all the time, even if we’re not consciously aware of it. When a friend waves at us and we walk over to her to say hi in return, we’re responding to an $S_d$.

**Same Song, Second Verse.** *Acquisition, extinction, spontaneous recovery, stimulus generalization,* and *stimulus discrimination* are all terms that we introduced in our discussion of classical conditioning. These terms apply just as much to operant conditioning as well. We can find the definitions in **Table 5.3**. Below, we’ll examine how three of these concepts apply to operant conditioning.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acquisition</td>
<td>Learning phase during which a response is established</td>
</tr>
<tr>
<td>Extinction</td>
<td>Gradual reduction and eventual elimination of the response after a stimulus is presented repeatedly</td>
</tr>
<tr>
<td>Spontaneous Recovery</td>
<td>Sudden reemergence of an extinguished response after a delay</td>
</tr>
<tr>
<td>Stimulus Generalization</td>
<td>Eliciting a response to stimuli similar to but not identical to the original stimulus</td>
</tr>
<tr>
<td>Stimulus Discrimination</td>
<td>Displaying a less pronounced response to stimuli that differs from the original stimulus</td>
</tr>
</tbody>
</table>

**Extinction.** In operant conditioning, extinction occurs when we stop delivering reinforcement to a previously reinforced behavior. Gradually, this behavior declines in frequency and disappears. If parents give a screaming child a toy to quiet her, they may be inadvertently reinforcing her behavior, because she’s learning to scream to get something. If parents buy earplugs and stop placating the child by giving toys, the screaming behavior gradually extinguishes. In such cases we often see an **extinction burst**. That is, shortly after withdrawing reinforcement the undesired behavior initially increases in intensity, probably because the child is trying harder to get reinforcement. So there’s some truth to the old saying that things sometimes need to get worse before they get better.

**Stimulus Discrimination.** As we mentioned earlier, one group of investigators used food reinforcement to train pigeons to distinguish paintings by Monet from those of Picasso (Watanabe et al., 1995). That’s stimulus discrimination because the pigeons are learning to tell the difference between two different types of stimuli.

**Stimulus Generalization.** Interestingly, these investigators also found that their pigeons displayed stimulus generalization. Following operant conditioning, they distinguished paintings by impressionist artists whose styles were similar to Monet’s, such as Renoir, from paintings by cubist artists similar to Picasso, such as Braque.

**PRINCIPLES OF REINFORCEMENT**

Before we tackle a new principle of behavior, try answering this question: If we want to train a dog to perform a trick, like catching a Frisbee, should we reinforce it for (a) each successful catch or (b) only some of its successful catches? If you’re like most people,
you'd answer (a), which seems to match our commonsense notions regarding the effects of reinforcement. It seems logical to assume that the more consistent the reinforcement, the more consistent will be the resulting behavior. But, in fact, our intuitions about reinforcement are backward.

**Partial Reinforcement.** According to Skinner’s principle of partial reinforcement, sometimes called Humphrey's paradox after psychologist Lloyd Humphreys (1939) who first described it, behaviors we reinforce only occasionally are slower to extinguish than those we reinforce every time. [LEARNING OBJECTIVE 5.7] Although this point may seem counter-intuitive, consider that an animal that expects to be rewarded every time it performs the target behavior may become reluctant to continue performing the behavior if the reinforcement becomes undependable. However, if an animal has learned that the behavior will be rewarded only occasionally, it’s more likely to continue the behavior in the hopes of getting reinforcement.

So if we want an animal to maintain a trick for a long time, we should actually reinforce it for correct responses only occasionally. Skinner (1969) noted that continuous reinforcement allows animals to learn new behaviors more quickly, but that partial reinforcement leads to a greater resistance to extinction. This principle may help to explain why some people remain trapped for years in terribly dysfunctional, even abusive, relationships. Some relationship partners provide intermittent reinforcement to their significant others, treating them miserably most of the time but treating them well on rare occasions. This pattern of partial reinforcement may keep individuals “hooked” in relationships that aren’t working.

**Schedules of Reinforcement.** Skinner (1938) found that animals’ behaviors differ depending on the schedule of reinforcement, that is, the pattern of delivering reinforcement. Remarkably, the effects of these reinforcement schedules are consistent across species as diverse as cockroaches, pigeons, rats, and humans. Although there are numerous schedules of reinforcement, we’ll discuss the four major ones here. [LEARNING OBJECTIVE 5.8] The principal reinforcement schedules vary along two dimensions:

1. The consistency of administering reinforcement. Some reinforcement contingencies are fixed, whereas others are variable. That is, in some cases experimenters provide reinforcement on a regular (fixed) basis, whereas in others they provide reinforcement on an irregular (variable) basis.

2. The basis of administering reinforcement. Some reinforcement schedules operate on ratio schedules, whereas others operate on interval schedules. In ratio schedules, the experimenter reinforces the animal based on the number of responses it's emitted. In interval schedules, the experimenter reinforces the animal based on the amount of time elapsed since the last reinforcement.

We can combine these two dimensions to arrive at four schedules of reinforcement (see Figure 5.8):

![Figure 5.8 Four Major Reinforcement Schedules.](image)

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**GLOSSARY**

- **Partial reinforcement**: only occasional reinforcement of a behavior, resulting in slower extinction than if the behavior had been reinforced continually.
- **Schedule of reinforcement**: pattern of reinforcing a behavior.
(1) In a **fixed ratio (FR)** schedule, we provide reinforcement after a regular number of responses. For example, we could give a rat a pellet after every 15 times it presses the lever in a Skinner box.

(2) In a **fixed interval (FI)** schedule, we provide reinforcement for producing the response at least once during a specified period of time. For example, a worker in a toy factory might get paid at the same time every Friday afternoon for the work she’s done, as long as she’s generated at least one toy during that one-week interval.

(3) In a **variable ratio (VR)** schedule, we provide reinforcement after a specific number of responses on average, but the precise number of responses required during any given period varies randomly. Playing the slot machines and other forms of gambling are examples of variable ratio schedules.

(4) In a **variable interval (VI)** schedule, we provide reinforcement for producing the response at least once during an average time interval, with the interval varying randomly. For example, we could give a dog a treat for performing a trick on a variable interval schedule with an average interval of 8 minutes. This dog may have to perform the trick at least once during a 7-minute interval the first time, but then during only a 1-minute interval the second time, then a longer 20-minute interval, and then a 4-minute interval, with the average of these intervals being 8 minutes.

Skinner discovered that different reinforcement schedules yield distinctive patterns of responding (see Figure 5.9). Ratio schedules tend to yield higher rates of responding than do interval schedules. This finding makes intuitive sense. If a dog gets a treat every five times he rolls over, he’s going to roll over more often than if he gets a treat every 5 minutes, regardless of whether he rolls over once or twenty times during that interval. In addition, variable schedules tend to yield more consistent rates of responding than do fixed schedules. This finding also makes intuitive sense. If we never know when our next treat is coming, it’s in our best interests to keep emitting the response to ensure we’ve emitted it enough times to earn the reward.

