

Learning Unit



CHAPTER OUTLINE

HOW DO WE LEARN?

CLASSICAL CONDITIONING

Pavlov's Experiments

Extending Pavlov's Understanding

Pavlov's Legacy

Close-Up: Trauma as Classical Conditioning

OPERANT CONDITIONING

Skinner's Experiments

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Skinner's Legacy

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Contrasting Classical and Operant Conditioning

LEARNING BY OBSERVATION

Mirrors in the Brain

Bandura's Experiments

Applications of Observational Learning



"Actually, sex just isn't that important to me." © 1984 by Sidney Harris, American Scientist Magazine.

When a chinook salmon first emerges from its egg in a stream's gravel bed, its genes provide most of the behavioral instructions it needs for life. It knows instinctively how and where to swim, what to eat, and how to protect itself. Following a built-in plan, the young salmon soon begins its trek to the sea. After some four years in the ocean, the mature salmon returns to its birthplace. It navigates hundreds of miles to the mouth of its home river and then, guided by the scent of its home stream, begins an upstream odyssey to its ancestral spawning ground. Once there, the salmon seeks out the best temperature, gravel, and water flow for breeding. It then mates and, its life mission accomplished, dies.

Unlike salmon, we are not born with a genetic plan for life. Much of what we do we learn from experience. Although we struggle to find the life direction a salmon is born with, our learning gives us more flexibility. We can learn how to build grass huts or snow shelters, submarines or space stations, and thereby adjust to almost any environment. Indeed, nature's most important gift to us may be our *adaptability*—our capacity to learn new behaviors that help us cope with changing circumstances.

Learning breeds hope. What is learnable we can potentially teach—a fact that encourages parents, teachers, coaches, and animal trainers. What has been learned we can potentially change by new learning—an assumption that underlies counseling, psychotherapy, and rehabilitation programs. No matter how unhappy, unsuccessful, or unloving we are, that need not be the end of our story.

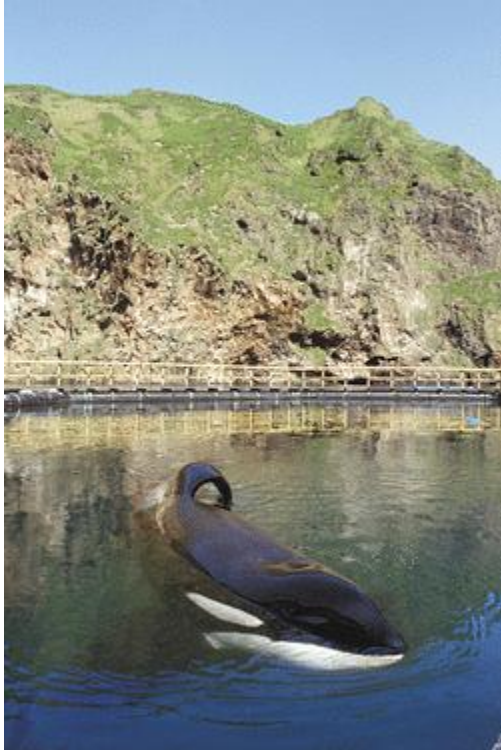
No topic is closer to the heart of psychology than **learning**, a *relatively permanent behavior change due to experience*. In earlier units we considered the learning of faulty thinking patterns, of visual perceptions, of a drug's expected effect. In later units we will see how learning shapes our thought and language, our motivations and emotions, our personalities and attitudes. This unit examines three types of learning: *classical conditioning*, *operant conditioning*, and *observational learning*.

6.1 How Do We Learn?

1: What are some basic forms of learning?

"Learning is the eye of the mind."

Thomas Drake, *Bibliotheca Scholastica Instructissima*, 1633



Nature without appropriate nurture Keiko—the killer whale of Free Willy fame—had all the right genes for being dropped right back into his Icelandic home waters. But lacking life experience, he required caregivers to his life's end in a Norwegian fjord. Jouanneau Thomas/CORBIS SYGMA

MORE THAN 200 YEARS AGO, philosophers such as John Locke and David Hume echoed Aristotle's conclusion from 2000 years earlier: We learn by *association*. Our minds naturally connect events that occur in sequence. Suppose you see and smell freshly baked bread, eat some, and find it satisfying. The next time you see and smell fresh bread, that experience will lead you to expect that eating it will once again be satisfying. So, too, with sounds. If you associate a sound with a frightening consequence, hearing the sound alone may trigger your fear. As one 4-year-old exclaimed after watching a TV character get mugged, "If I had heard that music, I wouldn't have gone around the corner!" (Wells, 1981).

Learned associations also feed our habitual behaviors (Wood & Neal, 2007). As we repeat behaviors in a given context—the sleeping posture we associate with bed, our walking routes from class to class, our eating popcorn in a movie theater—the behaviors become associated with the contexts. Our next experience of the context then automatically triggers the habitual response. Such associations can make it hard to kick a smoking habit; when back in the smoking context, the urge to light up can be powerful (Siegel, 2005).

Other animals also learn by association. Disturbed by a squirt of water, the sea slug *Aplysia* protectively withdraws its gill. If the squirts continue, as happens naturally in choppy water, the withdrawal response diminishes. We say the slug **habituates**. But if the sea slug repeatedly receives an electric shock just after being squirted, its withdrawal response to the squirt instead grows stronger. The animal relates the squirt to the impending shock. Complex animals can learn to relate their own behavior to its

outcomes. Seals in an aquarium will repeat behaviors, such as slapping and barking, that prompt people to toss them a herring.

By linking two events that occur close together, both the sea slug and the seals exhibit **associative learning**. The sea slug associates the squirt with an impending shock; the seal associates slapping and barking with a herring treat. Each animal has learned something important to its survival: predicting the immediate future.

Most of us would be unable to name the order of the songs on our favorite CD or playlist. Yet, hearing the end of one piece cues (by association) an anticipation of the next. Likewise, when singing your national anthem, you associate the end of each line with the beginning of the next. (Pick a line out of the middle and notice how much harder it is to recall the *previous* line.)

The significance of an animal's learning is illustrated by the challenges captive-bred animals face when introduced to the wild. After being bred and raised in captivity, 11 Mexican gray wolves—extinct in the United States since 1977—were released in Arizona's Apache National Forest in 1998. Eight months later, a lone survivor was recaptured. The pen-reared wolves had learned how to hunt—and to move 100 feet away from people—but had not learned to run from a human with a gun. Their story is not unusual. Twentieth-century records document 145 reintroductions of 115 species. Of those, only 11 percent produced self-sustaining populations in the wild. Successful adaptation requires both nature (the needed genetic predispositions) and nurture (a history of appropriate learning).

Conditioning is the process of learning associations. In *classical conditioning*, we learn to associate two stimuli and thus to anticipate events. We learn that a flash of lightning signals an impending crack of thunder, so when lightning flashes nearby, we start to brace ourselves (**Figure 6.1**).

Two related events:



Result after repetition:



Figure 6.1 Classical conditioning

In *operant conditioning*, we learn to associate a response (our behavior) and its consequence and thus to repeat acts followed by good results (**Figure 6.2**) and avoid acts followed by bad results.



To simplify, we will explore these two types of associative learning separately. Often, though, they occur together, as on one Japanese cattle ranch, where the clever rancher outfitted his herd with electronic pagers, which he calls from his cell phone. After a week of training, the animals learn to associate two stimuli—the beep on their pager and the arrival of food (classical conditioning). But they also learn to associate their hustling to the food trough with the pleasure of eating (operant conditioning).

The concept of association by conditioning provokes questions: What principles influence the learning and the loss of associations? How can these principles be applied? And what really are the associations: Does the beep on a steer's pager evoke a mental representation of food, to which the steer responds by coming to the trough? Or does it make little sense to explain conditioned associations in terms of cognition? (In **Unit 7B**, we will see how the brain stores and retrieves learning.)

Conditioning is not the only form of learning. Through *observational learning*, we learn from others' experiences. Chimpanzees, too, may learn behaviors merely by watching others perform them. If one sees another solve a puzzle and gain a food reward, the observer may perform the trick more quickly.

By conditioning and by observation we humans learn and adapt to our environments. We learn to expect and prepare for significant events such as food or pain (*classical conditioning*). We also learn to repeat acts that bring good results and to avoid acts that bring bad results (*operant conditioning*). By watching others we learn new behaviors (*observational learning*). And through language, we also learn things we have neither experienced nor observed.

6.2 Classical Conditioning

2: What is classical conditioning, and how did Pavlov's work influence behaviorism?

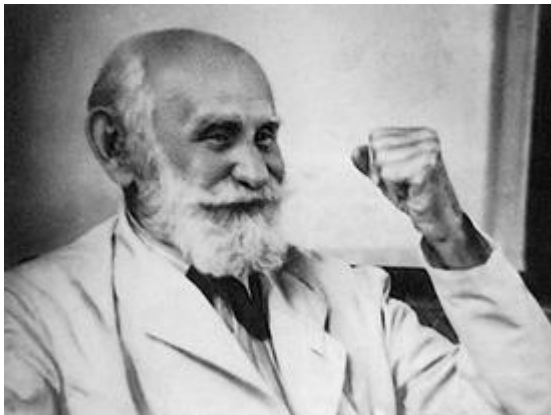
FOR MANY PEOPLE, THE NAME IVAN Pavlov (1849–1936) rings a bell. His early twentieth-century experiments—now psychology's most famous research—are classics, and the phenomenon he explored we justly call **classical conditioning**.

Pavlov's work also laid the foundation for many of psychologist John B. Watson's ideas. In searching for laws underlying learning, Watson (1913) urged his colleagues to discard reference to inner thoughts, feelings, and motives. The science of psychology should instead study how organisms respond to stimuli in their environments, said Watson: "Its theoretical goal is the prediction and control of behavior. Introspection forms no essential part of its methods." Simply said, psychology should be an objective science based on observable behavior. This view, which influenced North American psychology during the first half of the twentieth century, Watson called **behaviorism**. Watson and Pavlov shared both a disdain for "mentalistic" concepts (such as consciousness) and a belief that the basic laws of learning were the same for all animals—whether dogs or humans. Few researchers today propose that psychology should ignore mental processes, but most now agree that classical conditioning is a basic form of learning by which all organisms adapt to their environment.

6.2.1 Pavlov's Experiments

3: How does a neutral stimulus become a conditioned stimulus?

Pavlov was driven by a lifelong passion for research. After setting aside his initial plan to follow his father into the Russian Orthodox priesthood, Pavlov received a medical degree at age 33 and spent the next two decades studying the digestive system. This work earned him Russia's first Nobel Prize in 1904. But it was his novel experiments on learning, to which he devoted the last three decades of his life, that earned this feisty scientist his place in history.



Ivan Pavlov "Experimental investigation...should lay a solid foundation for a future true science of psychology" (1927). Sovfoto

Pavlov's new direction came when his creative mind seized on an incidental observation. Without fail, putting food in a dog's mouth caused the animal to salivate. Moreover, the dog began salivating not only to the taste of the food, but also to the mere sight of the food, or the food dish, or the person delivering the food, or even the sound of that person's approaching footsteps. At first, Pavlov considered these "psychic secretions" an annoyance—until he realized they pointed to a simple but important form of learning.

Pavlov and his assistants tried to imagine what the dog was thinking and feeling as it drooled in anticipation of the food. This only led them into fruitless debates. So, to explore the phenomenon more objectively, they experimented. To eliminate other possible influences, they isolated the dog in a small room, secured it in a harness, and attached a device to divert its saliva to a measuring instrument. From the next room, they presented food—first by sliding in a food bowl, later by blowing meat powder into the dog’s mouth at a precise moment. They then paired various *neutral events*—something the dog could see or hear but didn’t associate with food—with food in the dog’s mouth. If a sight or sound regularly signaled the arrival of food, would the dog learn the link? If so, would it begin salivating in anticipation of the food?

The answers proved to be yes and yes. Just before placing food in the dog’s mouth to produce salivation, Pavlov sounded a tone. After several pairings of tone and food, the dog, anticipating the meat powder, began salivating to the tone alone. In later experiments, a buzzer, a light, a touch on the leg, even the sight of a circle set off the drooling.¹ (This procedure works with people, too. When hungry young Londoners viewed abstract figures before smelling peanut butter or vanilla, their brains soon were responding in anticipation to the abstract images alone [Gottfried et al., 2003]).

Because salivation in response to food in the mouth was unlearned, Pavlov called it an **unconditioned response (UR)**. Food in the mouth automatically, *unconditionally*, triggers a dog’s salivary reflex (**Figure 6.3**). Thus, Pavlov called the food stimulus an **unconditioned stimulus (US)**.

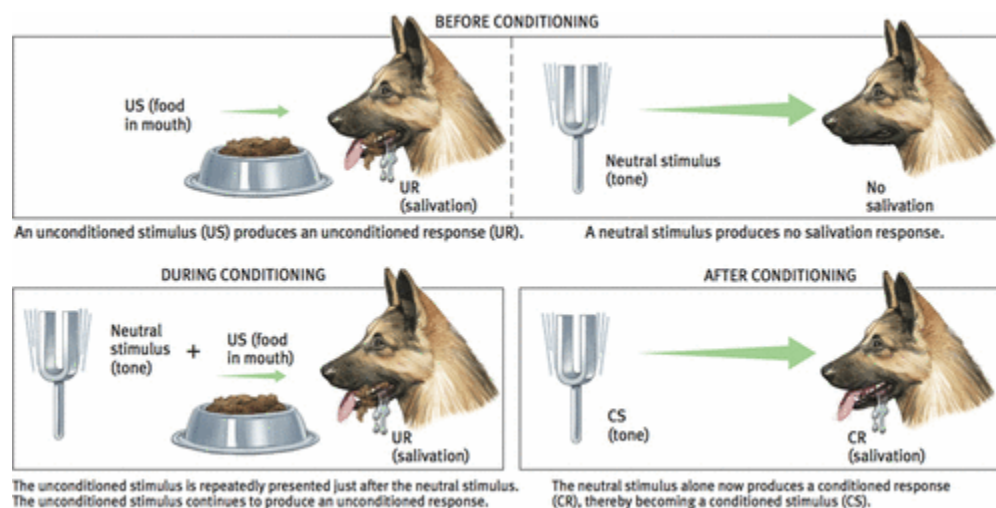


Figure 6.3 Pavlov’s classic experiment Pavlov presented a neutral stimulus (a tone) just before an unconditioned stimulus (food in mouth). The neutral stimulus then became a conditioned stimulus, producing a conditioned response.

Salivation in response to the tone was *conditional* upon the dog’s learning the association between the tone and the food. Today we call this learned response the **conditioned response (CR)**. The previously neutral (in this context) tone stimulus that now triggered the conditional salivation we call the **conditioned stimulus (CS)**. Distinguishing these two kinds of stimuli and responses is easy: Conditioned = learned; unconditioned = *unlearned*.

