CHAPTER 7

Learning: How Nurture Changes Us

Classical Conditioning

Psychomythology: Chemical Transfer of Learning in Planaria

Operant Conditioning

Cognitive Models of Learning

New Frontiers: Mirror Neurons and Observational Learning

Biological Influences on Learning

Classical and Operant Conditioning in Pop Psychology: Do Learning Fads Work?

Science in the News

Critical Points

References
Before Reading Further

Try your hand at the following four items. Just do your best.

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

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

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

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

Now, read the following paragraph.

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

Now go back and try again to answer the four questions at the beginning of this chapter.
to strong stimuli, like very loud tones or painful electric shocks. As their dependent measure they’ve often assessed a variable known as the skin conductance response (in the old days this variable was known as the “galvanic skin response”), which is a measure of the electrical conductivity of the fingertips. As the fingertips become moist as a consequence of perspiration, they become better conductors of electricity. Because the skin conductance response is generally a decent barometer of anxiety, some researchers use it in studies of habituation. Most researchers have found that the skin conductance response habituates much more slowly to strong than to weak stimuli. In fact, in the case of extremely strong stimuli, like painful electric shocks, we often see no habituation at all, even over many trials (Lykken, Iacono, Hansson, McGue, & Bouchard, 1988).

Indeed, in some cases repeated exposure to stimuli leads to sensitization — that is, responding more strongly over time to repeated stimuli — rather than habituation. Sensitization is most likely to occur when we find a stimulus to be dangerous, irritating, or both (incidentally, Aplysia show sensitization as well as habituation). Have you ever had the experience of trying to study when the person next to you was whispering, and the whispering just kept getting more and more annoying to the point that you found yourself on the verge of screaming (hopefully, that’s not happening while you’re reading this chapter)? If so, you’ve experienced sensitization.

Classical Conditioning

The story of habituation could hardly be more straightforward. We experience a stimulus, respond to it, and then stop responding to it after a while. We’ve learned something significant, but we haven’t actually learned to forge connections between two stimuli. Yet a great deal of learning in everyday life depends on associating one thing with another. If we never learned to connect one stimulus, like the sight of an apple, with another, like its smell, our worlds would remain what William James (1891) called a “booming, buzzing confusion” — a world of disconnected sensory experiences. Nevertheless, as a Russian scientist named Pavlov helped to show us, we forge such connections all of the time in daily life.

BRITISH ASSOCIATIONISM

In the early history of psychology, an entire school of thinkers, called the British Associationists, believed that we acquire virtually all of our knowledge by connecting one stimulus with another: the sound of our mother’s face with her voice; the appearance of a peach with its fuzzy feel; and the smell of a juicy steak with its mouth-watering taste. One we form these associations, we need only recall one element of the pair to retrieve the other. Indeed, even thinking about a sensation often triggers it. For example, as you read the sentence before last you might have sensed the subtle flavor of a sirloin steak in your mouth. The British Associationists, who included David Hartley (1707–1757) and John Stuart Mill (1806–1873), believed that simple associations provided the mental building blocks for more complex ideas. Your understanding of this paragraph, they would say, is a product of nature, not nurture.

Nevertheless, Pavlov’s discoveries, which emerged from a set of unforeseen observations that were largely unrelated to his central research interests.

Around the turn of the 20th century, Pavlov was busily studying the digestion of dogs. Interestingly, it was actually his discoveries concerning digestion, not classical conditioning, that earned Pavlov the Nobel Prize. Pavlov placed his dogs in a harness and inserted a cannula, or collection tube, into their salivary glands to study dogs’ salivary (spitting) responses to meat powder. Yet in the process of doing so, Pavlov observed something unexpected. Specifically, he found that his dogs began salivating not to the meat powder itself, but to previously neutral stimuli that had become associated with it, such as the research assistants who brought in their food. Indeed, Pavlov’s dogs even salivated to the footsteps of Pavlov’s research assistants approaching the laboratory room. The dogs seemed to be anticipating the meat powder and responding to stimuli that signaled its arrival.

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

THE CLASSICAL CONDITIONING PARADIGM

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

Here’s how classical conditioning works, and here’s how Pavlov first demonstrated it systematically (Figure 1). First, we begin with an initially neutral stimulus called the conditioned stimulus or CS. It crucial to understand that this stimulus doesn’t elicit much, if any, response from the organism. Interestingly, the term “conditioned stimulus” is appropriately a mistranslation from the original Russian. Pavlov actually referred to it as the conditional stimulus, because the animal’s response to it is conditional (that is, dependent) on learning. In the case of Pavlov’s dogs, the CS was usually a metronome (a clicking pendulum that keeps time), although Pavlov also found that tuning forks and whistles did a serviceable job as well. Incidentally, many introductory psychology textbooks refer incorrectly to Pavlov’s CS as a bell. In fact, when Western scientists first visited Pavlov’s Moscow laboratory in the 1990s, a bell was nowhere to be found.

Then, we pair the CS — again, in Pavlov’s case the sound of a metronome — again and again with an unconditioned stimulus or UCS. This term was “unconditional stimulus” in the original Russian, because the animal responds to it unconditionally — that is, all of the time. In the case of Pavlov’s dogs, the UCS was the meat powder. The UCS elicits an automatic, reflexive response that we call the unconditioned response or UCR, in this case salivation. The key point is that the animal doesn’t need to learn to respond to the UCS with the UCR. The UCR occurs without any training at all, because the response is a product of nature, not nurture.

After repeated pairing of the CS and UCS, Pavlov observed something remarkable. If he now presented the CS (the metronome) alone, it elicited a response, namely salivation. We call this new response the conditioned response or CR. Learning has occurred. The dog,

**Pavlov’s Discoveries**

The history of science teaches us that many great discoveries arise from serendipity or accident. Yet it takes a great scientist to capitalize on serendipitous observations; many lesser mortals simply overlook such chance observations, regarding them as meaningless flukes. As the great French microbiologist Louis Pasteur (who discovered the process of pasteurizing milk) observed, “chance favors the prepared mind.” So it was with Pavlov’s discoveries, which emerged from a set of unforeseen observations that were largely unrelated to his central research interests.

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**Replicability**

**Classical or respondent conditioning**

A form of learning in which animals come to respond to a previously neutral stimulus that had been paired with another stimulus that elicits an automatic response.

**Conditioned stimulus or CS**

A neutral stimulus, eliciting little, if any, response from the organism.

**Unconditioned stimulus or UCS**

A stimulus that elicits an automatic response.

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**Serendipity**

The story of habituation could hardly be more straightforward. We experience a stimulus, respond to it, and then stop responding to it after a while. We’ve learned something significant, but we haven’t actually learned to forge connections between two stimuli. Yet a great deal of learning in everyday life depends on associating one thing with another. If we never learned to connect one stimulus, like the sight of an apple, with another, like its smell, our worlds would remain what William James (1891) called a “booming, buzzing confusion” — a world of disconnected sensory experiences. Nevertheless, as a Russian scientist named Pavlov helped to show us, we forge such connections all of the time in daily life.

**British Associationism**

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which previously did nothing when it heard the metronome except perhaps turn toward it, now salivates when it hears the metronome. The CR, in contrast to the UCR, is a product of nurture, not nature.

In most cases, the CR is fairly similar to the UCR. But it is rarely identical; for example, Pavlov found that the amount of salivation in the CR was less than that in the UCR (we’ll later learn about one strange case in which the UCR is actually the opposite of the CR). (Photograph 2).

**AVERSIVE CONDITIONING**

Incidentally, we can classically condition organisms not only to positive UCSs, like food, but to negative UCSs, like pain or nausea. While in graduate school, one of the authors of your book was a victim of such aversive conditioning, that is, classical conditioning using an unpleasant UCS (Ehrnell & Kemppainen, 2005). Back then, she videotaped infants as part of a study of language development. Prior to each participant’s arrival, she walked over to the video recorder and pushed the eject button to insert a tape. Perhaps because the air in the room was dry, the recorder consistently gave her nasty electric shock whenever she pushed the eject button. Because the shock usually occurred in the midst of a busy series of events in anticipation of the participant’s arrival, she barely paid any attention to it. Nevertheless, one day she reached to push the eject button and noticed herself jerking her hand back reflexively as it approached the button.

Stanley Kubrick’s 1971 film, *A Clockwork Orange*, provides an unforgettable example of aversive conditioning involving the main character, Alexander de Large, portrayed by actor Malcolm McDowell. de Large’s prison captors, who hoped to eradicate his bloodthirsty lust for violence, forced him to watch film clips of aggressive individuals, like the members of Hitler’s army marching in unison, while experiencing nausea induced by injections of a serum. The aversive conditioning worked—only for a while (Photograph 3).