**Figure 5.9** Typical Response Patterns for the Four Reinforcement Schedules. Note the “scalloped” pattern in (b), the fixed interval response pattern. The subject decreases the reinforced behavior immediately after receiving reinforcement, then increases the behavior in anticipation of reinforcement as the time for reinforcement approaches.

Two other features of reinforcement schedules are worth noting. First, fixed interval schedules are associated with a “scalloped” pattern of responding. This FI **scallop** reflects the fact that the animal “waits” for a time after it receives reinforcement and then increases its rate of responding just before the interval is up as it begins to anticipate reinforcement.

Second, variable ratio (VR) schedules usually yield the highest rates of responding of all. It’s for this reason that there’s one place where we can be guaranteed to find a VR schedule: a casino. Roulette wheels, slot machines, and the like deliver cash rewards on an irregular basis, and they do so based on the gambler’s responses. Sometimes the gambler has to pull the arm of the slot machine (the “one-armed bandit”) hundreds of times before a win, but the prospect of winning is enough to keep the gamblers coming back for more.

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**GLOSSARY**

- **fixed ratio (FR) schedule**: pattern in which we provide reinforcement following a regular number of responses
- **fixed interval (FI) schedule**: pattern in which we provide reinforcement for producing the response at least once following a specified time interval
- **variable ratio (VR) schedule**: pattern in which we provide reinforcement after a specific number of responses on average, with the number varying randomly
- **variable interval (VI) schedule**: pattern in which we provide reinforcement for producing the response at least once during an average time interval, with the interval varying randomly
- **shaping by successive approximations**: conditioning a target behavior by progressively reinforcing behaviors that come closer and closer to the target
- **Premack principle**: principle that a less frequently performed behavior can be increased in frequency by reinforcing it with a more frequent behavior

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**Fact-OID**

The gambler’s fallacy describes the error of believing that random events have “memories.” After losing ten roulette spins in a row, the gambler often concludes that he’s now “due” to win. Yet his odds of winning on the eleventh spin are no higher than they were on his first ten spins.
times before receiving any money at all. At other times, the gambler pulls the arm only once and makes out like a bandit himself, perhaps walking away with thousands of dollars for a few seconds of work. The extreme unpredictability of the VR schedule is precisely what keeps gamblers addicted, because reinforcement can come at any time.

**APPLICATIONS OF OPERANT CONDITIONING**

If you’ve ever seen animals perform at a circus, zoo, or aquarium, you might wonder how on Earth the animals learned such elaborate routines. They typically do so by means of a procedure called **shaping by successive approximations**, or shaping for short. Using shaping, we reinforce behaviors that aren’t exactly the target behavior but that are progressively closer versions of it. Typically, we shape an organism’s response by initially reinforcing most or all responses that are close to the desired behavior, and then gradually **fading** (that is, decreasing the frequency of) our reinforcement for the not-exactly-right behaviors over time.

Animal trainers often combine shaping with a technique called **chaining**, in which they link a number of interrelated behaviors to form a longer series. Each behavior in the chain becomes a cue for the next behavior in the chain. By means of shaping and chaining, Skinner taught pigeons to play Ping-Pong, although they weren’t exactly Olympic-caliber table tennis players. During World War II, he also taught pigeons to guide missiles from airplanes to enemy targets by pecking at an image on a screen whenever the missile got closer to the target, although the U.S. military never adopted his creative approach to aerial warfare. In both cases, Skinner began by reinforcing initial approximations to the desired response. When teaching pigeons to play Ping-Pong, he first reinforced them for turning toward the paddles, then approaching the paddles, then placing the paddles in their beaks, then picking up the paddles with their beaks, and so on. Then, he chained later behaviors, like swinging the paddle and then hitting the ball, to the earlier behaviors. As we might imagine, shaping and chaining complex animal behaviors requires patience, as the process can take days or weeks. Still, the payoff can be substantial, because we can train animals to engage in numerous behaviors that lie well outside their normal repertoires. Indeed, all contemporary animal trainers rely on Skinnerian principles.

We can apply operant conditioning to myriad domains of modern human experience as well.

**WHAT DO you THINK?**

You are a new Sea World intern, assisting trainers to teach their youngest dolphin to jump from the water and hit a ball with her fin. What principles of operating conditioning would be useful in accomplishing this learning goal?

**Premack Principle.** Be honest: Did you put off reading this chapter until the last moment? If so, don’t feel ashamed, because procrastination is one of the most frequent study problems that college students report. Unfortunately, procrastinators tend to perform more poorly in their classes than do early birds (Tice & Baumeister, 1997). Although these findings are correlational and don’t establish that procrastination causes bad grades, they certainly suggest that putting things off isn’t ideal.

How can we overcome procrastination? Although there are several potential solutions for procrastination, among the best is probably the one discovered by David Premack (1965) in his research on monkeys. The **Premack principle** states that we can positively
reinforce a less frequently performed behavior with a more frequently performed behavior (Danaher, 1974). Although not a foolproof rule (Knapp, 1976), this guideline typically works surprisingly well. The Premack principle is also called “grandma’s rule,” because our grandmother reminded us to finish our vegetables before moving on to dessert. So, if you find yourself putting off a reading or writing task, think of behaviors you’d typically perform if given the chance—perhaps hanging out with a few close friends, watching a favorite TV program, or treating yourself to an ice cream cone. Then, reinforce yourself with these higher frequency behaviors only after you’ve completed your homework.

Superstitious Behavior. How many of the following behaviors do you perform?

- Never opening an umbrella indoors
- Not walking under a ladder
- Carrying a lucky charm or necklace
- Knocking on wood
- Crossing your fingers
- Avoiding the number 13 (as in not stopping on the thirteenth floor of a building)

If you’ve engaged in several of these actions, you’re at least somewhat superstitious. So are many Americans. For example, 12 percent of Americans are afraid of walking under a ladder (Vyse, 1997). So many people are afraid of the number 13 (triskaidekaphobia) that the floor designations in many tall buildings skip directly from 12 to 14 (Hock, 2002). This phobia isn’t limited to North America; in Paris, triskaidekaphobics who are going out to dinner with 12 other people can hire a quatorzième, a person paid to serve as a fourteenth guest.

How do superstitions relate to operant conditioning? In a classic study, Skinner (1948) placed eight food-deprived pigeons in a Skinner box while delivering reinforcement (bird feed) every 15 seconds independent of their behavior. That is, the birds received reinforcement regardless of what they did. After a few days, Skinner found that six of the eight pigeons had acquired remarkably strange behaviors. In the words of Skinner:

One bird was conditioned to turn counterclockwise about the cage, making two or three turns between reinforcements. Another repeatedly thrust its head into one of the upper corners of the cage. A third developed a tossing response as if placing its head beneath an invisible bar and lifting it repeatedly. (p. 168)

You may have observed similarly odd behaviors in large groups of birds that people are feeding in city parks; for example, some pigeons may prance around or walk rapidly in circles in anticipation of reinforcement.