Let's check your understanding with a second example. An experimenter sounds a tone just before delivering an air puff, which causes your eye to blink. After several repetitions, you blink to the tone alone. What is the US? The UR? The CS? The CR?²



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If Pavlov's demonstration of associative learning was so simple, what did he do for the next three decades? What discoveries did his research factory publish in his 532 papers on salivary conditioning (Windholz, 1997)? He and his associates explored five major conditioning processes: *acquisition*, *extinction*, *spontaneous recovery*, *generalization*, and *discrimination*.

Acquisition

4: In classical conditioning, what are the processes of acquisition, extinction, spontaneous recovery, generalization, and discrimination?

To understand the **acquisition**, or initial learning, of the stimulus-response relationship, Pavlov and his associates had to confront the question of timing: How much time should elapse between presenting the neutral stimulus (the tone, the light, the touch) and the unconditioned stimulus? In most cases, not much—half a second usually works well.

What do you suppose would happen if the food (US) appeared before the tone (CS) rather than after? Would conditioning occur?

Check yourself: If the aroma of cake baking sets your mouth to watering, what is the US? The CS? The CR? (Answers below.)

Remember:

US = **U**nconditioned **S**timulus

UR = **U**nconditioned **R**esponse

CS = **C**onditioned **S**timulus

CR = **C**onditioned **R**esponse

The cake (and its taste) are the US.

The associated aroma is the CS.

Not likely. With but a few exceptions, conditioning doesn't happen when the CS follows the US. Remember, classical conditioning is biologically adaptive because it helps humans and other animals *prepare* for good or bad events. To Pavlov's dogs, the tone (CS) signaled an important biological event—the arrival of food (US). To deer in the forest, the snapping of a twig (CS) may signal a predator's approach (US). If the good or bad event had already occurred, the CS would not likely signal anything significant.

Michael Domjan (1992, 1994, 2005) showed how a CS can signal another important biological event, by conditioning the sexual arousal of male Japanese quail. Just before presenting an approachable female, the researchers turned on a red light. Over time, as the red light continued to herald the female's arrival, the light caused the male quail to become excited. They developed a preference for their cage's red-light district, and when a female appeared, they mated with her more quickly and released more semen and sperm (Matthews et al., 2007). All in all, the quail's capacity for classical conditioning gives it a reproductive edge. Again we see the larger lesson: *Conditioning helps an animal survive and reproduce—by responding to cues that help it gain food, avoid dangers, locate mates, and produce offspring* (Hollis, 1997).

In humans, too, objects, smells, and sights associated with sexual pleasure—even a geometric figure in one experiment—can become conditioned stimuli for sexual arousal (Byrne, 1982). Psychologist Michael Tirrell (1990) recalls: "My first girlfriend loved onions, so I came to associate onion breath with kissing. Before long, onion breath sent tingles up and down my spine. Oh what a feeling!" (**Figure 6.4**)

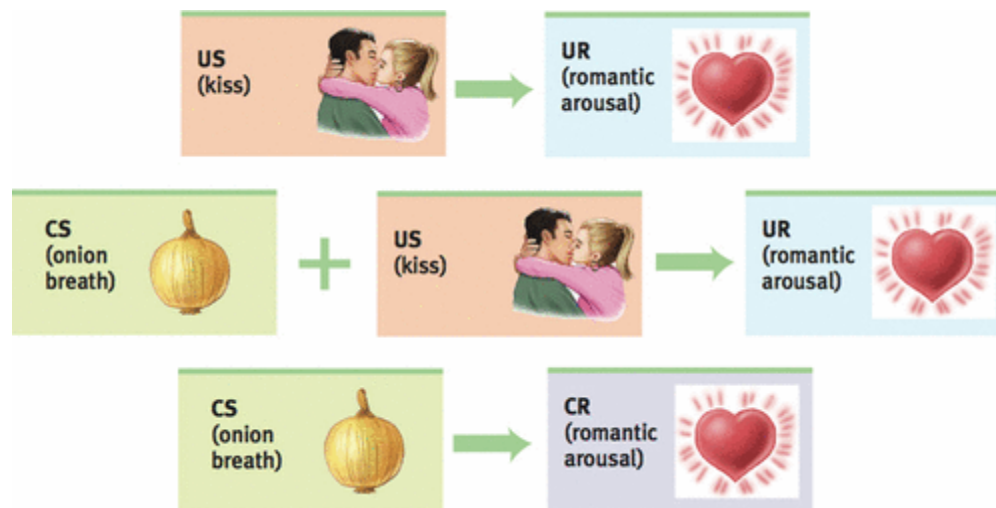


Figure 6.4 An unexpected CS Onion breath does not usually arouse romantic feelings. But when repeatedly paired with a kiss, it can become a CS and do just that.

Through **higher-order conditioning**, a new neutral stimulus can become a new conditioned stimulus. All that's required is for it to become associated with a previously conditioned stimulus. If a tone regularly signals food and produces salivation, then a light that becomes associated with the tone may also begin to trigger salivation. Although this higher-order conditioning (also called *second-order conditioning*) tends to be weaker than first-stage conditioning, it influences our everyday lives. Imagine that

something makes us very afraid (perhaps a big dog associated with a previous dog bite). If something else, such as the sound of a barking dog, brings to mind that big dog, the bark alone may make us feel a little afraid.

Associations can influence attitudes (De Houwer et al., 2001; Park et al., 2007). As Andy Field (2006) showed British children novel cartoon characters alongside either ice cream (*Yum!*) or Brussels sprouts (*Yuk!*), the children came to like best the ice-cream-associated characters. Michael Olson and Russell Fazio (2001) classically conditioned adults' attitudes, using little-known Pokémon characters. The participants, playing the role of a security guard monitoring a video screen, viewed a stream of words, images, and Pokémon characters. Their task, they were told, was to respond to one target Pokémon character by pressing a button. Unnoticed by the participants, when two other Pokémon characters appeared on the screen, one was consistently associated with various positive words and images (such as *awesome* or a hot fudge sundae); the other appeared with negative words and images (such as *awful* or a cockroach). Without any conscious memory for the pairings, the participants formed more gut-level positive attitudes for the characters associated with the positive stimuli.

Follow-up studies indicate that conditioned likes and dislikes are even stronger when people notice and are aware of the associations they have learned (De Houwer et al., 2005a, b; Pleyers et al., 2007). Cognition matters.

Extinction and Spontaneous Recovery

After conditioning, what happens if the CS occurs repeatedly without the US? Will the CS continue to elicit the CR? Pavlov discovered that when he sounded the tone again and again without presenting food, the dogs salivated less and less. Their declining salivation illustrates **extinction**, the diminished responding that occurs when the CS (tone) no longer signals an impending US (food).

Pavlov found, however, that if he allowed several hours to elapse before sounding the tone again, the salivation to the tone would reappear spontaneously (**Figure 6.5**). This **spontaneous recovery**—the reappearance of a (weakened) CR after a pause—suggested to Pavlov that extinction was suppressing the CR rather than eliminating it.

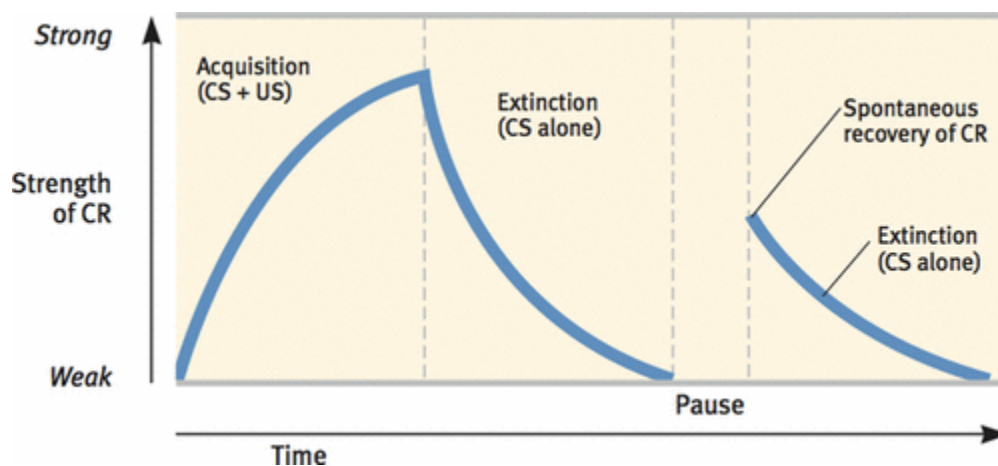
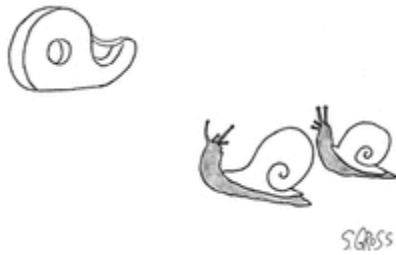


Figure 6.5 Idealized curve of acquisition, extinction, and spontaneous recovery The rising curve shows that the CR rapidly grows stronger as the CS and US are repeatedly paired (*acquisition*), then weakens as the CS is presented alone (*extinction*). After a pause, the CR reappears (*spontaneous recovery*).



Stimulus generalization "I don't care if she's a tape dispenser. I love her." © The New Yorker Collection, 1998, Sam Gross from cartoonbank.com. All rights reserved.

After breaking up with his fire-breathing heartthrob, Tirrell also experienced extinction and spontaneous recovery. He recalls that "the smell of onion breath (CS), no longer paired with the kissing (US), lost its ability to shiver my timbers. Occasionally, though, after not sensing the aroma for a long while, smelling onion breath awakens a small version of the emotional response I once felt."

Generalization

Pavlov and his students noticed that a dog conditioned to the sound of one tone also responded somewhat to the sound of a different tone that had never been paired with food. Likewise, a dog conditioned to salivate when rubbed would also drool a bit when scratched (Windholz, 1989) or when touched on a different body part (**Figure 6.6**). This tendency to respond to stimuli similar to the CS is called **generalization**.

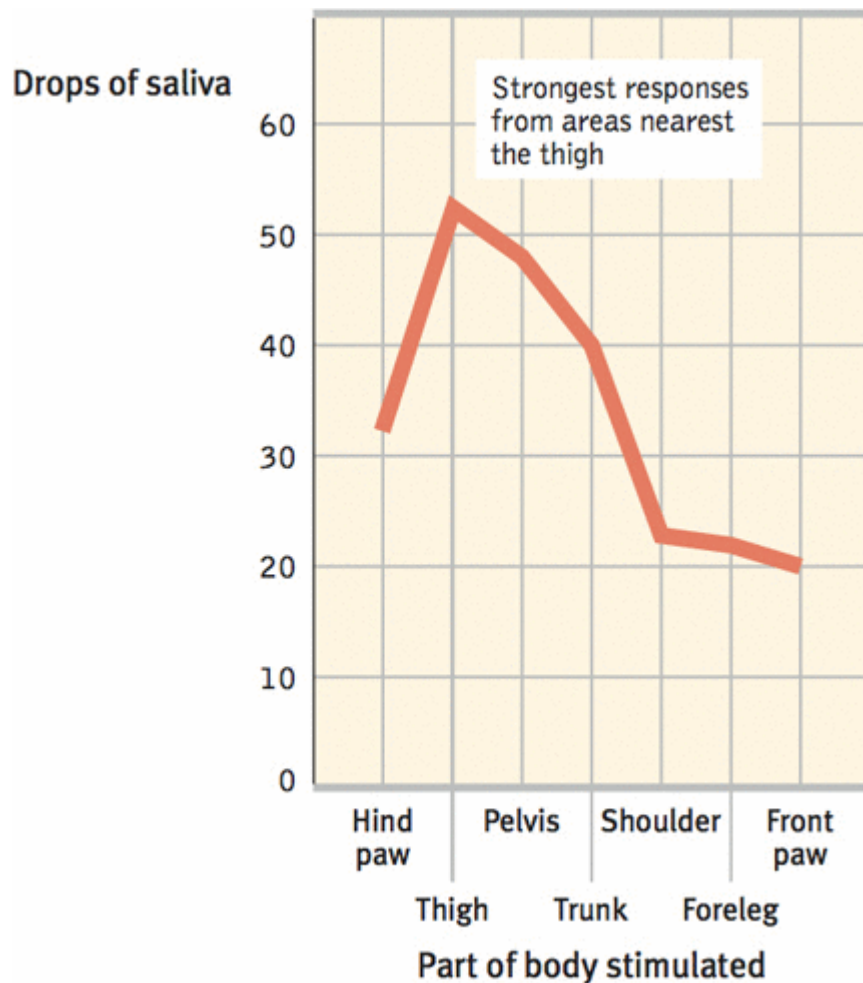


Figure 6.6 Generalization Pavlov demonstrated generalization by attaching miniature vibrators to various parts of a dog's body. After conditioning salivation to stimulation of the thigh, he stimulated other areas. The closer a stimulated spot was to the dog's thigh, the stronger the conditioned response. (From Pavlov, 1927.)

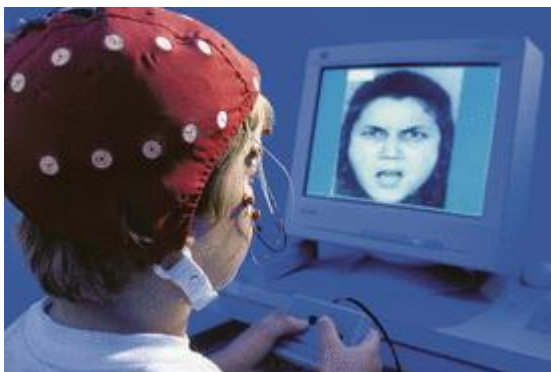


Figure 6.7 Child abuse leaves tracks in the brain Seth Pollak (University of Wisconsin–Madison) reports that abused children's sensitized brains react more strongly to angry faces. This generalized anxiety response may help explain why child abuse puts children at greater risk for psychological disorders. © UW–Madison News & Public Affairs. Photo by Jeff Miller

Generalization can be adaptive, as when toddlers taught to fear moving cars also become afraid of moving trucks and motorcycles. So automatic is generalization that one Argentine writer who underwent torture still recoils with fear when he sees black

shoes—his first glimpse of his torturers as they approached his cell. Generalization of anxiety reactions has been demonstrated in laboratory studies comparing abused with nonabused children (**Figure 6.7**). Shown an angry face on a computer screen, abused children's brain-wave responses are dramatically stronger and longer lasting (Pollak et al., 1998).

Because of generalization, stimuli similar to naturally disgusting or appealing objects will, by association, evoke some disgust or liking. Normally desirable foods, such as fudge, are unappealing when shaped to resemble dog feces (Rozin et al., 1986). Adults with childlike facial features (round face, large forehead, small chin, large eyes) are perceived as having childlike warmth, submissiveness, and naiveté (Berry & McArthur, 1986). In both cases, people's emotional reactions to one stimulus generalize to similar stimuli.