In real-life rather than on the big screen, psychologists have applied aversive conditioning with mixed success to the treatment of alcoholism. They’ve sometimes given alcoholics a medication known as disulfiram (Antabuse), which blocks the breakdown of alcohol, causing alcohol to go directly to the “drinker’s head” (Fulmer & Roth, 1979). As a consequence, upon drinking, disulfiram triggers an exceedingly unpleasant “flushing response” characterized by a red face, nausea, vomiting, and dizziness (as we’ll learn in Chapter 18, some individuals, especially of Asian descent, experience this flushing response naturally as a result of a genetic mutation). The idea here relies on classical conditioning: by pairing the CS (alcohol) with the UCS (a nausea-inducing drug), the CS itself eventually comes to elicit the CR (nausea). Nevertheless, in controlled studies the evidence for disulfiram’s effectiveness has been disappointing. Although it seems to work for some alcoholics, the big problem is that many individuals don’t comply with the treatment. That is, rather than not drinking, many simply avoid taking disulfiram (MacKillop, Lismann, Weinstein, & Rosenbaum, 2003). (Photograph 4).

**ADAPTIVE VALUE OF CLASSICAL CONDITIONING**

Why should we care about classical conditioning? Because it’s evolutionarily essential for us. Without classical conditioning, we couldn’t develop physiological associations to stimuli that signaled biologically important events, like things that we want to eat or want to eat us. Many of the physiological responses we display in classical conditioning are biologically adaptive. Salivation, for example, aids in the digestion of food. Although skin conductance responses aren’t terribly adaptive for us today, they were to our primate ancestors (Stern, Ray, & Davis, 1980), who found that moist fingers and toes came in handy for grasping tree limbs while escaping from predators (slightly wet fingertips help us to adhere to things, as you’ll discover if you moisten the tip of your index finger while turning to the next page of this book).

Moreover, without classical conditioning, we can’t learn many important associations. Take the example of people with psychopathic personalities, whom we encountered in Chapter 2 and will revisit in Chapter 18. As you might recall, such people (often called “psychopaths” for short) tend to be guileless, callous, and dishonest, and they often commit impulsive crimes. Half a century ago, David Lykken (1957) found that psychopaths tend to show extremely weak classical conditioning to painful electric shocks. Lykken first presented psychopaths and nonpsychopaths with repeated tones (CSs), followed almost immediately by electric shocks (UCSs) to the fingertips (the shocks really sting there, because our fingertips are brimming with nerve endings). Not surprisingly, both psychopaths and nonpsychopaths showed a whopping skin conductance response (UCR) to the shocks. Lykken repeated this process over and over: tone—shock, tone—shock, tone—shock, and on and on. Then, he presented his participants with the tones (CSs) alone, and measured their skin conductance responses, which were now the CRs. In contrast to nonpsychopaths, who showed pronounced skin conductance responses (CRs) to the tones alone, psychopaths exhibited weak skin conductance responses or none at all. Lykken’s findings may help to explain why psychopaths don’t learn from punishment and often find themselves in trouble with the law again and again (Hare, 2003; Newman & Kossoss, 1986): they don’t develop conditioned fear to signals of punishment. Whereas the rest of us may shudder in fear at the mere sight of a police car appearing suddenly in our rear-view mirror, psychopaths typically shrug off this visual stimulus with nonchalance. As a consequence of their indifference to signals of threat, psychopaths don’t inhibit irresponsible and even criminal behaviors that the rest of us do (Fowles, 1987; Lykken, 1995). (Photograph 5).

**ACQUISITION, EXTINCTION, SPONTANEOUS RECOVERY**

Pavlov noted, and others have since confirmed, that classical conditioning occurs in three phases. We’ll discuss each in turn.

**Acquisition.** The first phase of classical conditioning is acquisition: the process by which

we gradually learn the CR. If you look at Figure 2, you’ll see that as the CS and UCS are paired over and over again, the CR increases progressively in strength.

There are four different methods of pairing the CS and UCS. The first is delay conditioning, in which the CS precedes the UCS, but overlaps with it in time. In Pavlov’s conditioning paradigm, this means that the tone came first but stayed on while the dog encountered the meat powder. This kind of learning generally works well, especially when the delay between CS and onset of the UCS is brief. The optimal delay varies depending on what stimuli we’re pairing, but for many stimuli it’s about half of a second. The second method of pairing stimuli is simultaneous conditioning, in which the CS precedes the UCS and is separated from it by a short period of time. Trace conditioning also works well, although it’s generally not as effective as delay conditioning. Many students understandably find the difference between delay and trace conditioning to be baffling, because the terms “delay” and “trace” lend themselves to confusion. We can think of it this way: in delay conditioning, the CS and UCS overlap but are staggered in their presentation, whereas in trace conditioning the CS and UCS show no overlap at all, so the organism must rely on a “memory trace” – hence the name – of the original CS.

The third method of pairing stimuli is simultaneous conditioning, in which CS and UCS occur at precisely the same time. This kind of conditioning usually works a bit poorly. Fourth and finally, there’s backward conditioning, in which we present the UCS prior to the CS. Backward conditioning almost always works the most poorly of all forms of pairing. Although it sometimes results in learning (Sperch, Will, & Pinel, 1981), it sometimes produces no learning at all (Lieberman, 1990). The ineffectiveness of backward conditioning makes good evolutionary sense, because in this kind of conditioning, the CS doesn’t signal anything. If you always encountered a stop sign immediately after – rather than before – you drove into a crowded 4-way intersection, you’d be unlikely to learn how to avoid traffic accidents, because the signal comes after the threat to life and limb.

Extinction. What happens when, following the repeated pairing of CS and UCS, we present the CS by itself, without the UCS? As we’ve seen, the animal initially produces a CR. But what if we keep repeating the process by presenting the CS-again and again by itself? Eventually, we observe a process called extinction: the CR decreases in magnitude and eventually disappears (Figure 3). Following conditioning, after numerous presentations of the metronome without meat power, Pavlov’s dogs eventually stopped salivating. No meat, no spit. Extinction may also explain why the effectiveness of Alexander de Largue’s aversive conditioning treatment in A Clockwork Orange eventually wore out. Without the UCS (nausea-inducing serum), the CS (violence) no longer signaled the CR (nausea).

Most psychologists once believed that extinction is pretty much the same thing as forgetting: the CR merely fades away over repeated trials, just as many memories decay gradually in strength over time. Yet we now know that the truth is more complicated and more interesting than that, because extinction turns out to be an active rather than a passive process. That is, during extinction the new response, which in the case of Pavlov’s dogs was the absence of salivation, gradually “writes over” or inhibits the CS, namely salivation. The extinguished CS doesn’t vanish completely, it remains there all along, still waiting in the wings. This is contrast to most forms of traditional forgetting, in which the memory itself disappears. Interestingly, Pavlov had proposed this hypothesis in this writings, although few people believed him at the time. How do we know that he was right?

Spontaneous Recovery. We know it in several ways, but the most dramatic illustration comes from the phenomenon of spontaneous recovery. If we wait a while following extinction, and then present the CS again, something surprising happens. Like a phoenix rising from the ashes, the CR spookily reappears! So the CR was indeed there all along, just “waiting” to be released following another presentation of the CS. For example, following classical conditioning, Pavlov (1927) presented the CS (tongue) again and again, thereby completely extinguishing the CR (salivation). Yet when he waited two hours and then presented the CS again, the CR (salivation) returned. The animal hadn’t really forgotten the CR, it just suppressed it.

Closely related to spontaneous recovery is the renewal effect, which occurs when we extinguish a response in a setting different from that in which the animal acquired it, but then return the animal to the original setting. Upon doing so, the extinguished response reappears (Bouton, 1994). The renewal effect may help to explain why people with phobias – intense, irrational fears - that have been successfully treated sometimes experience a sudden reappearance of their symptoms upon returning to the environment in which they acquired their fears (Denniston, Chang, & Miller, 2003). Even though it may lead to a return of phobias in some circumstances, the renewal effect is often adaptive. If you’ve been bitten by a snake in one part of a forest, it makes good evolutionary sense to experience fear when you find yourself there again, even years later. That same snake or his slithery relatives may still be lying in wait next to the same tree.
Stimulus discrimination is the flip side of the coin to stimulus generalization; it occurs when we exhibit a CR to certain CSs, but not others. You can see stimulus discrimination in Figure 5, which demonstrates that Pavlov’s dogs learned to respond less, or not at all, to metronome sound that was markedly different from the original sound. Stimulus discrimination also helps us to understand why we can enjoy scary movies. Although we may sweat and hyperventilate just a bit while watching a great white shark chase after a swimmer in Jaws or other waterlogged movie thrillers, we don’t respond nearly as strongly as we would if that shark were pursuing us in a tank in our local aquarium. We’ve learned to discriminate between a motion picture stimulus and a real-life, flesh-and-blood (forgive the choice of words) stimulus.

Higher-order conditioning We’re not done with classical conditioning just yet, because organisms also learn to develop conditioned associations to other CSs that are associated with the original CS. Say, for example, that following Pavlov’s conditioning paradigm, we paired a picture of a circle with the original CS, the tone. Eventually, the dog will salivate to the circle as well as to the tone. This example illustrates the phenomenon of higher-order conditioning: the process by which organisms develop classically conditioned responses to CSs associated with the original CS (Gewirtz & Davis, 2000). As you might expect, second-order conditioning - in which one new CS is paired with the original CS - tends to be weaker than garden-variety classical conditioning, and third-order conditioning - in which a third CS is paired with the second-order CS - is even weaker. Fourth-order conditioning and beyond is often difficult or impossible.