According to Skinner, his pigeons had developed superstitious behavior: Actions linked to reinforcement by sheer coincidence (Morse & Skinner, 1957). There’s no actual association between superstitious behavior and reinforcement, although the animal acts as though there is. The behavior that the pigeon just happened to be performing immediately prior to reinforcement was strengthened—remember that reinforcement increases the probability of a response—so the pigeon kept on doing it (this kind of accidental operant conditioning is sometimes called superstitious conditioning). Not all studies have been able to replicate these findings in pigeons.
Operant Conditioning 

5-23

(Staddon & Simmelhag, 1971), although it’s likely that at least some animal superstitions develop in the fashion Skinner described.

One study has shown similar effects in children (Wagner & Morris, 1987). This study found that about three-fourths of the children involved in the study developed superstitious behaviors following periodic reinforcement.

Few people are more prone to superstitions than athletes. That’s probably because the outcome of so many sporting events, even those requiring a great deal of skill, depends heavily on chance. Baseball Hall of Famer Wade Boggs became famous for eating chicken before each game. Hall of Fame football player Jim Kelly forced himself to vomit before every game, and basketball player Chuck Person ate exactly two candy bars (always Snickers or Kit Kats) before every game (Vyse, 1997). Superstar golfer Tiger Woods always wears a red shirt when playing on Sundays.

Token Economies. One of the most successful applications of operant conditioning has been the token economy. Token economies are systems, often set up in psychiatric hospitals, for reinforcing appropriate behaviors and extinguishing inappropriate ones (Carr, Fraizier, & Roland, 2005; Kazdin, 1982). In token economies, staff members reinforce patients who behave in a desired fashion using tokens, chips, points, or other secondary reinforcers. Secondary reinforcers are neutral objects that patients can trade in for primary reinforcers—things that are naturally pleasurable, like a favorite food or drink. Typically, psychologists who construct token economies begin by identifying target behaviors, that is, actions they hope to make more frequent, such as talking quietly or being polite. Research suggests that token economies are often effective in improving behavior in hospitals, group homes, and juvenile detention units (Ayllon & Milan, 2002; Paul & Lentz, 1977).

Two-Process Theory: Putting Classical and Operant Conditioning Together

Up to this point, we’ve discussed classical and operant conditioning as though they were two entirely independent processes. Brain imaging studies provide some support for this distinction, showing that these two forms of learning are associated with activations in different brain regions. Classically conditioned fear reactions are based largely in the amygdala (LeDoux, 1996; Veit et al., 2002), whereas operantly conditioned responses are based largely in parts of the limbic system linked to reward (Robbins & Everitt, 1998; see Chapter 3).

However these two types of conditioning often interact. To see how, let’s revisit the question of how people develop phobias. We’ve seen that certain phobias arise in part by classical conditioning: A previously neutral stimulus (the CS)—say, a dog—is paired with an unpleasant stimulus (the UCS)—a dog bite—resulting in the CR of fear. So far, so good.

But why doesn’t the CR of fear eventually extinguish? Given what we’ve learned about classical conditioning, we might expect the CR of fear to fade away over time with repeated exposure to the CS of dogs. Yet this often doesn’t happen (Rachman, 1977).

We probably need both classical and operant conditioning to explain the persistence of such phobias (Mowrer, 1947). Here’s how: People acquire phobias by means of classical conditioning. Then, once they’re phobic, they start to avoid their feared stimulus whenever they see it. If they have a dog phobia, they may cross the street whenever they see someone walking toward them with a large German shepherd. When they do, they experience a reduction in anxiety—a surge of relief. They are negatively reinforcing their own fear by removing the fear-inducing stimulus.

Glossary

secondary reinforcer
neutral object that can be traded in for reinforcement itself

primary reinforcer
item or outcome that is naturally pleasurable
Cognitive Models of Learning

Thus far, we’ve omitted one word when discussing how we learn: thinking. That’s not accidental, because early behaviorists didn’t believe that thought played much of a causal role in learning.

**WATSON, SKINNER, AND THINKING**

Watson and Skinner held different views on thinking. Watson (1913) argued that psychology should focus exclusively on overt (that is, observable) behaviors. From Watson’s perspective, thinking and emotion lay outside the domain of scientific psychology.

In contrast, Skinner (1953) firmly believed that observable behavior, thinking, and emotion are all governed by the same laws of learning, namely, classical and operant conditioning. In other words, thinking and emotion are behaviors, they’re just covert—that is, unobservable—behaviors.

One frequent misconception about Skinner is that he didn’t believe in thinking. On the contrary, Skinner clearly thought—he wouldn’t have objected to our use of that word here—that humans and other intelligent animals think, but he insisted that thinking is no different in principle from any other behavior. For Skinner, this view is far more parsimonious than invoking different laws of learning for thinking than for other behaviors.

**S-O-R PSYCHOLOGY: THROWING THINKING BACK INTO THE MIX**

Over the past 30 or 40 years, psychology has moved increasingly away from a simple S-R (stimulus-response) psychology to a more complex S-O-R psychology, with O being the organism that interprets the stimulus before producing a response (Mischel, 1973; Wood-
worth, 1929). For S-O-R psychologists, the link between S and R isn’t mindless or automatic. Instead, the organism’s response to a stimulus depends on what this stimulus means to it. The S-O-R principle helps to explain a phenomenon we’ve probably all encountered. You’ve probably had the experience of giving two friends the same mild criticism (like, “It bothers me a little when you show up late”) and found that they reacted quite differently: One was apologetic, the other defensive.

To explain these differing reactions, Skinner would probably invoke your friends’ differing learning histories, in essence how each friend had been trained to react to criticism. In contrast, S-O-R theorists, who believe that cognition is central to explaining learning, would contend that the differences in your friends’ reactions stem from how they interpreted your criticism. Your first friend may have viewed your criticism as constructive feedback, your second friend as a personal attack.

Although S-O-R theorists attempted to integrate classical and operant conditioning with a more thought-based account, the Gestalt psychologists, about whom we learned in Chapter 4, had long argued for a critical role for the organism. As we’ll recall, Gestalt psychologists noted that what we perceive is different from and greater than the sum of the stimuli our sense organs receive. This fact implies that as organisms we’re performing mental operations, or transformations, on our experience of stimuli.

S-O-R theorists don’t deny that classical and operant conditioning occur, but they believe that these forms of learning usually depend on thinking. Take a person who’s been classically conditioned by tones and shock to sweat in response to the tones. Her skin conductance response will extinguish suddenly if she’s told that no more shocks are on the way (Grings, 1973). This phenomenon of cognitive conditioning, whereby our interpretation of the situation affects conditioning, suggests that conditioning is more than an automatic, mindless process (Brewer, 1974; Kirsch et al., 2004).

To explain psychology’s gradual transition away from behaviorism, we need to tell the story of a pioneering psychologist and his rats.

**LATENT LEARNING**

One of the first serious challenges to purely behaviorist accounts of learning was mounted by Edward Chace Tolman (1886–1959), whose contributions to the psychology of learning cannot be overestimated.