Discrimination

Pavlov's dogs also learned to respond to the sound of a particular tone and *not* to other tones. **Discrimination** is the learned ability to *distinguish* between a conditioned stimulus (which predicts the US) and other irrelevant stimuli. Being able to recognize differences is adaptive. Slightly different stimuli can be followed by vastly different consequences. Confronted by a guard dog, your heart may race; confronted by a guide dog, it probably will not.

6.2.2 Extending Pavlov's Understanding

5: Do cognitive processes and biological constraints affect classical conditioning?

In their dismissal of "mentalistic" concepts such as consciousness, Pavlov and Watson underestimated the importance of *cognitive processes* (thoughts, perceptions, expectations) and *biological constraints* on an organism's learning capacity.

Cognitive Processes

The early behaviorists believed that rats' and dogs' learned behaviors could be reduced to mindless mechanisms, so there was no need to consider cognition. But Robert Rescorla and Allan Wagner (1972) showed that an animal can learn the *predictability* of an event. If a shock always is preceded by a tone, and then may also be preceded by a light that accompanies the tone, a rat will react with fear to the tone but not to the light. Although the light is always followed by the shock, it adds no new information; the tone is a better predictor. The more predictable the association, the stronger the conditioned response. It's as if the animal learns an *expectancy*, an awareness of how likely it is that the US will occur.

Researcher Martin Seligman (1975, 1991) and others found that dogs strapped in a harness and given repeated shocks, with no opportunity to avoid them, learned a sense of helplessness. Later placed in another situation where they *could* escape the

punishment by simply leaping a hurdle, the dogs cowered as if without hope. In contrast, animals able to escape the first shocks learned personal control and easily escaped the shocks in the new situation. People, too, when repeatedly faced with traumatic events over which they have no control, come to feel helpless, hopeless, and depressed. Psychologists call this passive resignation **learned helplessness**. (More on this concept and its relation to our sense of control in **Unit 10**.)

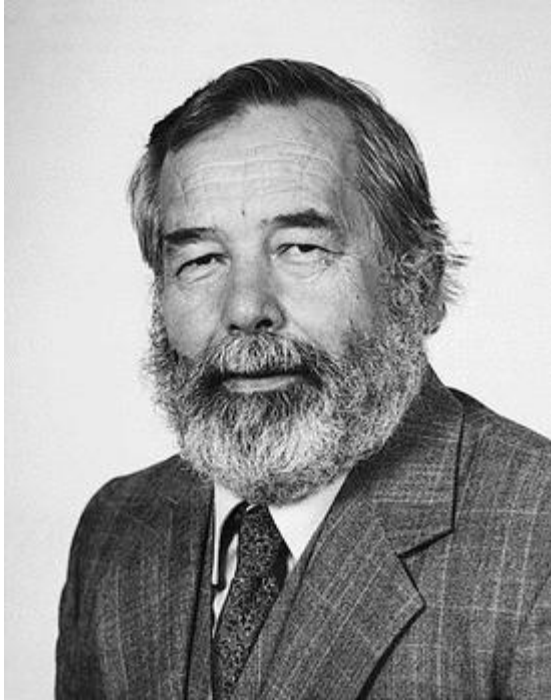
Such experiments help explain why classical conditioning treatments that ignore cognition often have limited success. For example, people receiving therapy for alcohol dependency may be given alcohol spiked with a nauseating drug. Will they then associate alcohol with sickness? If classical conditioning were merely a matter of “stamping in” stimulus associations, we might hope so, and to some extent this does occur (as we will see in **Unit 13**). However, the awareness that the nausea is induced by the drug, not the alcohol, often weakens the association between drinking alcohol and feeling sick. So, even in classical conditioning, it is (especially with humans) not simply the CS–US association but also the thought that counts.

“All brains are, in essence, anticipation machines.”

Daniel C. Dennett, *Consciousness Explained*, 1991

Biological Predispositions

Ever since Charles Darwin, scientists have assumed that all animals share a common evolutionary history and thus commonalities in their makeup and functioning. Pavlov and Watson, for example, believed that the basic laws of learning were essentially similar in all animals. So it should make little difference whether one studied pigeons or people. Moreover, it seemed that any natural response could be conditioned to any neutral stimulus. As learning researcher Gregory Kimble proclaimed in 1956, “Just about any activity of which the organism is capable can be conditioned and...these responses can be conditioned to any stimulus that the organism can perceive” (p. 195).



John Garcia As the laboring son of California farmworkers, Garcia attended school only in the off-season during his early childhood years. After entering junior college in his late twenties, and earning his Ph.D. in his late forties, he received the American Psychological Association's Distinguished Scientific Contribution Award "for his highly original, pioneering research in conditioning and learning." He was also elected to the National Academy of Sciences. Courtesy of John Garcia

Twenty-five years later, Kimble (1981) humbly acknowledged that "half a thousand" scientific reports had proven him wrong. More than the early behaviorists realized, an animal's capacity for conditioning is constrained by its biology. Each species' predispositions prepare it to learn the associations that enhance its survival. Environments are not the whole story.

John Garcia was among those who challenged the prevailing idea that all associations can be learned equally well. While researching the effects of radiation on laboratory animals, Garcia and Robert Koelling (1966) noticed that rats began to avoid drinking water from the plastic bottles in radiation chambers. Could classical conditioning be the culprit? Might the rats have linked the plastic-tasting water (a CS) to the sickness (UR) triggered by the radiation (US)?

To test their hunch, Garcia and Koelling gave the rats a particular taste, sight, or sound (CS) and later also gave them radiation or drugs (US) that led to nausea and vomiting (UR). Two startling findings emerged: First, even if sickened as late as several hours after tasting a particular novel flavor, the rats thereafter avoided that flavor. This appeared to violate the notion that for conditioning to occur, the US must immediately follow the CS.

Second, the sickened rats developed aversions to tastes but not to sights or sounds. This contradicted the behaviorists' idea that any perceivable stimulus could serve as a CS. But it made adaptive sense, because for rats the easiest way to identify tainted

food is to taste it. (If sickened after sampling a new food, they thereafter avoid the food—which makes it difficult to eradicate a population of “bait-shy” rats by poisoning.)

Humans, too, seem biologically prepared to learn some associations rather than others. If you become violently ill four hours after eating contaminated seafood, you will probably develop an aversion to the taste of the seafood but not to the sight of the associated restaurant, its plates, the people you were with, or the music you heard there. In contrast, birds, which hunt by sight, appear biologically primed to develop aversions to the *sight* of tainted food (Nicolaus et al., 1983). Organisms are predisposed to learn associations that help them adapt.

Remember those Japanese quail that were conditioned to get excited by a red light that signaled a receptive female’s arrival? Michael Domjan and his colleagues (2004) report that such conditioning is even speedier, stronger, and more durable when the CS is *ecologically relevant*—something similar to stimuli associated with sexual activity in the natural environment, such as the stuffed head of a female quail. In the real world, observes Domjan (2005), conditioned stimuli have a natural association with the unconditioned stimuli they predict.

This may help explain why we humans seem to be naturally disposed to learn associations between the color red and women’s sexuality, note Andrew Elliot and Daniela Niesta (2008). Female primates display red when nearing ovulation. In human females, enhanced bloodflow produces the red blush of flirtation and sexual excitement. Does the frequent pairing of red and sex—with Valentine’s hearts, red-light districts, and red lipstick—naturally enhance men’s attraction to women? Elliot and Niesta’s experiments consistently suggest that, without men’s awareness, it does (**Figure 6.8**).

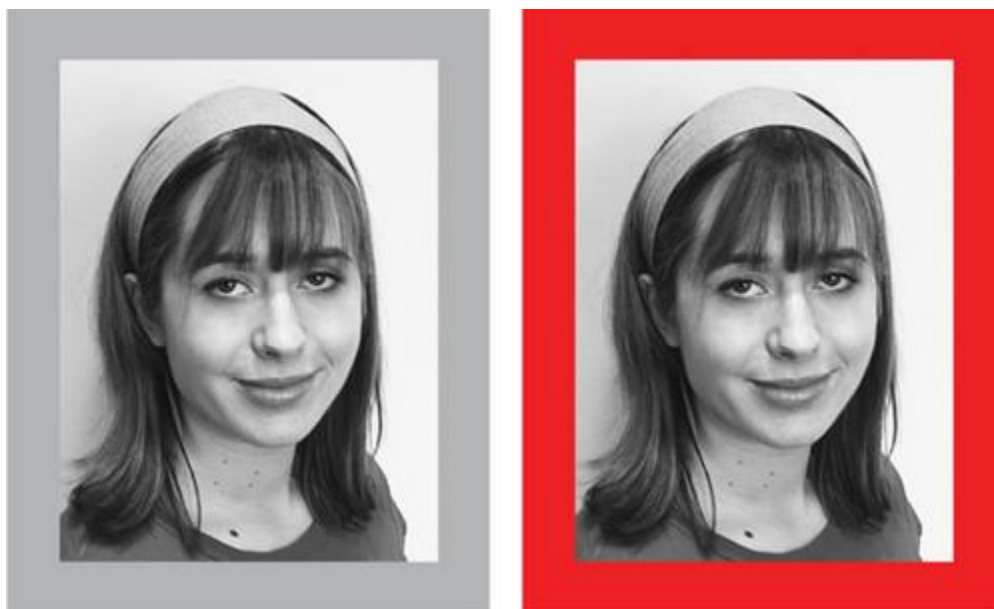


Figure 6.8 Romantic red In a series of experiments that controlled for other factors (such as the brightness of the image), men found women more attractive and sexually desirable when framed in red (Elliot & Niesta, 2008). Courtesy of Kathryn Brownson, Hope College



Taste aversion If you became violently ill after eating seafood, you probably would have a hard time eating it again. The smell and taste would have become a CS for nausea. This learning occurs readily because our biology prepares us to learn taste aversions to toxic foods. Colin Young-Wolff/PhotoEdit Inc.

Garcia's early findings on taste aversion were met with an onslaught of criticism. As the German philosopher Arthur Schopenhauer (1788–1860) once said, important ideas are first ridiculed, then attacked, and finally taken for granted. In Garcia's case, the leading journals refused to publish his work. The findings were impossible, said some critics. But, as often happens in science, Garcia and Koelling's taste-aversion research is now basic textbook material. It is also a good example of experiments that began with the discomfort of some laboratory animals and ended by enhancing the welfare of many others. In another conditioned taste-aversion study, coyotes and wolves that were tempted into eating sheep carcasses laced with a sickening poison developed an aversion to sheep meat (Gustavson et al., 1974, 1976). Two wolves later penned with a live sheep seemed actually to fear it. The study not only saved the sheep from their predators, but also saved the sheep-shunning coyotes and wolves from angry ranchers and farmers who had wanted to destroy them. Later applications of Garcia and Koelling's findings have prevented baboons from raiding African gardens, raccoons from attacking chickens, and ravens and crows from feeding on crane eggs—all while preserving predators who occupy an important ecological niche (Garcia & Gustavson, 1997).

All these cases support Darwin's principle that natural selection favors traits that aid survival. Our ancestors who readily learned taste aversions were unlikely to eat the same toxic food again and were more likely to survive and leave descendants. Nausea,

like anxiety, pain, and other bad feelings, serves a good purpose. Like a low-oil warning on a car dashboard, each alerts the body to a threat (Neese, 1991).

The discovery of biological constraints—our readiness to learn adaptive associations such as taste aversions—affirms the value of different levels of analysis, including the biological and cognitive (**Figure 6.9**), when we seek to understand phenomena such as learning. And once again, we see an important principle at work: *Learning enables animals to adapt to their environments*. Responding to stimuli that announce significant events, such as food or pain, is adaptive. So is a genetic predisposition to associate a CS with a US that follows predictably and immediately: Causes often immediately precede effects.

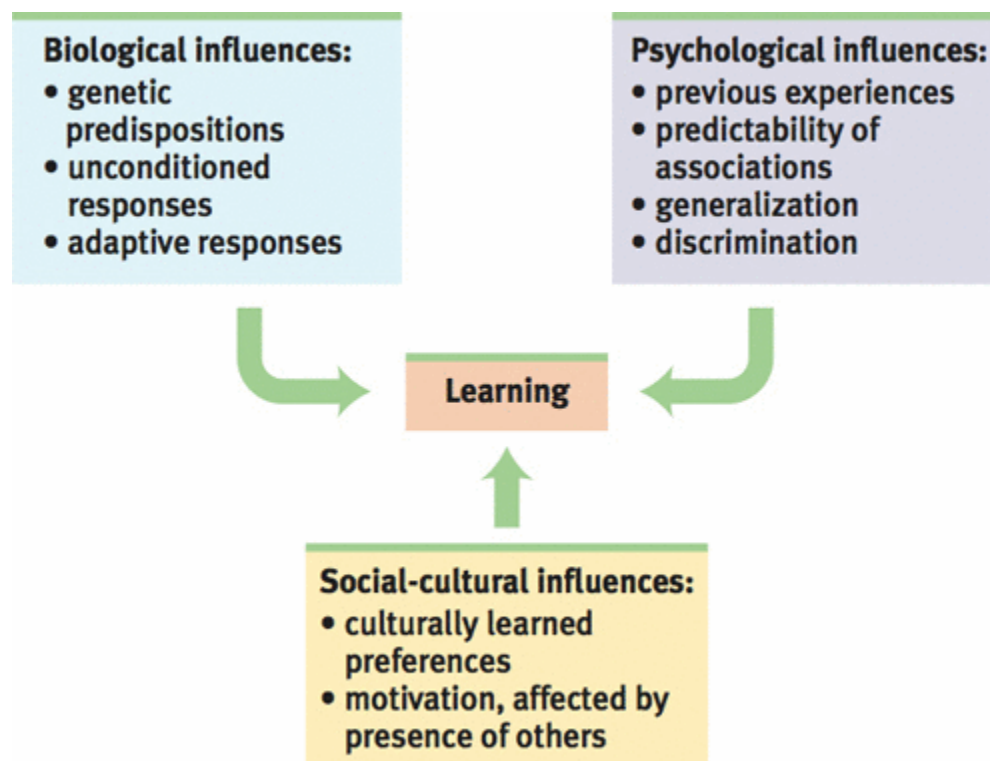


Figure 6.9 Biopsychosocial influences on learning Today's learning theorists recognize that our learning results not only from environmental experiences, but also from cognitive and biological influences.

"All animals are on a voyage through time, navigating toward futures that promote their survival and away from futures that threaten it. Pleasure and pain are the stars by which they steer."

Psychologists Daniel T. Gilbert and Timothy D. Wilson, "Prospection: Experiencing the Future," 2007

"Once bitten, twice shy."

Often, but not always, as we saw in the taste-aversion findings. Adaptation also sheds light on this exception. The ability to discern that effect need not follow cause immediately—that poisoned food can cause sickness quite a while after it has been eaten—gives animals an adaptive advantage. Occasionally, however, our predispositions trick us. When chemotherapy triggers nausea and vomiting more than an hour following treatment, cancer patients may over time develop classically conditioned nausea (and sometimes anxiety) to the sights, sounds, and smells associated with the clinic (**Figure 6.10**) (Hall, 1997). Merely returning to the clinic's waiting room or seeing the nurses can provoke these conditioned feelings (Burish & Carey, 1986; Davey, 1992). Under normal circumstances, such revulsion to sickening stimuli would be adaptive.