Higher-order conditioning allows us to extend classical conditioning to a host of stimuli in our environments. For example, it probably helps to explain why we feel thirsty after someone merely says the word “coke” on a sweltering summer day. We had already come to associate the sights, sounds, and smells of a Coca-cola with quenching our thirst, and we in turn eventually came to associate the word “coke” with these other CSs.

The phenomenon of higher-order conditioning also helps us to explain some surprising findings concerning addictions to heroin and other drugs. Many drug addictions are shaped in part by higher-order classical conditioning, with the situational context in which drugs are taken serving as a higher-order CS. For example, in the case of heroin addiction, although the needle serves as the CS, the setting in which the addict injects the drug (for example, alone versus with friends) is a higher-order CS. Behaviorists refer to these higher-order CSs as occasion setters, because they refer to the setting in which the CS occurs.

Although public perception has it that “breaking the grip” of heroin addiction is difficult or impossible, research evidence suggests otherwise (Sullum, 2003). For example, sociologist Lee Robins and her colleagues (Robins, Helzer, & Davis, 1975) examined 451 Vietnam veterans who had returned to the United States with cases of serious heroin addiction. Although many mental health experts confidently predicted a rash of heroin addiction among Vietnam veterans’ return to America, this epidemic never materialized. In fact, in Robins’ sample, 86% of heroin-addicted Vietnam veterans lost their addiction shortly after returning to the United States. What had happened? Because the occasion setters had changed from Vietnam to the United States, the veterans’ classically conditioned responses to heroin extinguished (Photograph 6).

Applications of Classical Conditioning to Daily Life Classical conditioning applies to myriad domains of everyday life. For example, four such applications: advertising, the acquisition of fears, the acquisition of fetishes, and disgust reactions.

Classical Conditioning and Advertising. Few people grasp the principles of classical conditioning, especially higher-order classical conditioning, better than advertisers (Photograph 7). By repeatedly pairing the sights and sounds of products with photographs of handsome hairy hunks and scantly clad beauties, the marketing whizzes of Madison Avenue try to establish classically conditioned connections between their brands and positive emotions. They do so for a good reason: it works.

For example, one researcher (Gorn, 1982) paired slides of either blue or beige pens (the CSs) with music that participants had rated as either enjoyable or not enjoyable (the UCSs). He then gave participants the opportunity to select a pen upon their departure from the lab. Whereas 79% of participants picked the pen that had been paired with music they liked, only 50% picked the pen that had been paired with music they disliked. Another researcher (Grossman, 1998) randomly assigned participants to two conditions: one in which they saw a fictitious brand of mouthwash (the CS) paired repeatedly with pleasant visual images, like a relaxing tropical scene (the UCS), and a second in which they saw the CSs and UCSs jumbled up in random order. Compared with the random presentation of CSs and UCSs, the repeated pairing between CS and UCS resulted in a significantly greater preference for the mouthwash three weeks later.

Nevertheless, not all researchers who have paired products with pleasurable stimuli have succeeded in demonstrating classical conditioning effects (Smith, 2002). For example, two researchers (Gresham & Shimp, 1983) paired various products, like Coke, Colgate toothpaste, and Grape Nuts cereal, with television commercials that had been rated as generating pleasant, unpleasant, or neutral emotions. They failed to find much evidence that these pairings affected participants’ preferences for the ads. Nevertheless, their negative findings are open to an alternative explanation: latent inhibition. Latent inhibition refers to the fact that when we’ve experienced a CS alone many times, it’s difficult to classically condition it to another stimulus (Vaill & Lipp, 1997). Because Gresham and Shimp relied on brands with which participants were already familiar, their negative findings may be attributable to latent inhibition. Indeed, when researchers have used novel brands, they’ve generally been able to demonstrate classical conditioning effects (Stuart, Shimp, & Engle, 1987).

The Acquisition of Fears. We’ve seen that classical conditioning can help to explain how we develop preferences for certain things, like products advertised on television. But can classical conditioning also help to explain the origins of abnormal behaviors, like phobias, fetishes, and extreme disgust reactions? There’s considerable evidence that it can.

The Strange Tale of Little Albert. The person who first demonstrated this point was none other than our old friend John B. Watson, the founder of behaviorism. In 1920, Watson and his graduate student Rosalie Rayner performed what by any standard must be regarded as one of the most ethically problematic studies in the history of psychology. Here’s what they did.

Watson and Rayner (1920) began with a 9-month-old infant who will forever be enshrined in the psychological literature as Little Albert. Little Albert, it so happened, was fond of furry little creatures, like white rats. Well, Watson and Rayner were about to change that.

Watson and Rayner first allowed Little Albert to play with a rat. But only seconds afterwards, Watson snuck up behind Albert and struck a gong with a steel hammer, creating an ear-splitting noise and startling poor Little Albert out of his wits. After seven such pairings of CS (rat) and UCS (sound from gong), Little Albert exhibited a CR (fear) to the rat alone. This fear was still present when Watson and Rayner exposed Little Albert to the rat five days later. Moreover, Watson and Rayner observed that Little Albert had become a victim of stimulus generalization, because he had begun to fear not merely rats, but also a rabbit, a dog, a furry coat and, to a lesser extent, a Santa Claus Mask and John B. Watson’s hair. Fortunately, Little Albert also demonstrated at least some stimulus discrimination, as he didn’t display much fear toward cotton balls or the hair of Dr. Watson’s research assistants (Photograph 8).

Watson and Rayner’s Little Albert demonstration is only a case study. As we noted in
Chapter 3, case studies are extremely limited in the conclusions they allow; for example, we can’t generalize from Little Albert’s case to the development of phobias in other children. Nevertheless, the Little Albert case provides an existence proof (see Chapter 3) that classical conditioning can produce phobia-like states in humans. Admittedly, not everyone has successfully replicated Watson and Rayner’s findings (Harris, 1979; Jones, 1930). This fact doesn’t mean that Watson and Rayner were wrong to claim that Little Albert’s fears arose from classical conditioning, but it does imply that there may be more to developing phobias than classical conditioning alone. We’ll come back to this point later in the chapter.

Incidentally, you might be wondering whatever became of Little Albert. As it turns out, the Little Albert story is the source of numerous psychology urban legends (Gölovich, 1991). For example, some textbooks state that Watson and Rayner removed Little Albert’s fear using deconditioning—pairing the CS (rat) with a pleasant UCS (such as food). This happy Hollywood-style ending never happened (Harris, 1979). In fact, we’ll probably never know Little Albert’s fate, because his mother, perhaps understandably fed up with Watson and Rayner’s madcap experimental adventures, withdrew him from the study about a month after it began, never to be heard from again. Needless to say, because Watson and Rayner’s madcap experimental adventures, Little Albert’s story has a happier ending.

Phobias. Do you suffer from a serious case of paratonvokalektrophobia? If so, don’t be overly concerned, because you aren’t the only person in the world who is mortally afraid of Friday the 13th. Because of stimulus generalization and higher-order conditioning, classical conditioning is remarkably flexible. As a consequence, we can develop fears of many stimuli, although certain phobias, such as those of snakes, spiders, heights, water, and blood, are considerably more widespread than others (American Psychiatric Association, 2000). Other phobias, like fear of being tickled by feathers (pteronephobia), fear of clowns (coutrophobia), fear of flutes (aulophonphobia), and fear of bald people (peladophobia), are downright strange, although such fears are rarely severe (see Table 1).

<table>
<thead>
<tr>
<th>Phobia</th>
<th>Description</th>
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<tbody>
<tr>
<td>Alliumphobia</td>
<td>Fear of garlic</td>
</tr>
<tr>
<td>Arachibutyrophobia</td>
<td>Fear of peanut butter sticking to the roof of your mouth</td>
</tr>
<tr>
<td>Bathmophobia</td>
<td>Fear of stars</td>
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<tr>
<td>Brotophobia</td>
<td>Fear of thunderstorms</td>
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<td>Buphaphobia</td>
<td>Fear of toads</td>
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<tr>
<td>Cactophobia</td>
<td>Fear of mirrors</td>
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<tr>
<td>Cynophobia</td>
<td>Fear of dogs</td>
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<tr>
<td>Euphoria</td>
<td>Fear of cats</td>
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<tr>
<td>Epistasisiophobia</td>
<td>Fear of nosebleeds</td>
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<tr>
<td>Lachanophobia</td>
<td>Fear of vegetables</td>
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<tr>
<td>Latrophobia</td>
<td>Fear of doctors</td>
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<tr>
<td>Lissophobia</td>
<td>Fear of bees</td>
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<tr>
<td>Melissophobia</td>
<td>Fear of snakes</td>
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<tr>
<td>Opiliodphobia</td>
<td>Fear of spiders</td>
</tr>
<tr>
<td>Peladophobia</td>
<td>Fear of bald people</td>
</tr>
<tr>
<td>Pegmonphobia</td>
<td>Fear of beards</td>
</tr>
<tr>
<td>Rhizophobia</td>
<td>Fear of getting wrinkled</td>
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<tr>
<td>Sallhaimphobia</td>
<td>Fear of Halloween</td>
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<tr>
<td>Taphophobia</td>
<td>Fear of being buried alive</td>
</tr>
<tr>
<td>Xiphophobia</td>
<td>Fear of razors</td>
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</table>

Table 1. Phobias Galore illustrates just how enormously varied people’s fears can be. Many of these phobias may be acquired at least partly by classical conditioning.