Tolman suspected that reinforcement wasn’t the be-all and end-all of learning. To understand why, answer this question: “Who was one of the first psychologists to challenge pure behaviorism?” If you’ve been paying attention, you answered “Tolman.” Yet immediately before we asked that question, you knew the answer, even though you had no opportunity to demonstrate it. According to Tolman (1932), you engaged in latent learning: learning that isn’t directly observable (Blodgett, 1929). We learn many things without showing them. Putting it a bit differently, there’s a crucial difference between competence—what we know—and performance—showing what we know (Bradbard et al., 1986).

Why is this distinction important? Because it implies that reinforcement isn’t necessary for learning. [LEARNING OBJECTIVE 5.9] Here’s how Tolman and C. H. Honzik (1930) demonstrated this point systematically.

They randomly assigned three groups of rats to go through a maze over a three-week period (see Figure 5.10). One group always received reinforcement in the form of cheese when it got to the end of the maze. A second group never received reinforcement when it got to the end of the maze. The first group made far fewer errors; that’s no great surprise.
The third group of rats received no reinforcement for the first 10 days and then started receiving reinforcement on the eleventh day.

As we can see in Figure 5.10, the rats in the third group showed a large and abrupt drop in their number of errors on receiving their very first reinforcement. In fact, within only a few days their number of errors didn’t differ significantly from the number of errors among the rats who were always reinforced.

According to Tolman, this finding means that the rats in the third group had been learning all along. They just hadn’t bothered to show it because they had nothing to gain. Once there was a payoff for learning, namely, a tasty morsel of cheese, they promptly became miniature maze masters.

According to Tolman (1948), the rats had developed **cognitive maps**—that is, spatial representations—of the maze. If you’re like most college students, you were hopelessly confused the first day you arrived on campus. Over time, however, you probably developed a mental sense of the layout of the campus, so that you now hardly ever become lost. That internal spatial blueprint, according to Tolman, is a cognitive map.

In a clever demonstration of cognitive maps, three investigators (McNamara, Long, & Wike, 1956) had one set of rats run repeatedly through a maze to receive reinforcement. They put another set of rats in little moving “trolley cars,” in which the rats could observe the layout of the maze but not obtain the experience of running through it. When the researchers gave the second group of rats the chance to run through the maze, they did just as well as the rats in the first group. As rodent tourists in trolley cars, they’d acquired cognitive maps of the maze.

The latent learning research of Tolman and others challenged strict behaviorist accounts of learning, because their work showed that learning could occur without reinforcement. To many psychologists, this research falsified the claim that reinforcement is necessary for all forms of learning. It also suggested that thinking, in the form of cognitive maps, plays a central role in at least some forms of learning.

**Observational Learning**

According to some psychologists, one important variant of latent learning is **observational learning**: learning by watching others (Bandura, 1965). In many cases, we learn by watching **models**: parents, teachers, and others who are influential to us. Many psychologists regard observational learning as a form of latent learning because it allows us to learn without reinforcement. [**LEARNING OBJECTIVE 5.10**] We can merely watch someone else being reinforced for doing something and take our cues from that person.

Observational learning spares us the expense of having to learn everything firsthand (Bandura, 1977). Most people have never been skydiving, but from our observations of people who’ve gone skydiving we have the distinct impression that it’s generally a good idea to have a parachute on before you jump out of a plane. Note that we didn’t need to learn this useful tidbit of advice by trial and error, or else we wouldn’t be here to talk about it. Observational learning can spare us from serious, even life-threatening, mistakes. But it can also contribute to our learning of maladaptive habits.

**Observational Learning of Aggression.** In classic research in the 1960s, Albert Bandura and his colleagues demonstrated that children can learn to act aggressively by watching aggressive role models (Bandura, Ross, & Ross, 1963).

Bandura and his colleagues asked preschool boys and girls to watch an adult (the model) interact with a large Bobo doll, a doll that bounces back to its original upright position after being hit (Bandura, Ross, & Ross, 1961). The experimenters randomly assigned some children to watch the adult model playing quietly and ignoring the Bobo doll, and others to watch the adult model punching the Bobo doll in the nose, hitting it
with a mallet, sitting on it, and kicking it around the room. As though that weren't enough, the model in the latter condition shouted out insults and vivid descriptions of his actions while inflicting violence: “Sock him in the nose,” “Kick him,” “Pow.”

Bandura and his coworkers then brought the children into a room with an array of appealing toys, including a miniature fire engine, a jet fighter, and a large doll set. Just as children began playing with these toys, the experimenter interrupted them, informing them that they needed to move to a different room. This interruption was intentional, as the investigators wanted to frustrate the children to make them more likely to behave aggressively. Then the experimenter brought them into a second room, which contained a Bobo doll identical to the one they’d seen.

On a variety of dependent measures, Bandura and his colleagues found that previous exposure to the aggressive model triggered significantly more aggression against the Bobo doll than did exposure to the nonaggressive model. The children who’d watched the aggressive model yelled at the doll much as the model had done, and they even imitated many of his verbal insults.

**Media Violence and Real-World Aggression.** The Bandura studies and scores of later studies of observational learning led psychologists to examine a theoretically and socially important question: Does exposure to media violence, such as in films or movies, contribute to real-world violence? Hundreds of investigators using correlational designs have reported that children who watch many violent television programs are more aggressive than other children (Wilson & Herrnstein, 1985). These findings, though, don’t demonstrate that media violence causes real-world violence (Freedman, 1984). They could simply indicate that highly aggressive children are more likely than other children to tune in to aggressive television programs. Alternatively, these findings could be due to a third variable, such as children’s initial levels of aggressiveness. That is, highly aggressive children may be more likely than other children to both watch violent television programs and to act aggressively.

Investigators have tried to get around this problem by using longitudinal designs (see Chapter 8), which track individuals’ behavior over time. Longitudinal studies show that children who watch many violent television shows commit more aggressive acts years later than do children who watch fewer violent television shows, even when researchers have equated children in their initial levels of aggression (Huesmann et al., 2003; see Figure 5.11). These studies offer somewhat more compelling evidence for a causal link between media violence and aggression than do correlational studies, but even they don’t demonstrate the existence of this link. For example, an unmeasured personality variable, like impulsivity, or a social variable, like weak parental supervision, might account for these findings. Moreover, just because variable A precedes variable B doesn’t mean that variable A causes variable B (see Chapter 8). For example, if we found that most common colds start with a scratchy throat and a runny nose, we shouldn’t conclude that scratchy throats and runny noses cause colds, only that they’re early signs of a cold.