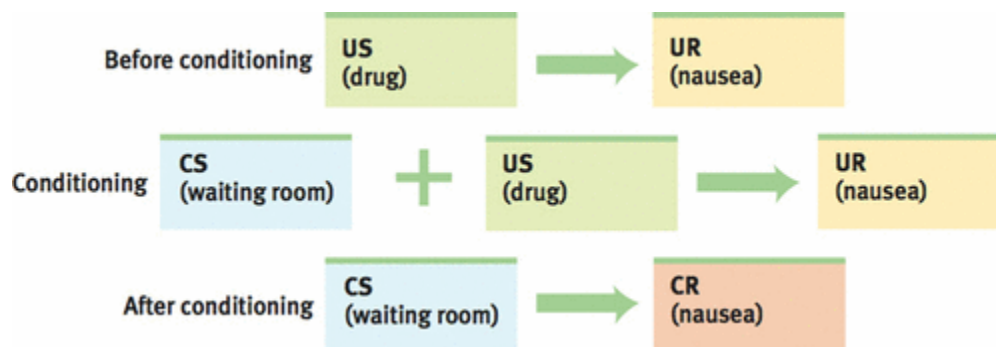


Figure 6.10 Nausea conditioning in cancer patients

6.2.3 Pavlov's Legacy

6: Why is Pavlov's work important?

What, then, remains of Pavlov's ideas? A great deal. Most psychologists agree that classical conditioning is a basic form of learning. Judged by today's knowledge of cognitive processes and biological predispositions, Pavlov's ideas were incomplete. But if we see further than Pavlov did, it is because we stand on his shoulders.

Why does Pavlov's work remain so important? If he had merely taught us that old dogs can learn new tricks, his experiments would long ago have been forgotten. Why should we care that dogs can be conditioned to salivate at the sound of a tone? The importance lies first in this finding: *Many other responses to many other stimuli can be classically conditioned in many other organisms*—in fact, in every species tested, from earthworms to fish to dogs to monkeys to people (Schwartz, 1984). Thus, classical conditioning is one way that virtually all organisms learn to adapt to their environment.

Second, *Pavlov showed us how a process such as learning can be studied objectively*. He was proud that his methods involved virtually no subjective judgments or guesses about what went on in a dog's mind. The salivary response is a behavior measurable in cubic centimeters of saliva. Pavlov's success therefore suggested a scientific model for

how the young discipline of psychology might proceed—by isolating the basic building blocks of complex behaviors and studying them with objective laboratory procedures.

"[Psychology's] factual and theoretical developments in this century—which have changed the study of mind and behavior as radically as genetics changed the study of heredity—have all been the product of objective analysis—that is to say, behavioristic analysis."

Psychologist Donald Hebb (1980)

Applications of Classical Conditioning

7: What have been some applications of classical conditioning?

Other units in this text—on consciousness, motivation, emotion, health, psychological disorders, and therapy—show how Pavlov's principles of classical conditioning apply to human health and well-being. Two examples:

- Former drug users often feel a craving when they are again in the drug-using context—with people or in places they associate with previous highs. Thus, drug counselors advise addicts to steer clear of people and settings that may trigger these cravings (Siegel, 2005).
- Classical conditioning even works on the body's disease-fighting immune system. When a particular taste accompanies a drug that influences immune responses, the taste by itself may come to produce an immune response (Ader & Cohen, 1985).



John B. Watson Watson (1924) admitted to “going beyond my facts” when offering his famous boast: “Give me a dozen healthy infants, well-formed, and my own specified world to bring them up in and I’ll guarantee to take any one at random and train him to become any type of specialist I might select—doctor, lawyer, artist, merchant-chief, and, yes, even beggar-man and thief, regardless of his talents, penchants, tendencies, abilities, vocations, and race of his ancestors.” Brown Brothers

In Watson and Rayner’s experiment, what was the US? The UR? The CS? The CR?
(Answers below.)

The US was the loud noise; the UR was the startled fear response; the CS was the rat;
the CR was fear.

Pavlov’s work also provided a basis for John Watson’s (1913) idea that human emotions and behaviors, though biologically influenced, are mainly a bundle of conditioned responses. Working with an 11-month-old named Albert, Watson and Rosalie Rayner (1920; Harris, 1979) showed how specific fears might be conditioned. Like most infants, “Little Albert” feared loud noises but not white rats. Watson and Rayner presented a white rat and, as Little Albert reached to touch it, struck a hammer against a steel bar just behind his head. After seven repeats of seeing the rat and hearing the frightening noise, Albert burst into tears at the mere sight of the rat (an ethically troublesome study by today’s standards). What is more, five days later Albert showed generalization of his conditioned response by reacting with fear to a rabbit, a dog, and a sealskin coat, but not to dissimilar objects such as toys.

Although Little Albert’s fate is unknown, Watson’s is not. After losing his professorship at Johns Hopkins University over an affair with Rayner (whom he later married), he became the J. Walter Thompson advertising agency’s resident psychologist. There he used his knowledge of associative learning to conceive many successful campaigns, including the classic one for Maxwell House coffee that helped make the “coffee break” an American custom (Hunt, 1993).

Some psychologists, noting that Albert’s fear wasn’t learned quickly, had difficulty repeating Watson and Rayner’s findings with other children. Nevertheless, Little Albert’s case has had legendary significance for many psychologists. Some have wondered if each of us might not be a walking repository of conditioned emotions (see Close-Up: Trauma as Classical Conditioning on the next page). Might extinction procedures or even new conditioning help us change our unwanted responses to emotion-arousing stimuli? One patient, who for 30 years had feared going into an elevator alone, did just that. Following his therapist’s advice, he forced himself to enter 20 elevators a day. Within 10 days, his fear had nearly extinguished (Ellis & Becker, 1982). In **Unit 12** and **Unit 13**, we will see more examples of how psychologists use behavioral techniques to treat emotional disorders and promote personal growth.

Trauma as Classical Conditioning

“A burnt child dreads the fire,” says a medieval proverb. Experiments with dogs reveal that, indeed, if a painful stimulus is sufficiently powerful, a single event is sometimes enough to traumatize the animal when it again faces the situation. The human

counterparts to these experiments can be tragic, as illustrated by one woman's experience of being attacked and raped, and conditioned to a period of fear. Her fear (CR) was most powerfully associated with particular locations and people (CS), but it generalized to other places and people. Note, too, how her traumatic experience robbed her of the normally relaxing associations with such stimuli as home and bed.

Four months ago I was raped. In the middle of the night I awoke to the sound of someone outside my bedroom. Thinking my housemate was coming home, I called out her name. Someone began walking slowly toward me, and then I realized. I screamed and fought, but there were two of them. One held my legs, while the other put a hand over my mouth and a knife to my throat and said, "Shut up...or we'll kill you." Never have I been so terrified and helpless. They both raped me, one brutally. As they then searched my room for money and valuables, my housemate came home. They brought her into my room, raped her, and left us both tied up on my bed.

We never slept another night in that apartment. We were too terrified. Still, when I go to bed at night—always with the bedroom light left on—the memory of them entering my room repeats itself endlessly. I was an independent person who had lived alone or with other women for four years; now I can't even think about spending a night alone. When I drive by our old apartment, or when I have to go into an empty house, my heart pounds and I sweat. I am afraid of strangers, especially men, and the more they resemble my attackers the more I fear them. My housemate shares many of my fears and is frightened when entering our new apartment. I'm afraid to stay in the same town, I'm afraid it will happen again, I'm afraid to go to bed. I dread falling asleep.

Eleven years later this woman could report—as do many trauma victims (Gluhoski & Wortman, 1996)—that her conditioned fears had mostly extinguished:

The frequency and intensity of my fears have subsided. Still, I remain cautious about personal safety and occasionally have nightmares about my experience. But more important is my renewed ability to laugh, love, and trust—both old friends and new. Life is once again joyful. I have survived.

(From personal correspondence, with permission.)

6.3 Operant Conditioning

8: What is operant conditioning, and how does it differ from classical conditioning?

IT'S ONE THING TO CLASSICALLY CONDITION a dog to salivate at the sound of a tone, or a child to fear moving cars. To teach an elephant to walk on its hind legs or a child to say *please*, we must turn to another type of learning—*operant conditioning*.

Classical conditioning and operant conditioning are both forms of associative learning, yet their difference is straightforward:

- *Classical conditioning* forms associations between stimuli (a CS and the US it signals). It also involves **respondent behavior**—actions that are automatic responses to a stimulus (such as salivating in response to meat powder and later in response to a tone).
- In **operant conditioning**, organisms associate their own actions with consequences. Actions followed by reinforcers increase; those followed by punishers decrease. Behavior that *operates* on the environment to *produce* rewarding or punishing stimuli is called **operant behavior**.

We can therefore distinguish classical from operant conditioning by asking: *Is the organism learning associations between events it does not control* (classical conditioning)? *Or is it learning associations between its behavior and resulting events* (operant conditioning)?

6.3.1 Skinner's Experiments

B. F. Skinner (1904–1990) was a college English major and an aspiring writer who, seeking a new direction, entered graduate school in psychology. He went on to become modern behaviorism's most influential and controversial figure. Skinner's work elaborated what psychologist Edward L. Thorndike (1874–1949) called the **law of effect**: Rewarded behavior is likely to recur (**Figure 6.11**). Using Thorndike's law of effect as a starting point, Skinner developed a *behavioral technology* that revealed principles of *behavior control*. These principles also enabled him to teach pigeons such unpigeonlike behaviors as walking in a figure 8, playing Ping-Pong, and keeping a missile on course by pecking at a screen target.

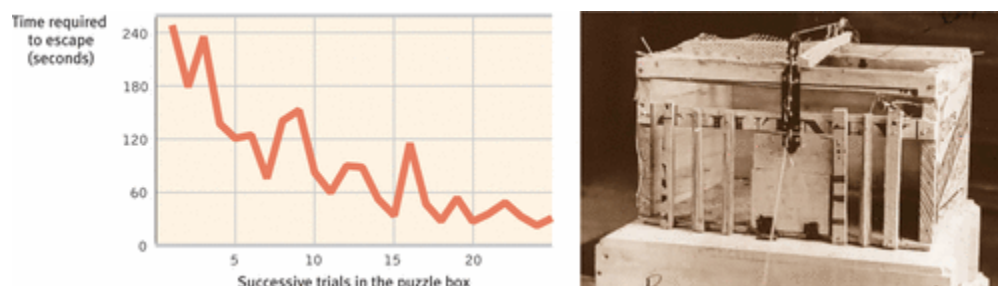


Figure 6.11 Cat in a puzzle box Thorndike (1898) used a fish reward to entice cats to find their way out of a puzzle box (above right) through a series of maneuvers. The cats' performance tended to improve with successive trials (above left), illustrating Thorndike's *law of effect*. (Adapted from Thorndike, 1898.) Yale University Library

For his pioneering studies, Skinner designed an **operant chamber**, popularly known as a *Skinner box* (**Figure 6.12**). The box has a bar or key that an animal presses or pecks to release a reward of food or water, and a device that records these responses. Operant conditioning experiments have done far more than teach us how to pull habits out of a rat. They have explored the precise conditions that foster efficient and enduring learning.

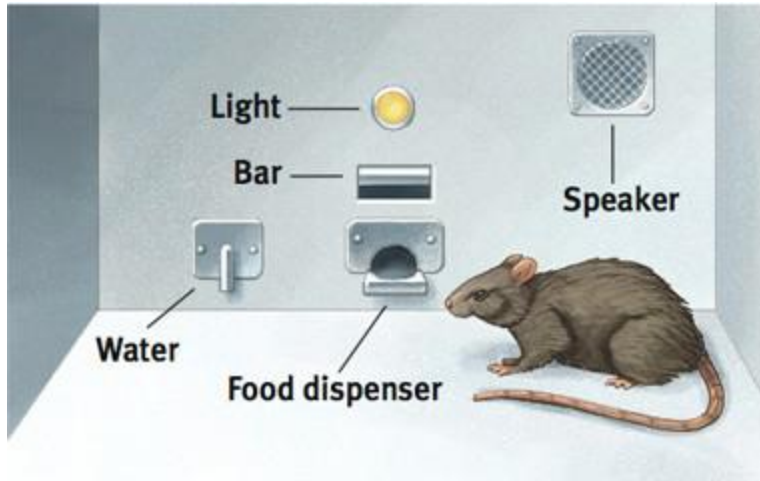


Figure 6.12 A Skinner box Inside the box, the rat presses a bar for a food reward. Outside, a measuring device (not shown here) records the animal's accumulated responses. Khamis Ramadhan/Panapress/Getty Images

Shaping Behavior



Shaping rats to save lives A Gambian giant pouched rat, having been shaped to sniff out land mines, receives a bite of banana after successfully locating a mine during training in Mozambique. Fred Bavendam/Peter Arnold, Inc.

In his experiments, Skinner used **shaping**, a procedure in which *reinforcers*, such as food, gradually guide an animal's actions toward a desired behavior. Imagine that you wanted to condition a hungry rat to press a bar. First, you would watch how the animal naturally behaves, so that you could build on its existing behaviors. You might give the rat a food reward each time it approaches the bar. Once the rat is approaching regularly, you would require it to move closer before rewarding it, then closer still. Finally, you would require it to touch the bar before you gave it the food. With this method of *successive approximations*, you reward responses that are ever-closer to the final desired behavior, and you ignore all other responses. By making rewards

contingent on desired behaviors, researchers and animal trainers gradually shape complex behaviors.



A discriminating creature University of Windsor psychologist Dale Woodyard uses a food reward to train this manatee to discriminate between objects of different shapes, colors, and sizes. Manatees remember such responses for a year or more. Fred Bavendam/Peter Arnold, Inc.

Shaping can also help us understand what nonverbal organisms perceive. Can a dog distinguish red and green? Can a baby hear the difference between lower-and higher-pitched tones? If we can shape them to respond to one stimulus and not to another, then we know they can perceive the difference. Such experiments have even shown that some animals can form concepts. If an experimenter reinforces a pigeon for pecking after seeing a human face, but not after seeing other images, the pigeon learns to recognize human faces (Herrnstein & Loveland, 1964). In this experiment, a face is a **discriminative stimulus**; like a green traffic light, it signals that a response will be reinforced. After being trained to discriminate among flowers, people, cars, and chairs, pigeons can usually identify the category in which a new pictured object belongs (Bhatt et al., 1988; Wasserman, 1993). They have even been trained to discriminate between Bach's music and Stravinsky's (Porter & Neuringer, 1984).

In everyday life, we continually reward and shape others' behavior, said Skinner, but we often do so unintentionally. Billy's whining, for example, annoys his mystified parents, but look how they typically deal with Billy:

Billy: Could you tie my shoes?

Father: (Continues reading paper.)