The good news is that we can not only develop phobias in part through classical conditioning, we can also eliminate them through classical conditioning. One of Watson’s students, Mary Cover Jones, created a 3-year-old named Little Peter, who had a phobia of rabbits. Fortunately, Little Peter’s story had a happier ending did Little Albert’s. Jones (1924) successfully treated Peter’s fear by giving him a piece of his favorite candy each time he moved a white rabbit closer to him. Eventually, the sight of the rabbit came to elicit a new CR: pleasure rather than fear. Modern day psychotherapists, although rarely feeding their clients candy, use similar principles to eliminate phobias. For example, they may pair feared stimuli with relaxation or other pleasurable stimuli (Wolpe, 1990; see Chapter 16).

Fetishes. Just as classical conditioning can lead us to develop fears of certain objects, it may also lead us to develop sexual attractions to other objects. Indeed, there’s good reason to believe that fetishism—sexual attraction to nonliving objects—often arises in part from classical conditioning (Akins, 2004). The same goes for a related condition, partialism, which is excessive sexual preoccupation with one part of the body to the exclusion of others, such as the breasts, feet, legs, or buttocks.

For reasons that scientists do not fully understand, men have a virtual monopoly on fetishes (American Psychiatric Association, 2000). Like phobias, fetishes can take a remarkably wide variety of forms. Most fetishes involve stimuli associated with women’s sexuality, like stockings, bras, and shoes. Nevertheless, others are far more difficult to explain. For example, one man achieved sexual gratification from looking at British SUV cars (de Silva & Pernet, 1992) and another from looking at flags (Lange, 1991). (Photograph 9).

Some conditions apparently related to fetishes are even more unusual. For example, individuals with apotemnophilia (or body integrity identity disorder) are almost constantly preoccupied with the idea of becoming amputees, and sometimes even amputate their own limbs to achieve that morbid goal. For certain individuals, the intense fascination with becoming an amputee appears to contain a sexual component. For example, some apotemnophiles appear to receive sexual gratification from thinking of themselves as future amputees (First, 2003). Individuals with yet another condition called autostotic enfraposition (or hypoxyphilia) derive sexual satisfaction from depriving themselves of oxygen while engaged in sexual activity, such as masturbation or intercourse. Many of them engage in strangulation, hanging, suffocation, or choking to achieve oxygen deprivation, which appears to intensify the sexual experience. Tragically, a number of individuals with this condition have died as a consequence of accidental oxygen deprivation (Hucker & Blanchard, 1992).

Although the origins of human fetishes are controversial, Michael Domjan and his colleagues were successful in classically conditioning fetishes in male Japanese quail. In one study, they presented male quails with a cylindrical object made of terrycloth, followed by a female quail with which they happily and promptly mated. After 30 such pairings, about half of the male quail attempted to mate repeatedly with the cylindrical object when it was presented alone (Koksal, Domjan, et al., 2004) (Photograph 10). This research doesn’t demonstrate, of course, that classical conditioning explains the acquisition of fetishes in humans; it’s an awfully long way from quails mating with terrycloth cylinders to humans.
that Adolph Hitler had previously worn. Would you wear it if someone told you that Adolph Hitler had worn it. If you're like most subjects in the studies of Paul Rozin and his colleagues, you'd hesitate (D'Amato, 1998). (Photograph 11).

Indeed, Rozin (who has earned the nickname of “Dr. Disgust”) and his colleagues have found that humans develop disgust reactions with surprising ease. In most cases, these reactions are probably the product of classical conditioning, because CSs associated with disgusting UCSs come to elicit disgust themselves. In many cases, these disgust reactions appear to be tied to stimuli that are biologically important to us, such as animals or objects that are dirty or potentially poisonous (Rozin & Fallon, 1987). For example, Rozin and his colleagues found that subjects who happily gobble up a delicious piece of fudge suddenly express a decided reluctance to do so when this piece of fudge is molded into the shape of dog feces (Rozin, Millman, & Nemeroff, 1986).

In another study, Rozin and his collaborators asked participants to drink from two glasses of water, both of which contained sugar (sucrose). In one case, the sucrose came from a bottle arbitrarily labeled “sugar”; in another, the sucrose came from a bottle arbitrarily labeled “Sodium Cyanide, Poison.” The investigators told subjects that both bottles were completely safe. Moreover, they even asked subjects to attach the arbitrary labels on the two glasses themselves, thereby allowing them to select which label went with which glass. Even so, subjects were extremely reluctant to drink from the glass that contained the sucrose labeled as poisonous (Rozin, Markovitz, & Ross, 1980). Participants’ responses in this study were irrational, but perhaps understandable: they were probably relying on the heuristic “better safe than sorry.” Classical conditioning helps keep us safe, even though it goes too far on occasion.

**Psychology**

**Chemical Transfer of Learning in Planaria**

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

McConnell’s animal of choice? The planaria, a flatworm that’s typically no more than a few inches long. Using classical conditioning, McConnell and his colleagues exposed planaria to a light, which served as the CS, while pairing it with a 1-second electric shock, which served as the UCS. When planaria receive an electric shock, they contract reflexively. After a number of pairings between light and shock, the light itself seems to cause planaria to contract (Thompson & McConnell, 1955). (Photograph 12)

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

Understandingly, McConnell’s memory transfer studies generated enormous excitement. Imagine if McConnell were right! You could sign up for your introductory psychology class, swallow a pill containing all of the basic psychological knowledge you’d need to get an A, and... voila, you’re now an expert psychologist. Indeed, McConnell went directly to the general public with his findings, proclaiming in Time, Newsweek, and other popular magazines that scientists were on the verge of developing a “memory pill” (Rilling, 1996). Yet it was not before long that the wind went out of McConnell’s scientific sails. There was one big hitch in McConnell’s grand plans for a memory pill: scientists couldn’t replicate his findings. Moreover, researchers brought up a host of alternative explanations for his results, some of which he hadn’t fully considered. For example, McConnell hadn’t completely ruled out the possibility that his findings were attributable to pseudoconditioning, which occurs when the CS by itself triggers the UCR. That is, McConnell hadn’t excluded the possibility that the light itself caused the planaria to contract (Collins & Pinch, 1993), perhaps leading him to the false conclusion that the cannibal planaria had acquired a classically conditioned reaction to the light. Eventually, after years of intense debate in the scientific literature and failed replications, most researchers concluded that McConnell was wrong: he had fooled himself into seeing a finding that was never there. McConnell’s planaria lab closed in 1971.

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

**CHAPTER 7 LEARNING: HOW NURTURE CHANGES US**

Operant Conditioning

What do the following six examples have in common?

1. Using bird feed as a reward, a behavioral psychologist teaches a pigeon to distinguish paintings by Monet from paintings by Picasso. By the end of the training, the pigeon is a veritable art aficionado.

2. Using fish as a treat, a trainer teaches a dolphin to jump out of the water, spin three times, splash in the water, and propel itself through a hoop.

3. A chimpanzee learns to signal “Amy want banana” whenever she’s hungry.

4. In his initial attempt at playing tennis, a frustrated 12 year old hits his opponent’s serve into the net the first 15 times. After 2 hours of practice, he successfully returns his opponent’s serve more than half of the time.

5. A woman in a stormy relationship makes manipulative suicidal threats (“If you break up with me, I’ll kill myself!”) whenever her boyfriend is about to leave her. Feeling sorry and concerned for her, he returns each time.

6. A hospitalized patient with dissociative identity disorder (known formerly as multiple personality disorder), displays features of an “alter” personality whenever staff members pay attention to him. When they ignore him, his alter personality seemingly vanishes.

The answer: all six are cases of operant conditioning (the first example, incidentally, comes from an actual study; Watanabe, Sakamoto, & Wakita, 1995). **Operant conditioning** is learning that is controlled by its consequences. These six examples, superficially different as they are, have one important thing in common. In all cases, the organism’s behavior is shaped by what comes after it, namely reward. Psychologists also refer to operant conditioning as **instrumental conditioning**, because the organism’s response serves an instrumental function. That is, the organism “gets something out” of the response, like food, sex, attention, or avoiding something unpleasant. We’ll soon discover how operant conditioning works, as well as how different subtypes of operant condition affect our behavior in different ways.