**WHAT DO you THINK?**

You are the media director for student affairs and you are responsible for selecting the movies for the weekly movie night on campus. Following a violent incident last semester, the administration is concerned that showing violent movies will provoke violent behavior from students. How would you evaluate whether violent movie viewing relates to campus violence?
Finally, some investigators have conducted field studies of the link between media violence and aggression (Anderson & Bushman, 2002). In field studies, researchers examine the relation between naturally occurring events and aggression in the real world. For example, one investigator (Williams, 1986) conducted a field study of a small, isolated mountain town in Canada that had no television before 1973. She called it “Notel,” short for “no television.” Compared with school-age children in two other Canadian towns that already had television, children in Notel showed a marked increase in physical and verbal aggression two years later. Nevertheless, these findings are difficult to interpret in light of a potential confound: At around the same time that Notel received television, the Canadian government constructed a large highway that connected Notel to nearby towns. This highway might have introduced the children in Notel to negative outside influences, including crime spilling over from other cities.

So what can we make of the literature on media violence and aggressive behaviors? Most psychological scientists today agree that media violence contributes to aggression in at least some circumstances (Anderson & Bushman, 2002; Bushman & Anderson, 2001). Nevertheless, it’s equally clear that media violence is only one small piece of a multifaceted puzzle. We can’t explain aggression by means of media violence alone because the substantial majority of individuals exposed to high levels of such violence don’t become aggressive (Freedman, 2002; Wilson & Herrnstein, 1985). We’ll examine other causal factors in aggression in Chapter 11.

### Ruling Out Rival Hypotheses

Biological Influences on Learning

For many decades, most behaviorists regarded learning as entirely distinct from biology. The animal’s learning history and genetic makeup were like two ships passing in the night. Yet we now understand that our biology influences the speed and nature of our learning in complex and fascinating ways. Here are three powerful examples.
**CONDITIONED TASTE AVersions**

One day in the 1970s, psychologist Martin Seligman went out to dinner with his wife. He ordered a filet mignon steak flavored with sauce béarnaise. Approximately six hours later, while at the opera, Seligman felt nauseated and became violently ill. He and his stomach recovered, but his love of sauce béarnaise didn’t. From then on, Seligman couldn’t even think of, let alone taste, sauce béarnaise without feeling like vomiting (Seligman & Hager, 1972).

The *sauce béarnaise syndrome*, also known as *conditioned taste aversion*, refers to the fact that classical conditioning can lead us to develop avoidance reactions to the taste of food. Before reading on, ask yourself a question: Does Seligman’s story contradict the other examples of classical conditioning we’ve discussed, like that of Pavlov and his dogs?

In fact, it does in at least three ways (Garcia & Hankins, 1977):

1. In contrast to most classically conditioned reactions, which require repeated pairings between CS and UCS, conditioned taste aversions typically require *only one trial* to develop.
2. The delay between CS and UCS in conditioned taste aversions can be as long as six or even eight hours (Rachlin, 1991).
3. Conditioned taste aversions tend to be remarkably specific and display little evidence of stimulus generalization. For example, an aversion to fried chicken may not generalize to baked chicken or fried fish.

These differences make good sense. We wouldn’t want to have to experience horrific food poisoning again and again to learn a conditioned association between taste and illness. Not only would doing so be incredibly unpleasant, but, in some cases, we’d be dead after the first trial. The lag time between eating and illness violates typical classical conditioning because close timing between the CS and UCS is typically necessary for learning. But, in this case, because food poisoning often sets in many hours rather than a few seconds after eating toxic food, making this association is appropriate and adaptive. [LEARNING OBJECTIVE 5.11]

Conditioned taste aversions are a particular problem among cancer patients undergoing chemotherapy, which frequently induces nausea and vomiting. As a result, they frequently develop an aversion to food that preceded chemotherapy, even though they realize it bears no logical connection to the treatment. Fortunately, health psychologists have developed a clever way around this problem. Capitalizing on the specificity of conditioned taste aversions, they ask cancer patients to eat an unfamiliar *scapegoat food*—a novel food of which they aren’t fond—prior to chemotherapy. In general, the taste aversion becomes conditioned to the scapegoat food rather than to patients’ preferred foods (Anderesen, Birch, & Johnson, 1990).

**WHAT DO you THINK?**

You are a professional food critic for the local newspaper who has developed an enormous aversion to chicken after getting food poisoning at a wedding. In your profession, you can’t afford to avoid particular foods. What could you do to re-condition yourself to enjoy eating chicken again?
The work of John Garcia and his colleagues demonstrated that animals tend to develop conditioned taste aversions only to certain stimuli, namely, those that trigger nausea in the real world. This research has helped many cancer patients undergoing chemotherapy. To avoid developing a taste aversion to common foods, patients eat an unfamiliar scapegoat food prior to chemotherapy.
John Garcia and one of his colleagues helped to demonstrate biological influences on conditioned taste aversions (Garcia & Koelling, 1966). They found that rats exposed to X-rays, which make them nauseated, developed conditioned aversions to a specific taste but not to a specific visual or auditory stimulus presented after the X-rays (Garcia & Koelling, 1966). In other words, the rats more readily associated nausea with taste than with other sensory stimuli after a single exposure. Conditioned taste aversions aren’t much fun, but they’re often adaptive. In the real world, poisoned drinks and foods, not sights and sounds, make animals feel sick. As a consequence, animals more easily develop conditioned aversions to stimuli that tend to trigger nausea in the real world (see Figure 5.12).

Because certain stimuli are more easily associated with particular outcomes, this finding contradicts the assumption of equipotentiality—the claim that we can pair all CSs equally well with all UCSs—a belief held by many traditional behaviorists (Plotkin, 2004). Notice that Martin Seligman felt nauseated at the thought of sauce béarnaise, but not at the thought of the opera or—fortunately—his wife.

PREPAREDNESS AND PHOBIAS

A second challenge to the equipotentiality assumption comes from research on phobias. If we look at the distribution of phobias in the general population, we’ll find something curious: People aren’t always afraid of things with which they’ve had the most frequent unpleasant experiences. Phobias of the dark, heights, snakes, spiders, deep water, and blood are commonplace, even though many people who fear these stimuli have never had a frightening encounter with them. In contrast, phobias of razors, knives, the edges of furniture, ovens, and electrical outlets are extremely rare, although many of us have been cut, bruised, burned, or otherwise hurt by them.

Seligman (1971) proposed that we can explain the distribution of phobias in the population by means of prepared learning: We’re evolutionarily predisposed to fear certain stimuli more than others. According to Seligman, that’s because certain stimuli, like steep cliffs and poisonous animals, posed a threat to our early human ancestors (Ohman & Mineka, 2001). In contrast, household items and appliances didn’t, because they weren’t around back then. In the words of Susan Mineka and Michael Cook (1993), prepared fears are “evolutionary memories.”

Mineka and Cook (1993) tested prepared learning by first exposing lab-reared rhesus monkeys, who had no previous exposure to snakes, to a snake. These monkeys displayed no fear of snakes. Next, the researchers showed the monkeys a videotape of fellow monkeys reacting in horror to snakes. Within less than half an hour, the monkeys acquired a fear of snakes by observational learning. The researchers then edited the videotape so that it looked as though the same monkeys were reacting in horror, but this time in response to flowers, a toy rabbit, a toy snake, or a toy crocodile. They then showed these doctored videotapes to different groups of monkeys who had no experience with flowers, rabbits, snakes, or crocodiles. The monkeys who observed these altered videotapes acquired fears of the toy snake and toy crocodile but not the flowers or toy rabbit. From the standpoint of preparedness, this finding is understandable. Snakes and crocodiles were dangerous to our primate ancestors, but flowers and rabbits weren’t (Ohman & Mineka, 2003). What’s most fascinating is that these fears were clearly learned, because the monkeys showed no fear until they observed the videos. But the video was much more effective in creating fear reactions to some stimuli than to others. The monkeys were apparently predisposed to learn some fears more readily than others but needed to observe others’ fear before that learning predisposition was activated.