Billy: Dad, I need my shoes tied.

Father: Uh, yeah, just a minute.

Billy: DAAAAD! TIE MY SHOES!

Father: How many times have I told you not to whine? Now, which shoe do we do first?

Billy's whining is reinforced, because he gets something desirable—his dad's attention. Dad's response is reinforced because it gets rid of something aversive—Billy's whining.

Or consider a teacher who pastes gold stars on a wall chart after the names of children scoring 100 percent on spelling tests. As everyone can then see, some children consistently do perfect work. The others, who take the same test and may have worked harder than the academic all-stars, get no rewards. The teacher would be better advised to apply the principles of operant conditioning—to reinforce all spellers for gradual improvements (successive approximations toward perfect spelling of words they find challenging).



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Types of Reinforcers

9: What are the basic types of reinforcers?

People often refer rather loosely to the power of “rewards.” This idea gains a more precise meaning in Skinner’s concept of a **reinforcer**: any event that strengthens (increases the frequency of) a preceding response. A reinforcer may be a tangible reward, such as food or money. It may be praise or attention—even being yelled at, for a child hungry for attention. Or it may be an activity—borrowing the family car after doing the dishes, or taking a break after an hour of study.



Positive reinforcement A heat lamp positively reinforces this Taronga Zoo meerkat’s behavior during a cold snap in Sydney, Australia. Reuters/Corbis

Although anything that serves to increase behavior is a reinforcer, reinforcers vary with circumstances. What's reinforcing to one person (rock concert tickets) may not be to another. What's reinforcing in one situation (food when hungry) may not be in another.

Up to now, we've really been discussing **positive reinforcement**, which strengthens a response by *presenting* a typically pleasurable stimulus after a response. But there are *two* basic kinds of reinforcement (**Table 6.1**). **Negative reinforcement** *strengthens* a response by *reducing* or *removing* something undesirable or unpleasant, as when an organism escapes an aversive situation. Taking aspirin may relieve your headache, and pushing the snooze button will silence your annoying alarm. These welcome results (end of pain, end of alarm) provide negative reinforcement and increase the odds that you will repeat these behaviors. For drug addicts, the negative reinforcement of ending withdrawal pangs can be a compelling reason to resume using (Baker et al., 2004). Note that contrary to popular usage, *negative reinforcement is not punishment*. (*Advice*: Repeat the last five words in your mind, because this is one of psychology's most often misunderstood concepts.) Rather, negative reinforcement *removes* a punishing (aversive) event.

Table 6.1

WAYS TO INCREASE BEHAVIOR		
Operant Conditioning Term	Description	Examples
Positive reinforcement	Add a desirable stimulus	Getting a hug; receiving a paycheck
Negative reinforcement	Remove an aversive stimulus	Fastening seatbelt to turn off beeping

Sometimes negative and positive reinforcement coincide. Imagine a worried student who, after goofing off and getting a bad test grade, studies harder for the next test. This increased effort may be negatively reinforced by reduced anxiety, and positively reinforced by a better grade. Whether it works by reducing something aversive, or by giving something desirable, *reinforcement is any consequence that strengthens behavior*.

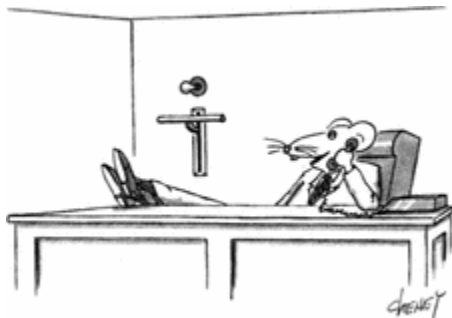
Remember whining Billy? In that example, whose behavior was positively reinforced and whose was negatively reinforced? (Answer below.)

Billy's whining was positively reinforced, because Billy got something desirable—his father's attention. His dad's response to the whining (doing what Billy wanted) was negatively reinforced, because it got rid of Billy's annoying whining.

Primary and Conditioned Reinforcers **Primary reinforcers**—getting food when hungry or having a painful headache go away—are unlearned. They are innately satisfying. **Conditioned reinforcers**, also called *secondary reinforcers*, get their power through learned association with primary reinforcers. If a rat in a Skinner box learns that a light reliably signals that food is coming, the rat will work to turn on the light. The light has become a conditioned reinforcer associated with food. Our lives are filled with conditioned reinforcers—money, good grades, a pleasant tone of voice—each of

which has been linked with more basic rewards. If money is a conditioned reinforcer—if people’s desire for money is derived from their desire for food—then hunger should also make people more money-hungry, reasoned one European research team (Briers et al., 2006). Indeed, in their experiments, people were less likely to donate to charity when food deprived, and less likely to share money with fellow participants when in a room with hunger-arousing aromas.

Immediate and Delayed Reinforcers Let’s return to the imaginary shaping experiment in which you were conditioning a rat to press a bar. Before performing this “wanted” behavior, the hungry rat will engage in a sequence of “unwanted” behaviors—scratching, sniffing, and moving around. If you present food immediately after any one of these behaviors, the rat will likely repeat that rewarded behavior. But what if the rat presses the bar while you are distracted, and you delay giving the reinforcer? If the delay lasts longer than 30 seconds, the rat will not learn to press the bar. You will have reinforced other incidental behaviors—more sniffing and moving—that intervened after the bar press.



"Oh, not bad. The light comes on, I press the bar, they write me a check. How about you?" © The New Yorker Collection, 1993, Tom Cheney from cartoonbank.com. All rights reserved.

Unlike rats, humans do respond to delayed reinforcers: the paycheck at the end of the week, the good grade at the end of the term, the trophy at the end of the season. Indeed, to function effectively we must learn to delay gratification. In laboratory testing, some 4-year-olds show this ability. In choosing a candy, they prefer having a big one tomorrow to munching on a small one right now. Learning to control our impulses in order to achieve more valued rewards is a big step toward maturity (Logue, 1998a, b). No wonder children who make such choices tend to become socially competent and high-achieving adults (Mischel et al., 1989).

But to our detriment, small but immediate consequences (the enjoyment of watching late-night TV, for example) are sometimes more alluring than big but delayed consequences (not feeling sluggish tomorrow). For many teens, the immediate gratification of risky, unprotected sex in passionate moments prevails over the delayed gratifications of safe sex or saved sex (Loewenstein & Furstenberg, 1991). And for too many of us, the immediate rewards of today’s gas-guzzling vehicles, air travel, and air conditioning have prevailed over the bigger future consequences of global climate change, rising seas, and extreme weather.

Reinforcement Schedules

10: How do different reinforcement schedules affect behavior?

So far, most of our examples have assumed **continuous reinforcement**: Reinforcing the desired response every time it occurs. Under such conditions, learning occurs rapidly, which makes continuous reinforcement preferable until a behavior is mastered. But extinction also occurs rapidly. When reinforcement stops—when we stop delivering food after the rat presses the bar—the behavior soon stops. If a normally dependable candy machine fails to deliver a chocolate bar twice in a row, we stop putting money into it (although a week later we may exhibit spontaneous recovery by trying again).

"The charm of fishing is that it is the pursuit of what is elusive but attainable, a perpetual series of occasions for hope."

Scottish author John Buchan (1875–1940)

Real life rarely provides continuous reinforcement. Salespeople do not make a sale with every pitch, nor do anglers get a bite with every cast. But they persist because their efforts have occasionally been rewarded. This persistence is typical with **partial (intermittent) reinforcement** schedules, in which responses are sometimes reinforced, sometimes not. Although initial learning is slower, intermittent reinforcement produces greater *resistance to extinction* than is found with continuous reinforcement. Imagine a pigeon that has learned to peck a key to obtain food. When the experimenter gradually phases out the delivery of food until it occurs only rarely and unpredictably, pigeons may peck 150,000 times without a reward (Skinner, 1953). Slot machines reward gamblers in much the same way—occasionally and unpredictably. And like pigeons, slot players keep trying, time and time again. With intermittent reinforcement, hope springs eternal. Lesson for parents: Partial reinforcement also works with children. *Occasionally* giving in to children's tantrums for the sake of peace and quiet intermittently reinforces the tantrums. This is the very best procedure for making a behavior persist.

Skinner (1961) and his collaborators compared four schedules of partial reinforcement. Some are rigidly fixed, some unpredictably variable.

Fixed-ratio schedules reinforce behavior after a set number of responses. Just as coffee shops reward us with a free drink after every 10 purchased, laboratory animals may be reinforced on a fixed ratio of, say, one reinforcer for every 30 responses. Once conditioned, the animal will pause only briefly after a reinforcer and will then return to a high rate of responding (**Figure 6.13**).

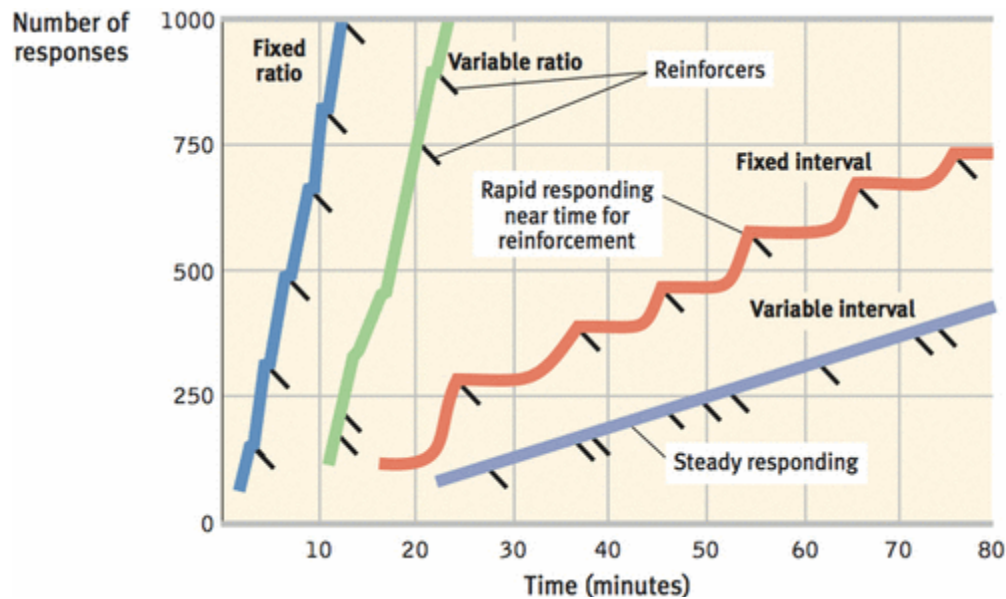


Figure 6.13 Intermittent reinforcement schedules Skinner's laboratory pigeons produced these response patterns to each of four reinforcement schedules. (Reinforcers are indicated by diagonal marks.) For people, as for pigeons, reinforcement linked to number of responses (a ratio schedule) produces a higher response rate than reinforcement linked to amount of time elapsed (an *interval* schedule). But the predictability of the reward also matters. An unpredictable (*variable*) schedule produces more consistent responding than does a predictable (*fixed*) schedule. Adapted from "Teaching machines" by B. F. Skinner. Copyright © 1961, Scientific American, Inc. All Rights Reserved.

Door-to-door salespeople are reinforced by which schedule? People checking the oven to see if the cookies are done are on which schedule? Airline frequent-flyer programs that offer a free flight after every 25,000 miles of travel use which reinforcement schedule? (Answers below.)

Door-to-door salespeople are reinforced on a variable-ratio schedule (after varying numbers of rings). Cookie checkers are reinforced on a fixed-interval schedule. Frequent-flyer programs use a fixed-ratio schedule.

Variable-ratio schedules provide reinforcers after an unpredictable number of responses. This is what slot-machine players and fly-casting anglers experience—unpredictable reinforcement—and what makes gambling and fly fishing so hard to extinguish even when both are getting nothing for something. Like the fixed-ratio schedule, the variable-ratio schedule produces high rates of responding, because reinforcers increase as the number of responses increases.

Fixed-interval schedules reinforce the first response after a fixed time period. Like people checking more frequently for the mail as the delivery time approaches, or checking to see if the Jell-O has set, pigeons on a fixed-interval schedule peck a key more frequently as the anticipated time for reward draws near, producing a choppy stop-start pattern (see [Figure 6.13](#)) rather than a steady rate of response.

Variable-interval schedules reinforce the first response after *varying* time intervals. Like the "You've got mail" that finally rewards persistence in rechecking for e-mail, variable-interval schedules tend to produce slow, steady responding. This makes sense, because there is no knowing when the waiting will be over ([Table 6.2](#)).

Table 6.2

SCHEDULES OF REINFORCEMENT		
	Fixed	Variable
Ratio	<i>Every so many:</i> reinforcement after every n^{th} behavior, such as buy 10 coffees, get 1 free, or pay per product unit produced	<i>After an unpredictable number:</i> reinforcement after a random number of behaviors, as when playing slot machines or fly-casting
Interval	<i>Every so often:</i> reinforcement for behavior after a fixed time, such as Tuesday discount prices	<i>Unpredictably often:</i> reinforcement for behavior after a random amount of time, as in checking for e-mail

Animal behaviors differ, yet Skinner (1956) contended that the reinforcement principles of operant conditioning are universal. It matters little, he said, what response, what reinforcer, or what species you use. The effect of a given reinforcement schedule is pretty much the same: "Pigeon, rat, monkey, which is which? It doesn't matter.... Behavior shows astonishingly similar properties."

Punishment

11: How does punishment affect behavior?

Reinforcement increases a behavior; **punishment** does the opposite. A *punisher* is any consequence that *decreases* the frequency of a preceding behavior (**Table 6.3**).

Table 6.3

WAYS TO DECREASE BEHAVIOR		
Type of Punisher	Description	Possible Examples
Positive punishment	Administer an aversive stimulus	Spanking; a parking ticket
Negative punishment	Withdraw a desirable stimulus	Time-out from privileges (such as time with friends); revoked driver's license

Swift and sure punishers can powerfully restrain unwanted behavior. The rat that is shocked after touching a forbidden object and the child who loses a treat after running into the street will learn not to repeat the behavior. A dog that has learned to come running at the sound of an electric can opener will stop coming if its owner starts running the machine to attract the dog and banish it to the basement.

Sureness and swiftness are also marks of effective criminal punishment, note John Darley and Adam Alter (in press). Studies show that criminal behavior, much of it impulsive, is not deterred by the threat of severe sentences. Thus, when Arizona introduced an exceptionally harsh sentence for first-time drunk drivers, it did not affect the drunk-driving rate. But when Kansas City started patrolling a high crime area to increase the sureness and swiftness of punishment, crime dropped dramatically.

So, how should we interpret the punishment studies in relation to parenting practices? Many psychologists and supporters of nonviolent parenting note four drawbacks of physically punishing children (Gershoff, 2002; Marshall, 2002).