Behaviorists refer to the behaviors emitted by the animal in response to reward as **operants**, because the animal “operates” on its environment to get what it wants. So, your dropping 65 cents into a soda machine to get a Diet Coke is an operant, as is your asking out an appealing classmate on a date. In both cases, you’re engaging in a behavior to obtain a desired consequence.

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

Operant conditioning differs from classical conditioning in three important ways. First, in classical conditioning, the organism’s response is elicited; that is, “pulled out” of the organism by the UCS, and then later, the CS. Remember that in classical conditioning, the UCS is a reflexive and automatic response that doesn’t require training. In contrast, in operant conditioning, the organism’s response is emitted, that is, generated by the organism in a seemingly voluntary fashion.

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

Third, in classical conditioning, the organism’s responses mostly involve the autonomic nervous system (see Chapter 4). In contrast, in operant conditioning, the organism’s responses mostly involve the skeletal muscles. That is, in contrast to classical conditioning, in which the learning involves changes in heart rate, breathing, perspiration, and other bodily systems, in operant conditioning the learning involves changes in voluntary motor behavior. Nevertheless, as we’ll discover in Chapter 9, there may be exceptions to this neat and tidy distinction.

**THE LAW OF EFFECT**

Generations of introductory psychology students have diligently recited the famous Law of Effect, put forth by psychologist E.L. Thorndike. The Law of Effect is the first and most important commandment of operant conditioning. Here it is:

- If a response, in the presence of a stimulus, is followed by a satisfying state of affairs, the bond between stimulus and response will be strengthened.

At first blush, that sentence seems about as clear as mud. Yet it is actually isn’t all that complicated, because it means that if an event that precedes something we do is followed by a reward, we’re more likely to repeat it. As a consequence, psychologists sometimes refer to forms of behaviorism as **S-R psychology** (S stands for stimulus, R for response). According to S-R theorists, most of our complex behaviors reflect the accumulation of connections between stimuli and responses: the sight of a close friend and saying hello, the smell of a delicious hamburger and reaching for it on our plate, the soft feel of a comfortable blanket and pulling it over our body at night. Almost everything we do voluntarily, S-R theorists maintain, like driving a car, eating a sandwich, and planting a kiss on someone’s lips, results from the gradual build-up of S-R bonds.

Thorndike (1898) discovered the law of effect in a classic study of cats and puzzle boxes. He placed a hungry cat in a box, and dropped a tantalizing piece of fish or bowl of milk immediately outside of it. To escape from the box, the cat needed to hit upon (literally) the right solution, which was pressing on a lever or string inside the box (Figure 6).

When Thorndike first placed one of his cats in the puzzle box, it typically flailed around aimlessly in a frantic effort to escape. Then, by sheer accident, the cat eventually found the correct solution, ran out of the box, and gobbled up its delectable reward. Thorndike wanted to find out what would happen to the cat’s behavior over time. Once it figured out the solution to the puzzle, would it get it right every time after that? As Figure 7, shows the results were surprising, at least to most psychologists of the time. Thorndike found that cats’ time to escape from the puzzle box decreased only gradually over 60 trials. According to Thorndike, his cats were learning entirely by trial and error. Indeed, Thorndike and many other S-R theorists went so far as to conclude that all learning, including all human learning, occurs by trial and error. For them, S-R bonds are gradually “stamped into” the organism by reward.

This graph, Thorndike concluded, also provides convincing evidence against the hypothesis that cats learn by **insight**, that is, by grasping the nature of the problem. Had his cats possessed insight into the nature of the problem, the results presumably would have looked more like what we see in Figure 8. This figure illustrates what psychologists often term the aha reaction: “Aha – I got it!” Once the animal solves the problem, it gets it correct just about every time after that. Yet Thorndike found no hint of an aha reaction, so he concluded that cats had no clue as to what they were doing. They acted pretty much like mindless robots.

Nevertheless, Thorndike may have jumped the gun by concluding that cats don’t learn by insight. Here’s the problem: Thorndike constructed the puzzle box in such a way that learning by grasping the nature of the problem is impossible. The puzzle box was designed in such a way that insight was impossible. Thorndike’s puzzle box required trial and error (i.e., S-R learning) to find the correct solution. The puzzle box was not designed to allow for insight learning. The next question then is: Could cats learn the puzzle box through insight learning?
it was virtually impossible for cats to figure out the relationship between their response — pressing the lever or pulling a string — and the outcome — escaping from the puzzle box (Kohler, 1925). So Thorndike hadn’t ruled out an alternative hypothesis, namely, that the learning occurred by trial and error simply because the cats had no other means of learning. We’ll come back to the issue of insight learning later in the chapter.

B.F. SKINNER AND REINFORCEMENT

Although Thorndike’s pioneering discoveries laid the groundwork for research on operant conditioning, the field of behavioral psychology didn’t emerge in full form until the research of Harvard University psychologist B.F. Skinner. Although Skinner appreciated the importance of Thorndike’s work, he found Thorndike’s experimental set-up to be unwieldy, because the researcher had to stick around to put the unhappy cat back into the puzzle box following each trial. This limitation made it difficult to study ongoing operant behavior over long time periods, like hours, days, or weeks.

Skinner therefore developed what came to be known as a Skinner box, a small chamber that permitted the study of operant conditioning over lengthy spans of time. Indeed, to study an animal’s behavior in a Skinner box, the experimenter doesn’t even need to be in the room. She can simply leave the animal in the Skinner box overnight and come back in the morning to find a cumulative record — an electronically recorded graph of the animal’s responses over time. The Skinner box could hardly be simpler. For rats, it contains a bar for pressing food, a tiny food dispenser for giving out pellets, and often a light that signals when reward is forthcoming (Photograph 13). Using the Skinner box, Skinner studied the operant behavior of rats, pigeons, and other animals, and mapped out their responses to reward. His discoveries forever altered the landscape of psychology.

TERMINOLOGY OF OPERANT CONDITIONING

To understand Skinner’s research, we need to introduce you to a bit of psychological jargon. There are three key concepts in Skinnerian psychology: reinforcement, punishment, and discriminant stimulus. We’ll explain each in turn.

Reinforcement. Up to this point, we’ve used the term “reward” to refer to any pleasant consequence that makes a behavior more likely to occur. Skinner would have disapproved of our language, because he found the term “reward” to be hopelessly imprecise and subjective. For example, the opportunity to eat a bowl of tofu might be rewarding for someone who loves the taste of tofu, but not for someone who finds the taste of tofu curiously reminiscent to that of a piece of kitchen sponge soaked in water. What’s rewarding is in the eye of the beholder — or in the case of tofu, the taste of the eater.

So rather than the term “reward,” Skinner (1953, 1971) preferred the term reinforcement, which means any outcome that strengthens the probability of a response. If we gave you an M & M each time you read a page of this chapter, and that made you more likely to read about the psychology of learning, then these M & M’s would be reinforcers (the term for anything that provides reinforcement).

Skinner distinguished between two types of reinforcement: positive and negative. Positive reinforcement is the presentation of a pleasant outcome, such as giving a rat a tasty piece of cheese each time it navigates through a maze correctly. In contrast, negative reinforcement is the withdrawal an unpleasant outcome, such as removing a misbehaving child from a “time out” once he’s stopped whining. So, in positive reinforcement, we give (something good), whereas in negative reinforcement, we take away (something bad). In both cases, the outcome for the organism is pleasurable (Photograph 14).

Legions of psychology students over the years have demonstrated the power of reinforcement using a rather unconventional participant: their professor. In the game “Condition Your Professor” (Vyse, 1997), a class of introductory psychology students agree to provide positive reinforcement — like smiling or nodding their heads — to their professor whenever he or she moves in a particular direction, such as toward or away from the student audience. One of us knows of a famous introductory psychology teacher who spent much of time lecturing from behind his podium. During one class, his students decided to smile profusely and nod their heads vigorously whenever he began to venture out from behind the podium. Sure enough, by the end of the class, the professor was spending most of his time well away from the podium. You and your classmates might want to attempt a similar stunt with your introductory psychology professor: just don’t mention that we suggested it.

Punishment. Many students — and even a few rusty psychology professors — confuse negative reinforcement with punishment, which means any outcome that weakens the probability of a response. To remember the difference between negative reinforcement and punishment, just remind yourself that negative reinforcement, like all kinds of reinforcement, strengthens the probability of a response. Punishment, in contrast, weakens it.

Just to make sure that you have a good grasp on the difference between these two concepts, try labeling each of the following examples as an instance of either negative reinforcement or punishment (you can find the answers written upside down at the bottom of this page).

(1) A boy keeps making noise in the back of a classroom despite a teacher’s repeated warnings. The teacher finally tells him to leave the room. When he returns two hours later, he’s much better behaved.

(2) A parent who was withholding a child’s allowance for not performing his household chores decides to restore his allowance after he’s performed his household chores two weeks in a row. He now does his household chores even more consistently.

(3) A parole board releases a previously aggressive criminal from prison for being a “model citizen” within the institution over the past 5 years. Upon his release, his hostile impulses toward others decrease sharply.