GLOSSARY

**equipotentiality**
assumption that any conditioned stimulus can be associated equally well with any unconditioned stimulus

**prepared learning**
evolutionary predisposition to learn some pairings of feared stimuli over others owing to their survival value
Still, the laboratory evidence for preparedness isn’t completely consistent. When researchers have paired either prepared stimuli—like snakes or spiders—or unprepared stimuli—like flowers or mushrooms—with electric shocks, they haven’t invariably replicated the finding that subjects more rapidly acquire fears to prepared than unprepared stimuli (Davey, 1995; McNally, 1987).

**INSTINCTIVE DRIFT**

Animal trainers Marian and Keller Breland taught pigeons, chickens, raccoons, pigs, and a host of other creatures to perform a variety of tricks—much like those we might see on David Letterman’s Stupid Pet Tricks segment—for circuses and television advertisers. As students of B. F. Skinner at Harvard, they relied on traditional methods of operant conditioning to shape their animals’ behavior.

In the process of their animal training adventures, the Brelands discovered that their little charges didn’t always behave as anticipated. In one case they tried to train raccoons to drop tokens into a piggy bank. Although they successfully trained the raccoons to pick up the coins using food reinforcement, they soon ran headfirst into a surprising problem. Despite repeated reinforcement for dropping the coins into the piggy bank, the raccoons began rubbing the coins together, dropping them, and rubbing them together again instead.

The raccoons had reverted to an innate behavior, namely, rinsing. They were treating the tokens like pieces of food, like the small hard shells they extract from the beds of ponds and streams (Timberlake, 2006). Breland and Breland (1961) referred to this phenomenon as **instinctive drift**: the tendency for animals to return to innate behaviors following repeated reinforcement. Researchers have observed instinctive drift in other animals, including rats (Powell & Curley, 1984). Psychologists don’t fully understand the reasons for such drift. Nevertheless, instinctive drift suggests that we can’t fully understand learning without taking into account innate biological influences because these influences place limits on what kinds of behaviors we can train through reinforcement.

**GLOSSARY**

instinctive drift  
tendency for animals to return to innate behaviors following repeated reinforcement

**QUIZ**

1. Many conditioned taste aversions are acquired in only a single trial.  
   - **TRUE**  
   - **FALSE**

2. Most research suggests that the assumption of equipotentiality is false.  
   - **TRUE**  
   - **FALSE**

3. The phenomenon of preparedness helps explain why virtually all major phobias are equally common in the general population.  
   - **TRUE**  
   - **FALSE**

4. With progressively more reinforcement, animals typically drift further and further away from their instinctual patterns of behavior.  
   - **TRUE**  
   - **FALSE**
Learning Fads: Do They Work?

Learning is hard work. It requires mental energy and concentration. Perhaps because learning new things requires so much time and effort on our part, many mental health professionals have marketed a motley assortment of techniques that supposedly help us to learn more quickly, or more easily, than we currently do. Do these newfangled methods work? We’ll find out by examining three popular techniques.

SLEEP-ASSISTED LEARNING

Imagine that you could master all of the information in this book while getting a few nights of sound sleep. You could pay someone to audiorecord the entire book, play the recording over the span of several weeknights, and you’d be all done. You could say good-bye to those late nights in the library reading about psychology.

As in many areas of psychology, hope springs eternal. Many proponents of sleep-assisted learning—learning new material while asleep—have made some extraordinary claims regarding this technique’s potential. Companies offer a variety of CDs that they claim can help us to learn languages, stop smoking, lose weight, or reduce stress, all while we’re comfortably catching up on our zzzzs. [LEARNING OBJECTIVE 5.12] These assertions are certainly quite remarkable. Does the scientific evidence for sleep-assisted learning stack up to its proponents’ impressive claims?

As is so often the case in life, things that sound too good to be true are often too good not to be true. Admittedly, the early findings on sleep-assisted learning were encouraging. One group of investigators exposed sailors to Morse code (a shorthand form of communication that radio operators sometimes use) while asleep. These sailors mastered Morse code three weeks faster than did other sailors (Simon & Emmons, 1955). Other studies from the former Soviet Union seemingly provided support for the claim that people could learn new material, such as tape-recorded words or sentences, while asleep (Aarons, 1976).

Nevertheless, these early positive reports neglected to rule out a crucial alternative explanation: The recordings may have awakened the subjects. The problem is that almost all of the studies showing positive effects didn’t monitor subjects’ electroencephalograms (EEGs; see Chapter 3) to ensure they were asleep while listening to the tapes (Druckman & Swets, 1988; Druckman & Bjork, 1994). Better-controlled studies that monitored subjects’ EEGs to make sure they were asleep offered little evidence for sleep-assisted learning. So to the extent that sleep-learning tapes “work,” it’s because subjects hear snatches of them while drifting in and out of sleep. As for that quick fix for reducing stress, we’d recommend skipping the tapes and just getting a good night’s rest.

DISCOVERY LEARNING

As we’ve discovered throughout this text, learning how to rule out rival explanations for findings is a key ingredient of critical thinking. But science educators haven’t always agreed on how to teach this crucial skill. One increasingly popular way of imparting this knowledge is discovery learning: giving students experimental materials and asking them to figure out the scientific
principles on their own (Klahr & Nigam, 2004). For example, a psychology professor who’s teaching operant conditioning might set her students up with a friendly rat, a maze, and a bountiful supply of cheese and ask them to determine which variables affect the rat’s learning. For instance, does the rat learn the maze most quickly when we reinforce it continuously or only occasionally?

Nevertheless, as David Klahr and his colleagues have shown, the old-fashioned method of direct instruction, in which we simply tell students how to solve problems, is often more effective and efficient than discovery learning. In one study, they examined third- and fourth-graders’ ability to isolate the variables that influence how quickly a ball rolls down a ramp, such as the ramp’s steepness or length. Only 23 percent of students assigned to a discovery learning condition later solved a slightly different problem on their own, whereas 77 percent of students assigned to a direct instruction condition did (Klahr & Nigam, 2004).

That’s not to say that discovery learning has no role in education, as in the long term it may encourage students to learn how to pose scientific questions on their own (Alferink, 2007; Kuhn & Dean, 2005). It may be a more effective technique for advanced students than beginning learners. Because many students may never figure out how to solve certain scientific problems independently, it’s ill advised as a stand-alone approach (Kirschner, Sweller, & Clark, 2006).