1. **Punished behavior is suppressed, not forgotten.** This suppression, though temporary, may (negatively) reinforce parents' punishing behavior. The child swears, the parent swats, the parent hears no more swearing and feels the punishment successfully stopped the behavior. No wonder spanking is a hit with so many U.S. parents of 3- and 4-year-olds—more than 9 in 10 of whom acknowledge spanking their children (Kazdin & Benjet, 2003).
2. **Punishment teaches discrimination.** Was the punishment effective in putting an end to the swearing? Or did the child simply learn that it's not okay to swear around the house, but it is okay to swear elsewhere?
3. **Punishment can teach fear.** The child may associate fear not only with the undesirable behavior but also with the person who delivered the punishment or the place it occurred. Thus, children may learn to fear a punishing teacher and try to avoid school. For such reasons, most European countries and most U.S. states now ban hitting children in schools (StopHitting.com, 2009). Eleven countries, including those in Scandinavia, further outlaw hitting by parents, giving children the same legal protection given to spouses (EPOCH, 2000).
4. **Physical punishment may increase aggressiveness by modeling aggression as a way to cope with problems.** We know that many aggressive delinquents and abusive parents come from abusive families (Straus & Gelles, 1980; Straus et al., 1997). But some researchers note a problem with studies that find that spanked children are at increased risk for aggression (and depression and low self-esteem). Well, yes, they say, just as people who have undergone psychotherapy are more likely to suffer depression—because they had preexisting problems that triggered the treatments (Larzelere, 2000, 2004). Which is the chicken and which is the egg? The correlations don't hand us an answer.

If one adjusts for preexisting antisocial behavior, then an occasional single swat or two to misbehaving 2- to 6-year-olds looks more effective (Baumrind et al., 2002; Larzelere & Kuhn, 2005). That is especially so if the swat is used only as a backup when milder disciplinary tactics (such as a *time-out*, removing them from reinforcing surroundings) fail, and when the swat is combined with a generous dose of reasoning and reinforcing. Remember: *Punishment tells you what not to do; reinforcement tells you what to do.* This dual approach can be effective. When children with self-destructive behaviors bite themselves or bang their heads, they may be mildly punished (say, with a squirt of water in the face), but they may also be rewarded (with positive attention and food) when they behave well. In class, teachers can give feedback on papers by saying, "No, but try this..." and "Yes, that's it!" Such responses reduce unwanted behavior while reinforcing more desirable alternatives.

Parents of delinquent youth are often unaware of how to achieve desirable behaviors without screaming or hitting their children (Patterson et al., 1982). Training programs can help reframe contingencies from dire threats to positive incentives—turning "You clean up your room this minute or no dinner!" to "You're welcome at the dinner table after you get your room cleaned up." When you stop to think about it, many threats of punishment are just as forceful, and perhaps more effective, if rephrased positively. Thus, "If you don't get your homework done, there'll be no car" would better be phrased as...

What punishment often teaches, said Skinner, is how to avoid it. Most psychologists now favor an emphasis on reinforcement: Notice people behaving well and commend them for it.

6.3.2 Extending Skinner's Understanding

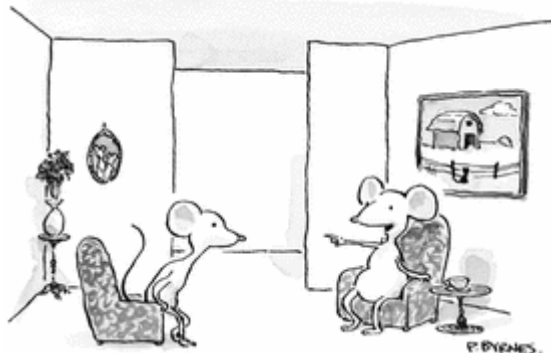
12: Do cognitive processes and biological constraints affect operant conditioning?

Skinner granted the existence of private thought processes and the biological underpinnings of behavior. Nevertheless, many psychologists criticized him for discounting the importance of these influences.

Cognition and Operant Conditioning

A mere eight days before dying of leukemia, Skinner (1990) stood before the American Psychological Association convention for one final critique of "cognitive science," which he viewed as a throwback to early twentieth-century introspectionism. Skinner died resisting the growing belief that cognitive processes—thoughts, perceptions, expectations—have a necessary place in the science of psychology and even in our understanding of conditioning. (He regarded thoughts and emotions as behaviors that follow the same laws as other behaviors.) Yet we have seen several hints that cognitive processes might be at work in operant learning. For example, animals on a fixed-interval reinforcement schedule respond more and more frequently as the time approaches when a response will produce a reinforcer. Although a strict behaviorist would object to talk of "expectations," the animals behave as if they expected that repeating the response would soon produce the reward.

For more information on animal behavior, see books by (I am not making this up) Robin Fox and Lionel Tiger.



"Bathroom? Sure, it's just down the hall to the left, jog right, left, another left, straight past two more lefts, then right, and it's at the end of the third corridor on your right." © The New Yorker Collection, 2000, Pat Byrnes, from cartoonbank.com. All rights reserved.

Latent Learning Evidence of cognitive processes has also come from studying rats in mazes, including classic studies by Edward Chase Tolman (1886–1959) and C.H. Honzik

that were done in Skinner's youth. After exploring a maze for 10 days, rats received a food reward at the end of the maze. They quickly demonstrated their prior learning of the maze—by immediately completing it as quickly as (and even faster than) rats that had been reinforced for running the maze all along (Tolman & Honzik, 1930). It seems that rats exploring a maze, with no obvious reward, are like people sightseeing in a new town. They seem to develop a **cognitive map**, a mental representation of the maze. This map, and their learning, is not demonstrated until the experimenter places food in the maze's goal box, which motivates the sightseeing rats to run the maze as quickly as possible—and typically as fast or faster than the rats that had been reinforced with food for running the maze.

During their explorations, the rats have seemingly experienced **latent learning**—learning that becomes apparent only when there is some incentive to demonstrate it. Children, too, may learn from watching a parent but demonstrate the learning only much later, as needed. The point to remember: *There is more to learning than associating a response with a consequence; there is also cognition.* In **Unit 7B**, we will encounter more striking evidence of cognitive abilities in solving problems and in using language.

Insight Learning Some learning occurs after little or no systematic interaction with our environment. For example, we may puzzle over a problem, and suddenly, the pieces fall together as we perceive the solution in a sudden flash of **insight**. Ten-year-old Johnny Appleton displayed insight in solving a problem that had stumped construction workers: how to rescue a young robin that had fallen into a narrow 30-inch-deep hole in a cement-block wall. Johnny's solution: Slowly pour in sand, giving the bird enough time to keep its feet on top of the constantly rising sand (Ruchlis, 1990).

Intrinsic Motivation The cognitive perspective has also led to an important qualification concerning the power of rewards: Promising people a reward for a task they already enjoy can backfire. Many think that offering tangible rewards will boost anyone's interest in an activity. Actually, in experiments, children promised a payoff for playing with an interesting puzzle or toy later play with the toy less than do their unpaid counterparts (Deci et al., 1999; Tang & Hall, 1995). It is as if the children think, "If I have to be bribed into doing this, it must not be worth doing for its own sake."



Pure love If this girl were suddenly told that she must look after her baby cousin from now on, she might lose some of the joy that her intrinsic motivation to care for him has provided. Courtesy of Christine Brune

Excessive rewards can undermine **intrinsic motivation**—the desire to perform a behavior effectively and for its own sake. **Extrinsic motivation** is the desire to behave in certain ways to receive external rewards or avoid threatened punishment.

To sense the difference, think about your experience in this course. Are you feeling pressured to finish this reading before a deadline? Worried about your grade? Eager for rewards that depend on your doing well? If yes, then you are extrinsically motivated (as, to some extent, almost all students must be). Are you also finding the course material interesting? Does learning it make you feel more competent? If there were no grade at stake, might you be curious enough to want to learn the material for its own sake? If yes, intrinsic motivation also fuels your efforts. Intrinsically motivated people work and play in search of enjoyment, interest, self-expression, or challenge.

Youth sports coaches who aim to promote enduring interest in an activity, not just to pressure players into winning, should focus on the intrinsic joy of playing and of reaching one's potential, note motivation researchers Edward Deci and Richard Ryan (1985, 1992, 2002). Giving people choices also enhances their intrinsic motivation (Patall et al., 2008). Nevertheless, rewards can be effective if used neither to bribe nor to control but to signal a job well done (Boggiano et al., 1985). "Most improved player" awards, for example, can boost feelings of competence and increase enjoyment of a sport. Rightly administered, rewards can raise performance and spark creativity (Eisenberger & Rhoades, 2001; Henderlong & Lepper, 2002). And extrinsic rewards (such as the college scholarships and jobs that often follow good grades) are here to stay.

Biological Predispositions



Natural athlete Animals can most easily learn and retain behaviors that draw on their biological predispositions, such as horses' inborn ability to move around obstacles with speed and agility. AP Photo/The Gallup Independent, Jeffery Jones

As with classical conditioning, an animal's natural predispositions constrain its capacity for operant conditioning. Using food as a reinforcer, you can easily condition a hamster to dig or to rear up because these actions are among the animal's natural food-searching behaviors. But you won't be so successful if you use food as a reinforcer to shape other hamster behaviors, such as face washing, that aren't normally associated with food or hunger (Shettleworth, 1973). Similarly, you could easily teach pigeons to flap their wings to avoid being shocked, and to peck to obtain food, because fleeing with their wings and eating with their beaks are natural pigeon behaviors. However, they would have a hard time learning to peck to avoid a shock, or to flap their wings to obtain food (Foree & LoLordo, 1973). The principle: *Biological constraints predispose organisms to learn associations that are naturally adaptive.*

After witnessing the power of operant technology, Skinner's students Keller Breland and Marian Breland (1961; Bailey & Gillaspy, 2005) began training dogs, cats, chickens, parakeets, turkeys, pigs, ducks, and hamsters, and they eventually left their graduate studies to form an animal training company. Over the ensuing 47 years they trained more than 15,000 animals from 140 species for movies, traveling shows, corporations, amusement parks, and the government. They also trained animal trainers, including Sea World's first director of training.

At first, the Brelands presumed that operant principles would work on almost any response an animal could make. But along the way, they confronted the constraints of biological predispositions. In one act, pigs trained to pick up large wooden "dollars" and deposit them in a piggy bank began to drift back to their natural ways. They would drop the coin, push it with their snouts as pigs are prone to do, pick it up again, and then

repeat the sequence—delaying their food reinforcer. This *instinctive drift* occurred as the animals reverted to their biologically predisposed patterns.

“Never try to teach a pig to sing. It wastes your time and annoys the pig.”

Mark Twain (1835–1910)

6.3.3 Skinner’s Legacy

B. F. Skinner was one of the most controversial intellectual figures of the late twentieth century. He stirred a hornet’s nest with his outspoken beliefs. He repeatedly insisted that external influences (not internal thoughts and feelings) shape behavior. And he urged people to use operant principles to influence others’ behavior at school, work, and home. Knowing that behavior is shaped by its results, he said we should use rewards to evoke more desirable behavior.

Skinner’s critics objected, saying that he dehumanized people by neglecting their personal freedom and by seeking to control their actions. Skinner’s reply: External consequences already haphazardly control people’s behavior. Why not administer those consequences toward human betterment? Wouldn’t reinforcers be more humane than the punishments used in homes, schools, and prisons? And if it is humbling to think that our history has shaped us, doesn’t this very idea also give us hope that we can shape our future?

Applications of Operant Conditioning

13: How might operant conditioning principles be applied at school, in sports, at work, at home, and for self-improvement?

In later units we will see how psychologists apply operant conditioning principles to help people moderate high blood pressure or gain social skills. Reinforcement technologies are also at work in schools, sports, workplaces, and homes (Flora, 2004), and these principles can support our self-improvement as well.

At School A generation ago, Skinner and others worked toward a day when teaching machines and textbooks would shape learning in small steps, immediately reinforcing correct responses. Such machines and texts, they said, would revolutionize education and free teachers to focus on each student’s special needs.

Stand in Skinner’s shoes for a moment and imagine two math teachers, each with a class of students ranging from whiz kids to slow learners. Teacher A gives the whole class the same lesson, knowing that the bright kids will breeze through the math concepts, and the slower ones will be frustrated and fail. With so many different

children, how could one teacher guide them individually? Teacher B, faced with a similar class, paces the material according to each student's rate of learning and provides prompt feedback, with positive reinforcement, to both the slow and the fast learners. Thinking as Skinner did, how might you achieve the individualized instruction of Teacher B?



Computer-assisted learning Computers have helped realize Skinner's goal of individually paced instruction with immediate feedback. Anderson Ross/Bend Images/Corbis

Computers were Skinner's final hope. "Good instruction demands two things," he said. "Students must be told immediately whether what they do is right or wrong and, when right, they must be directed to the step to be taken next." Thus, the computer could be Teacher B—pacing math drills to the student's rate of learning, quizzing the student to find gaps in understanding, giving immediate feedback, and keeping flawless records. To the end of his life, Skinner (1986, 1988, 1989) believed his ideal was achievable. Although the predicted education revolution has not occurred, today's interactive student software, Web-based learning, and online testing bring us closer than ever before to achieving his ideal.

In Sports Reinforcement principles can enhance athletic performance as well. Again, the key is to shape behavior, by first reinforcing small successes and then gradually increasing the challenge. Thomas Simek and Richard O'Brien (1981, 1988) applied these principles to teaching golf and baseball by starting with easily reinforced responses. Golf students learn putting by starting with very short putts. As they build mastery, they eventually step back farther and farther. Likewise, novice batters begin with half swings at an oversized ball pitched from 10 feet away, giving them the immediate pleasure of smacking the ball. As the hitters' confidence builds with their success and they achieve mastery at each level, the pitcher gradually moves back—to 15, then 22, 30, and 40.5 feet—and eventually introduces a standard baseball. Compared with children taught by conventional methods, those trained by this behavioral method show, in both testing and game situations, faster skill improvement.

In sports as in the laboratory, the accidental timing of rewards can produce superstitious behaviors. If a Skinner box food dispenser gives a pellet of food every 15 minutes, whatever the animal happened to be doing just before the food arrives (perhaps scratching itself) is more likely to be repeated and reinforced, which occasionally can produce a persistent superstitious behavior. Likewise, if a baseball or softball player gets a hit after tapping the plate with the bat he or she may be more likely to do so again. Over time the player may experience partial reinforcement for what becomes a superstitious behavior.



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At Work Skinner's ideas have also shown up in the workplace. Knowing that reinforcers influence productivity, many organizations have invited employees to share the risks and rewards of company ownership. Others focus on reinforcing a job well done. Rewards are most likely to increase productivity if the desired performance has been well-defined and is achievable. The message for managers? *Reward specific, achievable behaviors, not vaguely defined "merit."* Even criticism triggers the least resentment and the greatest performance boost when specific and considerate (Baron, 1988).

Operant conditioning also reminds us that reinforcement should be *immediate*. IBM legend Thomas Watson understood. When he observed an achievement, he wrote the employee a check on the spot (Peters & Waterman, 1982). But rewards need not be material, or lavish. An effective manager may simply walk the floor and sincerely affirm people for good work, or write notes of appreciation for a completed project. As Skinner said, "How much richer would the whole world be if the reinforcers in daily life were more effectively contingent on productive work?"