(4) A woman yells at her roommate for leaving dirty clothing scattered all around her apartment. Her roommate apologizes and never makes a mess again.

As in the case of reinforcement, there are two types of punishment. First, we can punish the organism by presenting it with a negative stimulus. For example, we could administer an electric shock to a rat each time it walks over to one section of the cage, or we could loudly say “No!” to a child who is behaving disruptively (this form of punishment goes by the strange name of positive punishment). Second, we can punish the organism by withdrawing a positive stimulus. For example, we could take away food from a child every time he misbehaves in a restaurant, or we could deduct money from an employee’s holiday bonus each time he shows up late for work (this form of punishment is sometimes called response cost).

A second frequent error is to confuse punishment with the disciplinary practices often associated with it. Skinner, who always insisted on precision in his language, was quick to remind readers that certain actions that might superficially appear to be punishments are actually reinforcements. Skinner defined reinforcements and punishments solely in terms of their consequences. For example, let’s imagine that a mother rushes into her 3-year-old child’s bedroom and yells, “Johnny, stop that!” each time that he demands angrily that she come in to play with him. Is mommy punishing Johnny’s demanding behavior? There’s no way to know without looking at the consequences. In some cases, Johnny’s demanding behavior may actually increase following mommy’s scolding, perhaps because she’s paying attention to him. If so, she’s reinforcing, not punishing, his angry demands.

Behaviorists who use parent training — a set of techniques for teaching parents how to

Ruling Alternative Hypothesis

Photograph 13

Using his famous “ Skinner box, ” B.F. Skinner ( shown here ) plotted out responses of rats and other animals to operate conditioning.

Photograph 14

Skinner box

a small chamber that permits the study of operant conditioning over lengthy spans of time.

cumulative record

an electronically recorded graph of an animal’s responses over time.

reinforcement

any outcome that strengthens the probability of a response.

Positive reinforcement

the presentation of a pleasant outcome.

negative reinforcement

the withdrawal an unpleasant outcome.

Answers: Printed upside down at bottom of the page

(1) punishment,

(2) positive punishment,

(3) negative reinforcement

(4) A woman yells at her roommate for leaving dirty clothing scattered all around her apartment. Her roommate apologizes and never makes a mess again.


punishment

any outcome that weakens the probability of a response.

parent training

a set of techniques for teaching parents how to treat the problematic behaviors of Oppositional children.

parental

the behavior of a parent.

parent training

the act of teaching or coaching parents how to handle their child’s behavior.
curb the problematic behaviors of oppositional children—often start by teaching parents the difference between discipline and punishment (Forehand & Long, 1988). That’s because many parents who discipline their children don’t realize that they’re sometimes reinforcing them accidentally for bad behavior. They might think that yelling at Sally to “Go to your room!” whenever she acts up is an effective disciplinary technique, but they’re forgetting that when Sally goes to her room she can play all of her favorite music CDs and video games to her heart’s content. As a result, they may be making her more likely to act up in the future.

Does punishment work in the long run? Popular wisdom tells us that it usually does: “Spare the rod, spoil the child.” Yet Skinner (1953) and most of his followers argued against the routine use of punishment to change behavior, because they believed that they could effectively shape most human behaviors for the better by means of reinforcement alone.

According to Skinner, punishment has several distinct disadvantages. First, it only tells the organism what not to do, not what to do. That is, punishment isn’t especially informative. For example, when we punish a young child for throwing a temper tantrum when he gets frustrated, he may learn not to throw a temper tantrum again. But he won’t learn how to deal with his frustration in a more constructive manner. Second, punishment often creates anxiety, which in turn interferes with future learning. Third, punishment may teach the organism only to become sneakier about the situations in which it can and can’t display forbidden behavior. For example, a child who is punished by Daddy for grabbing his brothers’ toys may learn to grab his brother’s toys when Daddy isn’t looking. Fourth, punishment from parents may provide a model for children’s aggressive behavior (Straus, Sugarman, & Giles-Sims, 1997). As a consequence, children whose parents spank them harshly may “get the message” that spanking is acceptable.

Indeed, numerous researchers have reported that the use of physical punishment by parents is positively correlated with aggressive behavior in children (Gershoff, 2002). For example, across many studies, Murray Strauss (1996) and his colleagues found that parental spanking is associated with a higher number of behavioral problems in children. In a study of 1,575 subjects drawn from the general population, Cathy Widom and her colleagues further found that children who are physically abused are at heightened risk for becoming aggressive in adulthood (Widom, 1989a, 1989b). Many researchers contend that this finding demonstrates that spanking and early physical abuse cause aggression. For example, Widom (1989a) concluded that her findings reveal the operation of a “cycle of violence,” whereby parental aggression begets childhood aggression. When these children become parents, many become abusers themselves. Similarly, Elizabeth Gershoff (2002) conducted a meta-analysis (see Chapter 3) of 88 studies of corporal punishment based on a whopping 39,309 participants. Although she found some evidence that corporal punishment is associated with short-term improvements in children’s behavior, she also reported that a history of such punishment in childhood is associated with an increased probability of becoming an abuser in adulthood.

Yet we must remember that the findings of Strauss, Widom, and Gershoff are merely correlational and don’t prove causality. Other interpretations are possible. For example, because children share half of their genes with each parent, and because aggression is partly heritable (Krueger, Hicks, & McGue, 2001), it’s possible that the correlation between parent’s physical aggression and their children’s aggression is due to the fact that parents who are physically aggressive pass on this predisposition to their children (DiLalla & Gottesman, 1991). It’s also conceivable that the causal arrow is reversed. For example, children who are extremely aggressive may be difficult to control and may therefore elicit spanking from their parents. This hypothesis doesn’t excuse spanking or imply that it’s acceptable, of course, but it may help to explain why it occurs. In addition, it’s possible that mild levels of punishment are effective, but that severe forms of punishment, including abuse, aren’t (Baumrind, Larearere, & Cowan, 1992).

Making matters still more complicated, the association between spanking and childhood behavior problems depends on both race and culture. Although spanking and other forms of physical discipline are positively correlated with childhood behavior problems in White families, they are negatively correlated with childhood behavior problems in African-American families (Lansford, Deater-Deckard, Dodge, Bates, & Pettit, 2004). Apparently, physical discipline means something different—perhaps a deep commitment to rearing children properly—in African-American than in White families. Moreover, spanking tends to be more highly correlated with childhood aggression and anxiety in countries in which spanking is rare, like China or Thailand, than in countries in which spanning is common, like Kenya or India (Lansford et al., 2005). The reasons for this difference aren’t clear, although children who are spanked in countries in which spanking is more culturally accepted may feel less stigmatized than children in countries in which spanking is culturally condemned.

So when, if ever, is punishment effective in the long term? Most research suggests that punishment works best when it (a) is delivered consistently and (b) follows the undesired behavior promptly. For example, in a correlational study of crime and punishment in a sample of over 28,000 men in Denmark, Patricia Brennan and Sarnoff Mednick (1994) found that consistently delivered prison sentences were associated with lower rates of reoffending than were inconsistently delivered prison sentences. In contrast, the length or severity of the prison sentence was unrelated to the risk of reoffending. Discipline may not need to be harsh to be effective (Photograph 15).

Discriminant stimulus. One other key term in operant conditioning lingo is the discriminant stimulus, typically abbreviated simply as Sd. A discriminant stimulus is any stimulus that signals the presence of reinforcement. When you snap your fingers at a dog in the hopes of having it come over to you, the dog may approach you to get a much-appreciated petting. For the dog, your finger snapping is an Sd—it’s a signal that if it comes near you, it will receive reinforcement (Photograph 16). According to behaviorists, we’re responding to Sds virtually all of the time, even if we’re not consciously aware of it. For example, let’s say that while walking across campus tomorrow you encounter a friend who smiles or waves at you. Most likely, you’ll either smile or wave back, and if you’re not busy you might walk over to say hello. By smiling or waving, your friend has given you the “green light” to say hello; that green light is his Sd. In the very next sentence, you’re about to learn something interesting. The previous sentence was also an Sd, because it was a signal that if you read this sentence, you’d be reinforced by acquiring a piece of intriguing knowledge. See, it worked.

Acquisition, extinction, spontaneous recovery, and stimulus generalization and discrimination. If you feel that you’re experiencing a case of déjà vu (see Chapter 8), don’t be concerned, because you’ve indeed seen all of these terms before. Acquisition, extinction, spontaneous recovery, and stimulus generalization and discrimination apply just as much to operant conditioning as to classical conditioning.