LEARNING STYLES

Few beliefs about learning are as widespread as the idea that all individuals have their own distinctive learning styles—their preferred means of acquiring information. According to proponents of this view, some students are “analytical” learners who excel at breaking down problems into different components, whereas others are “holistic” learners who excel at viewing problems as a whole. Still others are “verbal” learners who prefer to talk through problems, whereas others are “spatial” learners who prefer to visualize problems in their heads (Cassidy, 2004; Desmedt & Valcke, 2004). Some educational psychologists have claimed to boost learning dramatically by matching methods of instructions to people’s learning styles. According to them, children who are verbal learners should learn much faster and better with written material, children who are spatial learners should learn much faster and better with visual material, and so on.

Appealing as these assertions are, they haven’t stood the test of careful research. For one thing, it’s difficult to assess learning style reliably (Snider, 1992; Stahl, 1999). As we’ll recall from Chapter 2, reliability refers to consistency in measurement. In this case, researchers have found that different measures designed to assess people’s learning styles often yield very different answers about their preferred mode of learning. In part, that’s probably because few of us are purely analytical or holistic learners, verbal or spatial learners, and so on; most of us are a blend of both styles. Moreover, studies have generally revealed that tailoring different methods to people’s learning styles doesn’t result in enhanced learning (Kavale & Forness, 1987; Kratzig & Arbuthnott, 2006; Tarver & Dawson, 1978). Like a number of other fads in popular psychology, the idea of learning styles seems to be more fiction than fact (Alferink, 2007; Stahl, 1999).
WHAT DO you THINK?

You are a 6th grade teacher meeting with the parents of one of your students. The parents insist their child is strictly a visual learner and that your teaching style is preventing her from learning. How would you persuade them that their child’s learning isn’t being hindered?

QUICKTHINK

1. Sleep-assisted learning techniques work only if subjects stay completely asleep during learning.  
   - TRUE  
   - FALSE

2. Discovery learning tends to be more efficient than direct instruction for solving most scientific problems.  
   - TRUE  
   - FALSE

3. There’s little evidence that matching teaching methods to people’s learning styles enhances learning.  
   - TRUE  
   - FALSE

ANSWERS: (1) F  (2) F  (3) T  
(p. 5-33); (2) F  (p. 5-34); (3) T  (p. 5-34)
**CLASSICAL CONDITIONING** (pp. 5-5–5-12)

### 5.1 Describe examples of classical conditioning and discriminate conditioned stimuli and responses from unconditioned stimuli and responses

In classical conditioning, animals come to respond to a previously neutral stimulus (the CS) that has been paired with another stimulus (the UCS) that elicits an automatic response (the UCR). After repeated pairings with the UCS, the CS comes to elicit a conditioned response (CR) similar to the UCR.

1. A change in an organism’s behavior or thought as a result of experience is called **conditioning**. (p. 5-4)
2. If the dog continues to salivate at the sound of the metronome when the meat powder is absent, this is called **extinction**. (p. 5-6)
3. Identify the components of the classical conditioning model used in Pavlov’s dog research. (p. 5-7)

4. If Lynne has a crush on her neighborhood mail carrier and her heart starts to race every time she sees a mail truck as a result, the mail truck is the (conditioned/unconditioned) stimulus and the mail carrier is the (conditioned/unconditioned) stimulus. (p. 5-7)

### 5.2 Explain how conditioned responses are acquired, maintained, and extinguished

Acquisition is the process by which we gradually learn the CR. Extinction occurs when, following repeated presentation of the CS alone, the CR decreases in magnitude and eventually disappears. Extinction appears to involve an “overwriting” of the CR by new information.

5. The learning phase during which a conditioned response is established is called **acquisition**. (p. 5-8)
6. After numerous presentations of the metronome without meat powder, Pavlov’s dogs eventually stopped salivating; this is the process of **extinction**. (p. 5-8)
7. A sudden reemergence of an extinguished conditioned response after a delay in exposure to the conditioned stimulus is called **spontaneous recovery**. (p. 5-8)
8. Being able to enjoy a scary movie is an example of stimulus **generalization**. (p. 5-9)

### 5.3 Explain how complex behaviors can result from classical conditioning and how they emerge in our daily lives

Higher-order conditioning occurs when organisms develop classically conditioned responses to other CSs associated with the original CS.

9. Advertisers use **conditioning** to get customers to associate their products with an enjoyable stimulus. (p. 5-10)

10. Describe the methods used by Watson and Rayner to condition fear in Little Albert and explain why their work could not be conducted today for ethical reasons. (pp. 5-10–5-11)

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**OPERANT CONDITIONING** (pp. 5-13–5-24)

### 5.4 Describe how behaviors are acquired through operant conditioning

Operant conditioning is learning that is controlled by the consequences of the organism’s behavior. It is also referred to as instrumental conditioning since the organism “gets something” out of the response.

1. The behaviors emitted by the animal to receive a reward are known as **operant responses**. (p. 5-13)

### 5.5 Identify the similarities and differences between operant and classical conditioning

Both forms of conditioning involve many of the same processes, including acquisition and extinction. Nevertheless, in operant conditioning, responses are emitted rather than elicited, the reward is contingent on behavior, and responses mostly involve skeletal muscles rather than the autonomic nervous system.

2. Complete the table to show the differences between classical and operant conditioning. (p. 5-13)

<table>
<thead>
<tr>
<th>Classical Conditioning</th>
<th>Operant Conditioning</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target behavior is . . .</td>
<td></td>
</tr>
<tr>
<td>Reward is . . .</td>
<td></td>
</tr>
<tr>
<td>Behavior depends primarily on . . .</td>
<td></td>
</tr>
</tbody>
</table>
5.6 Describe reinforcement and its effects on behavior
Thorndike’s law of effect tells us that if a response, in the presence of a stimulus, is followed by a reward, it is likely to be repeated, resulting in the gradual “stamping in” of S-R connections. Reinforcement can be either positive (pleasant outcome) or negative (withdrawal of a negative outcome).

3. Positive reinforcement and negative reinforcement can both be considered “rewards” because they both ______ the likelihood of performing a behavior. (p. 5-16)

4. A physics professor announces to his class that students who are earning 90% or higher in the class do not have to take the midterm exam. This is an example of (positive/negative reinforcement). (p. 5-16)

5.7 Distinguish negative reinforcement from punishment as influences on behavior
Negative reinforcement increases a behavior, whereas punishment weakens a response. One disadvantage of punishment is that it tells the organism only what not to do, not what to do.

5. Whereas ______, is the removal of a negative outcome or consequence of a behavior that strengthens the probability of the behavior, ______ is the outcome or consequence of a behavior that weakens the probability of the behavior. (p. 5-16)

6. According to Skinner, one of the disadvantages of punishment is that it often creates ______, which interferes with future learning. (p. 5-17)

5.8 Describe the four major schedules of reinforcement and their effects on behavior
Partial reinforcement tends to result in slower acquisition but also slower extinction than reinforcement on every instance. The pattern of behavior exhibited by the animal experiencing partial reinforcement varies, depending on the schedule of reinforcement. The four most common schedules are determined by whether the schedule of reinforcement is fixed or variable and whether it is based on the ratio of behaviors produced or the amount of time that has elapsed, and each has a distinct pattern of behavior associated with it.