At Home As we have seen, parents can apply operant conditioning practices. Parent-training researchers remind us that parents who say "Get ready for bed" but cave in to protests or defiance reinforce whining and arguing (Wierson & Forehand, 1994). Exasperated, they may then yell or gesture menacingly. When the child, now frightened, obeys, that in turn reinforces the parents' angry behavior. Over time, a destructive parent-child relationship develops.

To disrupt this cycle, parents should remember the basic rule of shaping: *Notice people doing something right and affirm them for it.* Give children attention and other reinforcers when they are behaving *well* (Wierson & Forehand, 1994). Target a specific behavior, reward it, and watch it increase. When children misbehave or are defiant, don't yell at them or hit them. Simply explain the misbehavior and give them a time-out.



"I wrote another five hundred words. Can I have another cookie?" © The New Yorker Collection, 2001, Mick Stevens from cartoonbank.com. All rights reserved.

For Self-Improvement Finally, we can use operant conditioning principles to improve our own lives (see Close-Up: Training Our Partners on the next page). To build up your *self-control*, you need to reinforce your own desired behaviors and extinguish the undesired ones. Psychologists suggest taking these steps:

1. **State your goal—to cease smoking, eat less, exercise more, or stop procrastinating—in measurable terms, and announce it.** You might, for example, aim to boost your study time by an hour a day and share that goal with some close friends.
2. **Monitor how often you engage in your desired behavior.** You might log your current study time, noting under what conditions you do and don't study. (When I began writing textbooks, I logged how I spent my time each day and was amazed to discover how much time I was wasting.)
3. **Reinforce the desired behavior.** To increase your study time, give yourself a reward (a snack or some activity you enjoy) only after you finish your extra hour of study. Agree with your friends that you will join them for weekend activities only if you have met your realistic weekly studying goal.
4. **Reduce the rewards gradually.** As your new behaviors become more habitual, give yourself a mental pat on the back instead of a cookie.

In addition, we can literally learn from ourselves. There is some evidence that when we have feedback about our bodily responses, we can sometimes change those responses. (See Close-Up: Biofeedback in section 6.3.4.)

Training Our Partners

By Amy Sutherland

For a book I was writing about a school for exotic animal trainers, I started commuting from Maine to California, where I spent my days watching students do the seemingly impossible: teaching hyenas to pirouette on command, cougars to offer their paws for a nail clipping, and baboons to skateboard.

I listened, rapt, as professional trainers explained how they taught dolphins to flip and elephants to paint. Eventually it hit me that the same techniques might work on that stubborn but lovable species, the American husband.

The central lesson I learned from exotic animal trainers is that I should reward behavior I like and ignore behavior I don't. After all, you don't get a sea lion to balance a ball on the end of its nose by nagging. The same goes for the American husband.

Back in Maine, I began thanking Scott if he threw one dirty shirt into the hamper. If he threw in two, I'd kiss him. Meanwhile, I would step over any soiled clothes on the floor without one sharp word, though I did sometimes kick them under the bed. But as he basked in my appreciation, the piles became smaller.

I was using what trainers call "approximations," rewarding the small steps toward learning a whole new behavior....Once I started thinking this way, I couldn't stop. At the school in California, I'd be scribbling notes on how to walk an emu or have a wolf accept you as a pack member, but I'd be thinking, "I can't wait to try this on Scott...."

After two years of exotic animal training, my marriage is far smoother, my husband much easier to love. I used to take his faults personally; his dirty clothes on the floor were an affront, a symbol of how he didn't care enough about me. But thinking of my husband as an exotic species gave me the distance I needed to consider our differences more objectively.

Excerpted with permission from Sutherland, A., (2006, June 25). What Shamu taught me about a happy marriage, *New York Times*.

6.3.4 Contrasting Classical and Operant Conditioning

Both classical and operant conditioning are forms of associative learning, and both involve acquisition, extinction, spontaneous recovery, generalization, and discrimination. The similarities are sufficient to make some researchers wonder if a single stimulus-response learning process might explain them both (Donahoe & Vegas, 2004). Their procedural difference is this: Through classical (Pavlovian) conditioning, an organism associates different stimuli that it does not control and responds automatically (respondent behaviors) (**Table 6.4**). Through operant conditioning, an organism associates its operant behaviors—those that act on its environment to produce rewarding or punishing stimuli—with their consequences. Cognitive processes and biological predispositions influence both classical and operant conditioning.

Table 6.4

COMPARISON OF CLASSICAL AND OPERANT CONDITIONING		
	Classical Conditioning	Operant Conditioning
Basic idea	Organisms learn associations between events they don't control.	Organisms learn associations between their behavior and resulting events.
Response	Involuntary, automatic.	Voluntary, operates on environment.
Acquisition	Associating events; CS announces US.	Associating response with a consequence (reinforcer or punisher).
Extinction	CR decreases when CS is repeatedly presented alone.	Responding decreases when reinforcement stops.
Spontaneous recovery	The reappearance, after a rest period, of an extinguished CR.	The reappearance, after a rest period, of an extinguished response.
Generalization	The tendency to respond to stimuli similar to the CS.	Organisms' responses to similar stimuli are also reinforced.
Discrimination	The learned ability to distinguish between a CS and other stimuli that do not signal a US.	Organisms learn that certain responses, but not others, will be reinforced.
Cognitive processes	Organisms develop expectation that CS signals the arrival of US.	Organisms develop expectation that a response will be reinforced or punished; they also exhibit latent learning, without reinforcement.
Biological predispositions	Natural predispositions constrain what stimuli and responses can easily be associated.	Organisms best learn behaviors similar to their natural behaviors; unnatural behaviors instinctively drift back toward natural ones.

"O! This learning, what a thing it is."

William Shakespeare, *The Taming of the Shrew*, 1597

Biofeedback

Knowing the damaging effects of stress, could we train people to counteract stress, bringing their heart rate and blood pressure under conscious control? When a few psychologists started experimenting with this idea, many of their colleagues thought them foolish. After all, these functions are controlled by the autonomic ("involuntary") nervous system. Then, in the late 1960s, experiments by respected psychologists made the skeptics wonder. Neal Miller, for one, found that rats could modify their heartbeat if given pleasurable brain stimulation when their heartbeat increased or decreased. Later research revealed that some paralyzed humans could also learn to control their blood pressure (Miller & Brucker, 1979).

Miller was experimenting with **biofeedback**, a system of recording, amplifying, and feeding back information about subtle physiological responses. Biofeedback instruments mirror the results of a person's own efforts, thereby allowing the person to learn techniques for controlling a particular physiological response (**Figure 6.14**). After a decade of study, however, researchers decided the initial claims for biofeedback were overblown and oversold (Miller, 1985). A 1995 National Institutes of Health panel declared that biofeedback works best on tension headaches.

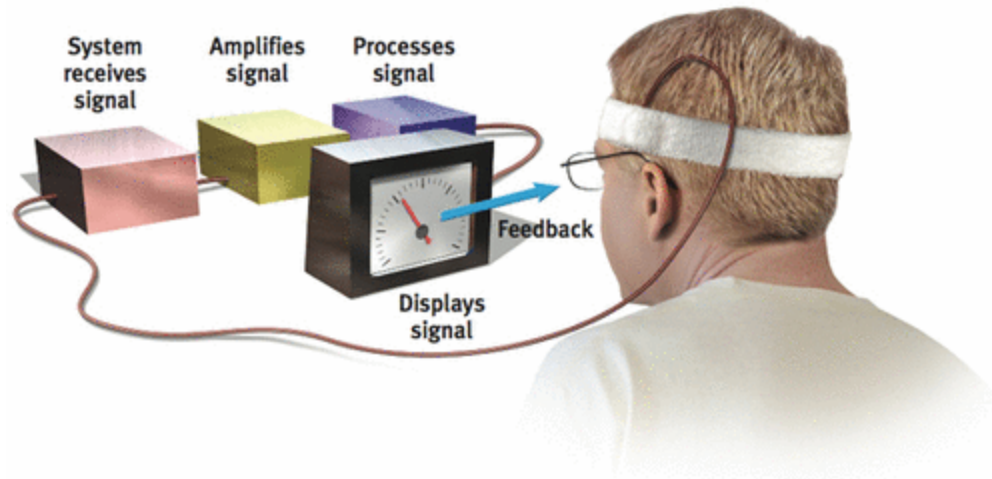


Figure 6.14 Biofeedback systems Biofeedback systems—such as this one, which records tension in the forehead muscle of a headache sufferer—allow people to monitor their subtle physiological responses. As this man relaxes his forehead muscle, the pointer on the display screen (or a tone) may go lower.

6.4 Learning by Observation

14: What is observational learning, and how is it enabled by mirror neurons?

FROM DROOLING DOGS, RUNNING RATS, and pecking pigeons we have learned much about the basic processes of learning. But conditioning principles don't tell us the whole story. Higher animals, especially humans, can learn without direct experience, through **observational learning**, also called *social learning*, because we learn by observing and imitating others. A child who sees his sister burn her fingers on a hot stove learns not to touch it. And a monkey watching another selecting certain pictures to gain treats learns to imitate that behavior (**Figure 6.15**). We learn all kinds of specific behaviors by observing and imitating models, a process called **modeling**. Lord Chesterfield (1694–1773) had the idea: “We are, in truth, more than half what we are by imitation.”

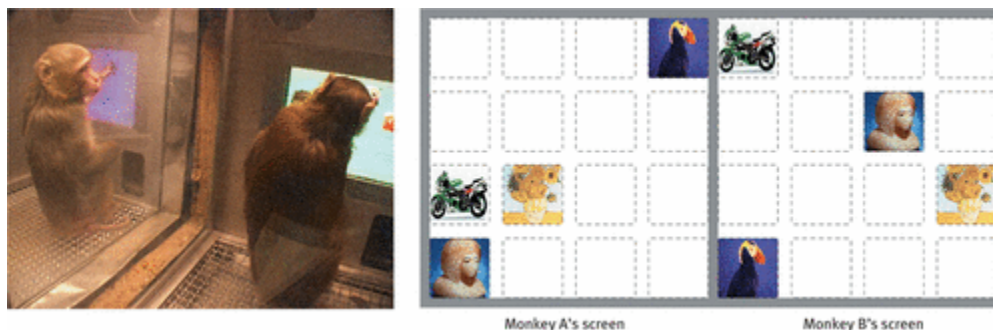


Figure 6.15 Cognitive imitation When Monkey A (below left) sees Monkey B touch four pictures on a display screen in a certain order to gain a banana, Monkey A learns to imitate that order, even when shown a different configuration (Subiaul et al., 2004). ©Herb Terrace
©Herb Terrace

We can glimpse the roots of observational learning in other species. Rats, pigeons, crows, and gorillas all observe others and learn (Byrne & Russon, 1998; Dugatkin, 2002). So do monkeys. Rhesus macaque monkeys rarely make up quickly after a fight—unless they grow up with forgiving older macaques. Then, more often than not, their fights, too, are quickly followed by reconciliation (de Waal & Johanowicz, 1993). Monkey see, monkey do. Chimpanzees learn all sorts of foraging and tool use behaviors by observation, which then are transmitted across generations within their local culture (Hopper et al., 2008; Whiten et al., 2007).

Imitation is all the more striking in humans. Our catch-phrases, hem lengths, ceremonies, foods, traditions, vices, and fads all spread by one person copying another. Even as 2½-year-olds, when many of our mental abilities were near those of chimpanzees, we considerably surpassed chimps at social tasks such as imitating another's solution to a problem (Herrmann et al., 2007).

6.4.1 Mirrors in the Brain

On a 1991 hot summer day in Parma, Italy, a lab monkey awaited its researchers' return from lunch. The researchers had implanted wires next to its motor cortex, in a frontal lobe brain region that enabled the monkey to plan and enact movements. When the monkey moved a peanut into its mouth, for example, the monitoring device would buzz. That day, as one of the researchers reentered the lab, ice cream cone in hand, the monkey stared at him. As the student raised the cone to lick it, the monkey's monitor again buzzed—as if the motionless monkey had itself moved (Blakeslee, 2006; Iacoboni, 2008).

Having earlier observed the same weird result when the monkey watched humans or other monkeys move peanuts to their mouths, the flabbergasted researchers, led by Giacomo Rizzolatti (2002, 2006), eventually surmised that they had stumbled onto a previously unknown type of neuron: **mirror neurons**, whose activity provides a neural basis for imitation and observational learning. When a monkey grasps, holds, or tears something, these neurons fire. And they likewise fire when the monkey observes another doing so. When one monkey sees, these neurons mirror what another monkey does.

It's not just monkey business. Imitation shapes even very young humans' behavior. Shortly after birth, a baby may imitate an adult who sticks out his tongue. By 8 to 16 months, infants imitate various novel gestures (Jones, 2007). By age 12 months, they begin looking where an adult is looking (Brooks & Meltzoff, 2005). And by age 14 months (**Figure 6.16**), children imitate acts modeled on TV (Meltzoff, 1988; Meltzoff & Moore, 1989, 1997). Children see, children do.



Figure 6.16 Learning from observation This 14-month-old boy in Andrew Meltzoff's laboratory is imitating behavior he has seen on TV. In the top photo the infant leans forward and carefully watches the adult pull apart a toy. In the middle photo he has been given the toy. In the bottom photo he pulls the toy apart, imitating what he has seen the adult do. Meltzoff, A. N. (1988). Imitation of televised models by infants. *Child Development*, 59, 1221–1229. Photos courtesy of A. N. Meltzoff and M. Hanuk.

PET scans of different brain areas reveal that humans, like monkeys, have a mirror neuron system that supports empathy and imitation (Iacoboni, 2008). As we observe another's action, our brain generates an inner simulation, enabling us to experience the other's experience within ourselves. Mirror neurons help give rise to children's empathy and to their ability to infer another's mental state, an ability known as *theory of mind*. As noted in [Unit 9](#), people with autism display reduced imitative yawning and mirror neuron activity—"broken mirrors," some have said (Ramachandran & Oberman, 2006; Senju et al., 2007; Williams et al., 2006).