For example, in operant conditioning, extinction occurs when we stop delivering reinforcement to a previously reinforced behavior. Gradually, this behavior declines in frequency and disappears. Let’s imagine that you’re a behavioral psychologist assigned to help two exasperated parents eliminate the yelling behavior of their 4-year-old child, Jimmy. After observing the family for a few days, you notice something curious every time Jimmy
screams, the parents give him his favorite toy robot in a desperate effort to shut him up. It works, and Jimmy indeed quiets down in the short term. But having read Chapter 6 of your introductory psychology text, you have a sneaking suspicion that their practice may be backfiring, because it may be reinforcing Jimmy’s screaming in the long term. So you instruct the parents to stop giving Jimmy his toy robot each time he acts up. Sure enough, if they wait long enough his screaming behavior will gradually extinguish. Interestingly, though, in such cases we often see an extinction burst. That is, shortly after withdrawing reinforcement: the undesired behavior initially increases in intensity. That’s probably because the child is “upping the ante”: by screaming even more intensely, he’s trying harder to get reinforcement. So there’s some truth to the saying that things sometimes need to get worse before they get better (Photograph 17).

Stimulus discrimination and generalization also occurs in operant conditioning. As we mentioned earlier, using food reinforcements, one group of investigators trained pigeons to distinguish paintings by Monet from those of Picasso (Watanabe et al., 1995). That’s stimulus discrimination, because the pigeons are learning to tell the difference between two different types of stimuli. Interestingly, the investigators also found that these pigeons exhibited stimulus generalization. Following operant conditioning, they were also able to distinguish paintings by artists similar to Monet, such as Renoir, from paintings by artists similar to Picasso, such as Braque.

The similarities between classical and operant conditioning, including the fact that we find acquisition, extinction, stimulus generalization, and so on, in both, have led some theorists to argue that these two forms of learning aren’t as different as some psychologists believe (Brown & Jenkins, 1968; Staddon, 2003). Although there certainly are important similarities between classical and operant conditioning, brain imaging studies demonstrate that these two forms of learning are rooted in different brain regions. For example, classically conditioned fear reactions are based largely in the amygdala (LeDoux, 1996; Veit, Fior, Ehr, Lotze, Grodd, & Birbaumer, 2002), whereas operant conditioned responses are based largely in the nucleus accumbens and related limbic systems linked to reward (Robbins & Everitt, 1998; see Chapter 4).

PRINCIPLES OF REINFORCEMENT

Using the Skinner box as his miniature laboratory, Skinner uncovered a variety of general principles of behavior. To demonstrate one of them, first try to answer a little quiz question. If you wanted to train a dog to perform a trick, like catching a Frisbee, would you reinforce it for correct responses only occasionally. This principle may also help to explain why some people remain trapped for years in horribly dysfunctional relationships. Some relationship partners provide intermittent reinforcement to their significant others, treating them miserably most of the time but treating them well on rare occasions. This pattern of partial reinforcement may keep individuals “hooked” in relationships that aren’t working (Photograph 18).

Schedules of reinforcement. Skinner (1938) also found that animals’ behaviors vary as a function of different schedules of reinforcement, that is, patterns of delivering reinforcement. Remarkably, the effects of these reinforcement schedules are consistent across species as diverse as cockroaches, pigeons, rats, and humans. Although there are numerous schedules of reinforcement, we’ll discuss four here. The principal reinforcement schedules vary along two dimensions: (1) the consistency of administering reinforcement and (2) the basis of administering reinforcement. Let’s explain.

With regard to consistency of administering reinforcement, some reinforcement contingencies are fixed, whereas others are variable. That is, in some cases the experimenter provides reinforcement on a regular (fixed) basis, whereas in others the experimenter provides reinforcement on an irregular (variable) basis. With regard to the basis of administering reinforcement, some reinforcement schedules operate on ratio schedules, whereas others operate on interval schedules. In ratio schedules, the experimenter reinforces the animal depending on the number of responses it has emitted. In interval schedules, the experimenter reinforces the animal depending on the amount of time that has elapsed since its last response.

We can cross these two dimensions to arrive at four major schedules of reinforcement (Figure 9). In a fixed ratio (FR) schedule, we provide reinforcement after a regular number of responses. For example, we could give a rat a pellet after it presses the lever in a Skinner box 15 times. In a fixed interval (FI) schedule, we provide reinforcement after a regular period of time. For example, assume that he’s done her job well, we could pay a worker in a factory every two weeks. In a variable ratio schedule, we provide reinforcement after an irregular number of responses. For example, we could give a pigeon a piece of bird feed after 6 pecks, then after 15 pecks, then after 1 peck, then after 35 pecks, and so on. Finally, in a variable interval schedule, the experimenter provides reinforcement after irregular time intervals. For example, we could give a dog a treat for performing a trick after 7 minutes, then 1 minute, then 20 minutes, then 3 minutes, and so on.

Skinner discovered that these reinforcement schedules yielded distinctive patterns of responding (Figure 10). For example, he found that ratio schedules tend to yield higher rates of responding than do interval schedules. In addition, variable schedules tend to yield more consistent rates of responding than do interval schedules.

Two other features of reinforcement schedules are worth noting. First, fixed interval schedules tend to be associated with a “scalloped” pattern of responding. This FI scallop reflects the fact that the animal “waits” for a time after it receives reinforcement, and then jacks up its rate of responding as it begins to anticipate reinforcement (Figure 11). Second, as you can see in Figure 10, variable ratio (VR) schedules tend to yield the highest rates of responding of all reinforcement contingencies. Indeed, there’s one place...
where you can be guaranteed to find a VR schedule: a casino. Roulette wheels, slot machines, and the like deliver cash rewards on an irregular basis, and they do so based on the gambler’s responses. Sometimes the gambler has to pull the arm of the slot machine (the so-called “one-armed bandit”) hundreds of times before receiving any money at all. At other times, the gambler pulls the arm only once and makes out like a bandit himself, perhaps walking off with hundreds of dollars for a few seconds of work. The extreme unpredictability of the VR schedule is precisely what keeps gamblers hooked, because reinforcement can come at any time (Photograph 19). The VR schedule also keeps pigeons hooked. For example, Skinner (1953) found that pigeons placed on VR schedules sometimes continued to peck on a disk for after more than 150,000 nonreinforced responses. In some cases, they pecked the disk so many times that they ground down through the beads. Like desperate gamblers in a Las Vegas casino hoping for a huge payoff, they wouldn’t give up despite repeated disappointments. For Skinner, much of what we term “persistence” is merely a consequence of being on a reinforcement schedule that is difficult to extinguish, especially a VR schedule.

APPLICATIONS OF OPERANT CONDITIONING.

There’s an old joke that just as magicians pull rabbits out of hats, behavioral psychologists pull habits out of rats, and there’s a grain of truth to this one. By means of operant conditioning, behaviorists train rats and other organisms to develop learned habits. They typically do so by means of a procedure called shaping by successive approximations, often called shaping for short. Using shaping, we reinforce progressively closer versions of a desired response. Typically, we shape an organism’s response by initially reinforcing most or all correct responses, and then gradually fading (that is, decreasing the frequency of) our reinforcement over time.

When you learned to drive a car, your Driver’s Ed instructor (or perhaps one of your parents, depending on who taught you) used shaping to help you learn how to parallel park. Your instructor first taught you to pull up aside another car, then put the car in reverse, then turn the steering wheel by a certain amount, then gradually back up the car while looking behind you, and so on, all the while reinforcing you verbally (“Good, that’s better…” “Yes, that’s right… keep going”). Eventually, you learned the complete sequence of steps required to parallel park a car.

By means of shaping, Skinner taught pigeons to play ping-pong, although they weren’t exactly Olympic-caliber table tennis players. During World War II, Skinner also taught dolphins to steer torpedoes toward enemy ships by pecking a target whenever the torpedo got closer to the bulls-eye, although the U.S. military never ended up adopting his creative approach to naval warfare (Photograph 20). In both cases, Skinner began by reinforcing initial approximations to the desired response. For example, when teaching pigeons to play ping-pong, he first reinforced them for turning toward the rockets, then approaching the rockets, then placing the rockets in their mouths, then picking up the rockets with their mouths, then swinging the rocket, and so on. As you might imagine, shaping complex animal behaviors requires patience, as the process may take days or weeks. Still, the payoff can be substantial, because one can train animals to engage in numerous behaviors that lie well outside their normal repertoire. Indeed, all contemporary animal trainers rely on Skinnerian shaping principles (Photograph 21).

Behaviorists do more than pull habits out of rats, because they also pull habits out of humans. Indeed, one of the great triumphs of modern psychology has been the application of operant conditioning to myriad domains of modern life. We’ll look at four applications here: the Premack principle, superstitious behavior, token economies, and teaching language to autistic children.

The gambler’s fallacy is the incorrect belief that random events have a memory (Ayton & Fischer, 2004; Schulman, 2002). Along with the seductive power of VR schedules, this fallacy contributes to the perennial allure of dice and craps tables.

The gambler’s fallacy is a reasoning error because the odds that a penny will come up heads or tails remain exactly 50% with each flip. Many gamblers believe mistakenly that following a long string of unsuccessful rolls of the dice they are “due” for the next roll is bound to turn out in their favor. Nevertheless, the dice don’t “remember” their previous rolls, so the probability starts anew with each roll. Or take the case of parents who’ve had five boys in a row, but want a girl desperately. They may try to have a 6th child, believing that their 6th child is almost certain to be a girl. Because the odds of having a girl stay at about 50% each time, they may be in store for another disappointment.