7. According to the principle of partial reinforcement, behaviors we reinforce only occasionally are (slower/quicker) to extinguish than those we reinforce every time. (p. 5-19)

8. Skinner discovered that different ______, ______ yield distinctive patterns of responding. (p. 5-20)

9. Casino gambling is a prime example of a ______ ______. (p. 5-20)

10. Identify the typical response patterns for the four reinforcement schedule types. (p. 5-20)

5.9 Outline the evidence that supports learning in the absence of conditioning
S-O-R psychologists believe that the organism’s interpretation of stimuli plays a central role in learning. Tolman’s work on latent learning, which showed that animals can learn without reinforcement, challenged the radical behaviorist view of learning.

1. Early behaviorists (believed/didn’t believe) that thought played an important causal role in learning. (p. 5-24)

2. Watson believed psychologists should focus only on ______ behaviors. (p. 5-24)

3. Skinner believed that observable behavior, ______, and ______ are all governed by the laws of learning. (p. 5-24)

4. In the past few decades, psychology has increasingly moved away from a simple S-R psychology to a more complex ______ psychology. (p. 5-24)

5. When talking to employees about their performance, why might managers want to adapt their style depending on the person they’re talking to? (p. 5-25)

6. According to Tolman, the rats in his study had developed spatial representations of the maze that he called ______ ______. (p. 5-26)

5.10 Explain how learning can occur through observation
Research suggests that individuals can acquire aggressive behavior by observational learning. Correlational studies, longitudinal studies, laboratory studies, and field studies suggest that media violence contributes to aggression.

7. According to some psychologists, an important variant of latent learning is ______ learning, in which one learns by watching others without instruction or reinforcement. (p. 5-26)

8. In classic research in the 1960s, ______ ______ and his colleagues demonstrated that children can learn to act aggressively by watching aggressive role models. (p. 5-26)

9. Longitudinal studies that correlate the amount of violent TV watched in childhood with the number of aggressive acts they committed in adulthood (have/have not) demonstrated causality. (p. 5-27)
Explain how biological predispositions can facilitate learning of some associations

Most psychologists have increasingly recognized that our genetic endowment influences learning. Conditioned taste aversions refer to the phenomenon whereby classical conditioning can lead us to develop avoidance reactions to the taste of food. John Garcia and his colleagues showed that conditioned taste aversions violate the principle of equipotentiality, because they demonstrated that certain CSs are more easily conditioned to certain UCSs. Research on preparedness suggests that we are evolutionarily predisposed to learn to fear some stimuli more easily than others.

1. Classical conditioning can lead us to develop an avoidance reaction to the taste of food known as _______. (p. 5-29)
2. Explain how conditioned taste aversions can actually help cancer patients undergoing chemotherapy. (p. 5-30)
3. Through his research with rats, Garcia helped to demonstrate the _______ influences on conditioned taste aversions. (msp. 5-31)
4. The rats in Garcia’s study more readily associated nausea with _______ than with any other sensory stimuli. (msp. 5-31)
5. Garcia’s finding challenged the assumption of _______, the belief of many behaviorists that we can pair all CSs equally well with all UCSs. (msp. 5-31)
6. Conditioned taste aversions aren’t much fun, but they’re often in the real world. An example would be an animal that develops a conditioned taste aversion to a poisoned food or drink. (p. 5-31)
7. According to Seligman, we’re evolutionarily predisposed to fear certain stimuli more than others by means of _______ _______. (p. 5-31)
8. In Mineka’s and Cook’s study, the monkeys (acquired/didn’t acquire) fears of nondangerous stimuli, such as flowers. (p. 5-31)
9. Mineka’s and Cook’s study was clearly a case of learning because the monkeys were (afraid/unafraid) of snakes prior to the experiment. (p. 5-31)
10. Describe the phenomenon whereby animals return to evolutionarily selected behavior and how that behavior has affected researchers’ understanding of learning. (p. 5-32)
Do You Know All of the Terms in This Chapter?
Find out by using the Flashcards. Want more practice? Take additional quizzes, try simulations, and watch video to be sure you are prepared for the test!

CHAPTER EXAM

Correlation vs. Causation pp. 5-17, 5-21, 5-27
Falsifiability pp. 5-10, 5-26
Replicability pp. 5-6, 5-10, 5-12, 5-23, 5-32
Extraordinary Claims pp. 5-33
Occam's Razor pp. 5-24

5.12 Evaluate popular techniques marketed to enhance learning
Proponents of sleep-assisted learning claim that individuals can learn new material while asleep, but studies have yielded negative results. Although popular in science education, discovery learning approaches often appear to be less effective and efficient than direct instruction. Some educational psychologists claim to be able to boost learning by matching individuals’ learning styles with different teaching methods. Nevertheless, learning styles are difficult to assess reliably; moreover, studies that have matched learning styles with teaching methods have typically yielded negative results.

1. Proponents of ________ ________ claim that, just by listening to instructional tapes while you sleep, you can learn any number of new things, such as a foreign language. (p. 5-33)

2. Controlled studies that monitored subjects’ EEGs to make sure the subjects were asleep while listening to the instructional tapes revealed evidence (supporting/refuting) the effectiveness of sleep-assisted learning. (p. 5-33)

3. Explain the extraordinary claims about how sleep-assisted learning works and identify shortcomings in researchers’ attempts to validate those claims. (msp. 5-33)

4. When you give students experimental materials and ask them to figure out a scientific principle on their own, this is known as ________ _________. (p. 5-33)

5. Klahr and his colleagues have shown that the old-fashioned method of ________ ________, in which we simply tell students how to solve problems, is often most efficient and effective. (p. 5-34)

6. Discovery learning may be a more effective technique for ________ students than for ________ students. (p. 5-34)

7. Individuals’ preferred or optimal method of acquiring new information is referred to as ________ _________. (p. 5-34)

8. Proponents of this view believe that some students are ________ learners who excel at breaking down problems into different components, while others are ________ learners who excel at viewing problems as a whole. (p. 5-34)

9. Studies have generally shown that tailoring different methods to people’s learning styles (does/doesn’t) result in enhanced learning. (msp. 5-34)

10. Provide a valid argument against teaching to students’ learning styles. (p. 5-34)

Many people believe that punishment is necessary for raising children properly, while others believe that any form of physical punishment, no matter how mild, constitutes abuse and creates a potential for future aggression in the child. Synthesize the arguments both in favor of and against physical punishment. Which side are you more inclined to side with? Why?

Drugs such as Antabuse are often used to help people with a substance abuse disorder, in this case alcohol abuse, stop drinking. These drugs act by inducing severe vomiting whenever alcohol is consumed. Consider how the effects of such drugs might continue long after the drugs have stopped, in helping people to avoid drinking alcohol.

1. Look past the hype and pick out the learning techniques that really work.

Learning Fads: Do They Work?