For most of us, however, our mirror neurons make emotions contagious. We grasp others' states of mind—often feeling what they feel—by mental simulation. We find it harder to frown when viewing a smile than when viewing a frown (Dimberg et al., 2000, 2002). We find ourselves yawning after observing another's yawn, laughing when others laugh. When watching movies, a scorpion crawling up someone's leg makes us tighten up; observing a passionate kiss, we may notice our own lips puckering. Seeing a loved one's pain, our faces mirror their emotion. But as **Figure 6.17** shows, so do our brains. In this fMRI scan, the pain imagined by an empathic romantic partner has triggered some of the same brain activity experienced by the loved one actually having the pain (Singer et al., 2004). Even fiction reading may trigger such activity, as we mentally simulate the experiences described (Mar & Oatley, 2008). The bottom line: *Our brain's mirror neurons underlie our intensely social nature.*

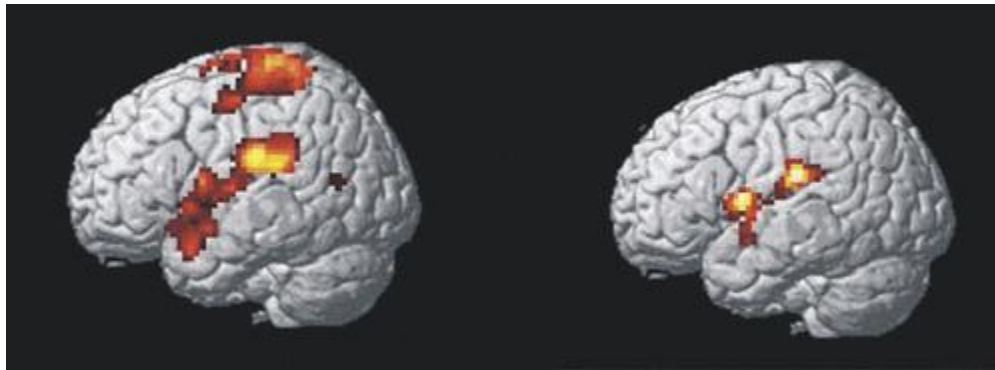


Figure 6.17 Experienced and imagined pain in the brain Brain activity related to actual pain (left) is mirrored in the brain of an observing loved one (right). Empathy in the brain shows up in emotional brain areas, but not in the somatosensory cortex, which receives the physical pain input. Reprinted with permission from The American Association for the Advancement of Science, Subiaul et al., *Science* 305:407–410 (2004) ©2004 AAAS.

6.4.2 Bandura's Experiments

Picture this scene from a famous experiment by Albert Bandura, the pioneering researcher of observational learning (Bandura et al., 1961). A preschool child works on a drawing. An adult in another part of the room is building with Tinkertoys. As the child watches, the adult gets up and for nearly 10 minutes pounds, kicks, and throws around the room a large inflated Bobo doll, yelling, "Sock him in the nose....Hit him down....Kick him."

The child is then taken to another room filled with appealing toys. Soon the experimenter returns and tells the child she has decided to save these good toys "for the other children." She takes the now-frustrated child to a third adjacent room containing a few toys, including a Bobo doll. Left alone, what does the child do?

Compared with children not exposed to the adult model, those who viewed the model's actions were much more likely to lash out at the doll. Apparently, observing the aggressive outburst lowered their inhibitions. But something more was also at work, for the children imitated the very acts they had observed and used the very words they had heard (**Figure 6.18**).



Figure 6.18 The famous Bobo doll experiment Notice how the children's actions directly imitate the adult's. Courtesy of Albert Bandura, Stanford University

What determines whether we will imitate a model? Bandura believes part of the answer is reinforcements and punishments—those received by the model as well as by the imitator. By watching, we learn to anticipate a behavior's consequences in situations like those we are observing. We are especially likely to imitate people we perceive as similar to ourselves, as successful, or as admirable.

6.4.3 Applications of Observational Learning

The big news from Bandura's studies is that we look and we learn. Models—in one's family or neighborhood, or on TV—may have effects—good or bad. Many business organizations effectively use *behavior modeling* to train communications, sales, and customer service skills (Taylor et al., 2005). Trainees gain skills faster when they not only are told the needed skills but also are able to observe the skills being modeled effectively by experienced workers (or actors simulating them).

"Children need models more than they need critics."

Joseph Joubert, *Pensées*, 1842

Prosocial Effects

15: What is the impact of prosocial modeling and of antisocial modeling?

The good news is that **prosocial** (positive, helpful) models can have prosocial effects. To encourage children to read, read to them and surround them with books and people who read. To increase the odds that your children will practice your religion, worship and attend religious activities with them. People who exemplify nonviolent, helpful behavior can prompt similar behavior in others. India's Mahatma Gandhi and America's Martin Luther King, Jr., both drew on the power of modeling, making nonviolent action a powerful force for social change in both countries. Parents are also powerful models. European Christians who risked their lives to rescue Jews from the Nazis usually had a close relationship with at least one parent who modeled a strong moral or humanitarian concern; this was also true for U.S. civil rights activists in the 1960s (London, 1970;

Oliner & Oliner, 1988). The observational learning of morality begins early. Socially responsive toddlers who readily imitate their parents tend to become preschoolers with a strong internalized conscience (Forman et al., 2004).



A model player Los Angeles Galaxy soccer star David Beckham provided a powerful role model for aspiring players at this youth soccer clinic in Harlem. As the sixteenth-century proverb states, "Example is better than precept." REUTERS/Gary Hershorn

Models are most effective when their actions and words are consistent. Sometimes, however, models say one thing and do another. Many parents seem to operate according to the principle "Do as I say, not as I do." Experiments suggest that children learn to do both (Rice & Grusec, 1975; Rushton, 1975). Exposed to a hypocrite, they tend to imitate the hypocrisy by doing what the model did and saying what the model said.

Antisocial Effects

The bad news is that observational learning may have *antisocial effects*. This helps us understand why abusive parents might have aggressive children, and why many men who beat their wives had wife-battering fathers (Stith et al., 2000). Critics note that being aggressive could be passed along by parents' genes. But with monkeys we know it can be environmental. In study after study, young monkeys separated from their mothers and subjected to high levels of aggression grew up to be aggressive themselves (Chamove, 1980). The lessons we learn as children are not easily unlearned as adults, and they are sometimes visited on future generations.

TV is a powerful source of observational learning. While watching TV, children may "learn" that bullying is an effective way to control others, that free and easy sex brings pleasure without later misery or disease, or that men should be tough and women

gentle. And they have ample time to learn such lessons. During their first 18 years, most children in developed countries spend more time watching TV than they spend in school. In the United States, where 9 in 10 teens watch TV daily, someone who lives to age 75 will have spent 9 years staring at the tube (Gallup, 2002; Kubey & Csikszentmihalyi, 2002). With more than 1 billion TV sets playing in homes worldwide, CNN reaching 150 countries, and MTV broadcasting in 17 languages, television has created a global pop culture (Gundersen, 2001; Lippman, 1992).

"The problem with television is that the people must sit and keep their eyes glued to a screen: The average American family hasn't time for it. Therefore the showmen are convinced that...television will never be a serious competitor of [radio] broadcasting."

New York Times, 1939

TV's greatest effect may stem from what it displaces. Children and adults who spend 4 hours a day watching TV spend 4 fewer hours in active pursuits—talking, studying, playing, reading, or socializing with friends. What would you have done with your extra time if you had never watched TV, and how might you therefore be different?

Television viewers are learning about life from a rather peculiar storyteller, one that reflects the culture's mythology but not its reality. During the late twentieth century, the average child viewed some 8000 TV murders and 100,000 other acts of violence before finishing elementary school (Huston et al., 1992). If we include cable programming and video rentals, the violence numbers escalate. An analysis of more than 3000 network and cable programs aired in the 1996–1997 season revealed that nearly 6 in 10 featured violence, that 74 percent of the violence went unpunished, that 58 percent did not show the victims' pain, that nearly half the incidents involved "justified" violence, and that nearly half involved an attractive perpetrator. These conditions define the recipe for the *violence-viewing effect* described in many studies (Donnerstein, 1998).

How much are we affected by repeated exposure to violent programs? Was the judge who in 1993 tried two British 10-year-olds for murdering a 2-year-old right to suspect that the pair had been influenced by "violent video films"? Were the American media right to think that the teen assassins who killed 13 of their Columbine High School classmates had been influenced by repeated exposure to *Natural Born Killers* and splatter games such as *Doom*? To understand whether violence viewing leads to violent behavior, researchers have done some 600 correlational and experimental studies (Anderson & Gentile, 2008; Comstock, 2008; Murray, 2008).

Correlational studies do support this link:

- In the United States and Canada, homicide rates doubled between 1957 and 1974, just when TV was introduced and spreading. Moreover, census regions with later dates for TV service also had homicide rates that jumped later.
- White South Africans were first introduced to TV in 1975. A similar near-doubling of the homicide rate began after 1975 (Centerwall, 1989).

- Elementary schoolchildren with heavy exposure to media violence (via TV, videos, and video games) also tend to get into more fights (**Figure 6.19**).

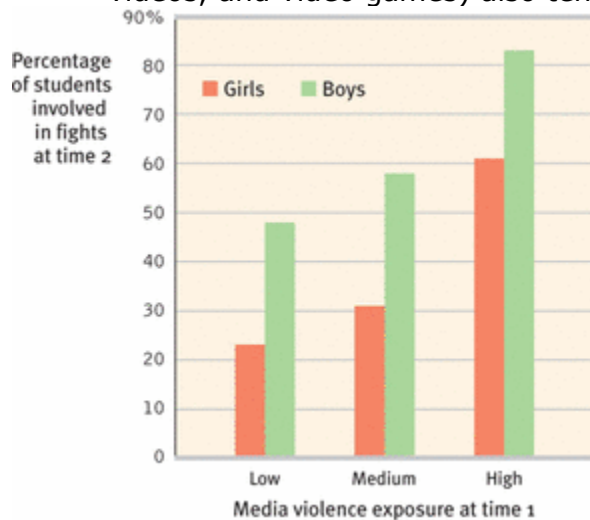


Figure 6.19 Media violence viewing predicts future aggressive behavior Douglas Gentile and his colleagues (2004) studied more than 400 third to fifth graders. After controlling for existing differences in hostility and aggression, the researchers reported increased aggression in those heavily exposed to violent television, videos, and video games. Ron Chapple/Taxi/Getty Images

But as we know from **Unit 2**, correlation does not imply causation. So these studies do not prove that viewing violence causes aggression (Freedman, 1988; McGuire, 1986). Maybe aggressive children prefer violent programs. Maybe abused or neglected children are both more aggressive and more often left in front of the TV. Maybe violent programs simply reflect, rather than affect, violent trends.

"Thirty seconds worth of glorification of a soap bar sells soap. Twenty-five minutes worth of glorification of violence sells violence."

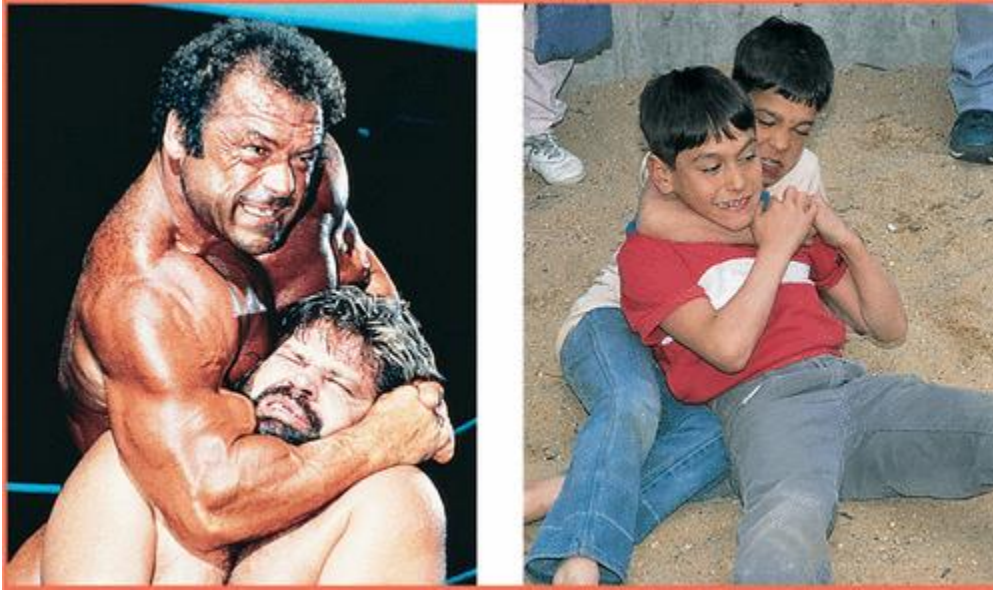
U.S. Senator Paul Simon, Remarks to the Communitarian Network, 1993

Gallup surveys asked American teens (Mazzuca, 2002): "Do you feel there is too much violence in the movies, or not?"

1977: 42 percent said yes.

1999: 23 percent said yes.

To pin down causation, psychologists use experiments. In this case, researchers randomly assigned some viewers to observe violence and others to watch entertaining nonviolence. Does viewing cruelty prepare people, when irritated, to react more cruelly? To some extent, it does. "The consensus among most of the research community," reported the National Institute of Mental Health (1982), "is that violence on television does lead to aggressive behavior by children and teenagers who watch the programs." This is especially so when an attractive person commits seemingly justified, realistic violence that goes unpunished and causes no visible pain or harm (Donnerstein, 1998).



Violence viewing leads to violent play Research has shown that viewing media violence does lead to increased expression of aggression in the viewers, as with these boys imitating pro wrestlers. Bob Daemmrich/The Image Works
Glassman/The Image Works



"Don't you understand? This is life, this is what is happening. We can't switch to another channel." © The New Yorker Collection, 2000, J. Day from cartoonbank.com. All rights reserved.

The violence-viewing effect seems to stem from at least two factors. One is *imitation* (Geen & Thomas, 1986). As we noted earlier, children as young as 14 months will imitate acts they observe on TV. As they watch, their mirror neurons simulate the behavior, and after this inner rehearsal they become more likely to act it out. One research team observed a sevenfold increase in violent play immediately after children viewed *Power Rangers* (Boyatzis et al., 1995). These children, like those we saw earlier in the Bobo doll experiment, often precisely imitated the models' violent acts, including flying karate kicks. Imitation may also have played a role in the first eight days after the 1999 Columbine High School massacre, when every U.S. state except Vermont had to deal with copycat threats or incidents. Pennsylvania alone had 60 threats of school violence (Cooper, 1999).

Prolonged exposure to violence also *desensitizes* viewers; they become more indifferent to it when later viewing a brawl, whether on TV or in real life (Rule & Ferguson, 1986).

Adult males who spent three evenings watching sexually violent movies became progressively less bothered by the rapes and slashings. Compared with those in a control group, the film watchers later expressed less sympathy for domestic violence victims, and they rated the victims' injuries as less severe (Mullin & Linz, 1995).

Indeed, suggested Edward Donnerstein and his co-researchers (1987), an evil psychologist could hardly imagine a better way to make people indifferent to brutality than to expose them to a graded series of scenes, from fights to killings to the mutilations in slasher movies. Watching cruelty fosters indifference.

Our knowledge of learning principles comes from the work of thousands of investigators. This unit has focused on the ideas of a few pioneers—Ivan Pavlov, John Watson, B. F. Skinner, and Albert Bandura. They illustrate the impact that can result from single-minded devotion to a few well-defined problems and ideas. These researchers defined the issues and impressed on us the importance of learning. As their legacy demonstrates, intellectual history is often made by people who risk going to extremes in pushing ideas to their limits (Simonton, 2000).