The gambler’s fallacy probably stems in part from a misapplication of the representativeness heuristic (see Chapter 3). To understand why, consider the following two sequences of ten successive penny flips, with H being heads and T being tails.

HHHHHHHHHH
HHHHHHHHHH

Which of these sequences is more likely?

In fact, both sequences are equally probable, because the odds of an H and a T with each flip are each 50%. Nevertheless, many people assume that the second sequence is more likely, because this sequence seems more representative, that is, more typical of a random sequence of coin flips. After several consecutive heads, a tail somehow seems more probable. It isn’t.

CRITICAL THINKING QUESTION

How might the effect of VR schedules help to explain why people are more likely to believe in psychic experiences despite the absence of strong evidence for their existence?

Before reading any further, here’s another little quiz question. Imagine that you’ve flipped a penny 10 times in a row and that it’s come up tails all 10 times. What are the odds that it will come up heads the 11th time?

The answer? 50%.

If your answer was higher than 50%, don’t feel bad. Scores of highly intelligent people make this understandable mistake, which is called the gambler’s fallacy. The gambler’s fallacy is the incorrect belief that random events have a memory (Ayton & Fischer, 2004; Schulman, 2002). Along with the seductive power of VR schedules, this fallacy contributes to the perennial allure of dice and craps tables.

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CRITICAL THINKING QUESTION

What variable conditions account for the correlation between procrastination and poor grades?
Operant Conditioning

How can we overcome procrastination? We hope you won’t put off reading the next two paragraphs, because we have a possible remedy for dilly-dallying. Although there are many potential solutions to procrastination, one of the best is probably the Premack Principle, discovered by David Premack (1965) in his research on monkeys. This principle states that we can positively reinforce a less frequently performed behavior with a more frequently performed behavior (Danaher, 1974). Although not a foolproof rule (Knapp, 1976), this guideline typically works surprisingly well. The Premack Principle is also known as “Grandma’s Rule,” because our grandmother reminded us that we need to finish our vegetables before moving on to dessert. If we give children the opportunity to choose between spinach and chocolate ice cream, they’ll vote with their mouths, and choose to eat chocolate ice cream at a much higher frequency than they eat spinach. In this way, we can get children to eat spinach by reinforcing them with chocolate ice cream if, and only if, they’ve finished their spinach.

Similarly, we can help to overcome our schoolwork procrastination by engaging in a higher-frequency behavior once we’ve completed our assignments. So, if you find yourself putting off a reading or writing task, try to think of behaviors that you’d typically perform if given the chance – perhaps hanging out with a few of your close friends, watching a favorite TV program, or munching down an ice cream cone. Then, reinforce yourself with these higher-frequency behaviors only after you’ve completed your homework. Research indicates that this approach may help people to avoid putting off things they’ve long dreaded, like going to the dentist (Ramter, 1980).

If you’re procrastinating in your schoolwork and are contemplating using the Premack Principle to help you get over it, don’t put off trying it.

Superstitious behavior. How many of the following behaviors do you engage in?

- Never opening an umbrella indoors.
- Not walking under a ladder.
- Crossing the street whenever you see a black cat.
- Carrying a lucky charm or pendant.
- Touching the front door before entering a house.
- Crossing your fingers.
- Knocking on wood.
- Crossing your fingers.
- Avoiding the number 13 (like not stopping on the 13th floor of a building).
- Putting a coin in your pocket before entering a house.
- Rubbing a lucky object before sitting down to eat.
- Throwing a coin at a pot to break it if you break a pot.
- Touching the front door before entering a house.
- Crossing your fingers.

If you perform several of these behaviors, you are “very superstitious,” in the words of singer Stevie Wonder. So are quite a few Americans. For example, 12% of Americans are afraid of walking under a ladder, while 14% are afraid of crossing paths with a black cat (Vrye, 1997). So many people are afraid of the number 13 (incidentally, the technical name for this fear is triskaidekaphobia) that the floor designations in many tall buildings skip directly from 12 to 14 (Hock, 2002). This phobia isn’t limited to North America; in Paris, triskaidekaphobics who are going out to dinner with 12 other people can hire out for a quatorzieme, a person paid to serve as a 14th guest (Photograph 22).

Many college students also adopt superstitious rituals prior to their exams. Psychologist Stuart Vrye (1997) found that 62% of undergraduates had used a “lucky” pen or had worn a “lucky” piece of jewelry or clothing before an exam. Thirty-one percent had performed a specific sequence of actions (like saying certain words) prior to a test, and 26% ate a special food.

How do superstitions relate to operant conditioning? In a classic study, B.F. Skinner (1948) placed 8 food-deprived pigeons in a Skinner box while delivering reinforcement (bird food) every 15 seconds independent of their behavior. In other words, the birds received reinforcement regardless of what they did. After a few days, Skinner found that 6 of the 8 birds had acquired remarkably strange behaviors. In the words of Skinner:

One bird was conditioned to turn counterclockwise about the cage, making two or three turns between reinforcements. Another repeatedly thrust its head into one of the upper corners of the cage. A third developed a tossing response as if placing its head beneath an invisible bar and lifting it repeatedly. Two birds developed a pendulum motion of the head and body in which the head was extended forward and swing from right to left (p. 168).

When Skinner extended the reinforcement interval to a few minutes, one of the pigeons even performed a miniature “dance” of sorts while awaiting food. You may have observed similar odd behaviors in large groups of birds that are feeding in city parks; for example, you may have seen pigeons prance around or walk rapidly in circles in anticipation of reinforcement.

According to Skinner, his pigeons had developed superstitions. Tiger Woods is superstitious: he always wears a red shirt on Sundays. In this chapter at least, his superstition seems to have worked.

Photograph 22
Triskaidekaphobia, or fear of the number 13, is so prevalent that some tall buildings skip from the 12th to the 14th floor.

Photograph 23
Like many athletes, superstar golfer Tiger Woods is superstitious: he always wears a red shirt on Sundays. In this chapter at least, his superstition seems to have worked.
Token economies. One of the most successful applications of operant conditioning has been the development of token economies. These are systems, often set up in psychiatric hospitals, for reinforcing appropriate behaviors and extinguishing inappropriate behaviors (Carr, Frazer, & Roland, 2005; Kazdin, 1982). In token economies, staff members reinforce patients who behave in a desired fashion using tokens, chips, points, or other secondary reinforcers. Secondary reinforcers are neutral objects that patients can later trade in for primary reinforcers—things that are naturally pleasurable, like a favorite food or drink (Photograph 24).

Typically, psychologists who construct token economies begin by identifying certain target behaviors, that is, actions that they wish to make more frequent. One psychiatric hospital unit in which one of the authors of your textbook worked consisted mostly of children with serious behavior problems, which included yelling and cursing at staff members. In this unit, one target behavior in the token economy was being polite to staff members. So whenever a child was especially polite to a staff member, he was rewarded with points, which he could later trade in for something he wanted, like ice cream or attending a movie with staff members. Whenever a child was rude to a staff member, he was punished with a loss of points (as you may recall from earlier in the chapter, this type of punishment is called response cost).

Research suggests that token economies are often effective in improving behavior in hospitals, group homes, and juvenile detention units (Alloy & Milan, 2002). Nevertheless, token economies remain controversial, because the behaviors learned in these institutions don’t always transfer to the outside world (Carr et al., 2015). That’s especially likely if the patients return to environments in which they’re reinforced for socially inappropriate behaviors (Photograph 25).

Teaching language to autistic children. As we learned in Chapter 3, infantile autism (known officially as autistic disorder) is a severe condition marked by shortcomings in social attachment, capacity for imagination, and language. About three-fourths of autistic individuals are mentally retarded, and most are profoundly linguistically impaired. As we also learned in that chapter, many well-meaning mental health professionals have used facilitated communication or other pseudoscientific methods in an effort to teach language to autistic individuals (Jacobson, Mullick, & Schwartz, 1995). Although these techniques are ineffective, the good news is that applied behavior analysis (ABA) can be quite helpful in remedying the language deficits of individuals with autism and other developmental disabilities. ABA is a set of techniques based on operant conditioning principles that relies on the careful measurement of behavior before and after implementing interventions (Romanczyk et al., 2005). ABA for autism makes extensive use of shaping techniques; mental health professionals reinforce autistic individuals with food and other primary reinforcers as they reach progressively closer approximations to certain words and eventually, complete sentences.

Ivar Lovaas and his colleagues at the University of California-Los Angeles have pioneered by far the best known ABA program for autism (Lovaas, 1987; McEachlin, Smith, & Lovaas, 1993). The results of Lovaas’ work have been promising, as they indicate that an experimental group of children with autism who undergo ABA training emerge with superior language and intellectual skills compared with control groups of children with autism who do not undergo such training (Green, 1996; Matson, Benavidez, Compton, Paclowaskyj, & Baglio, 1996). (Photograph 26).

Nevertheless, ABA researchers haven’t been immune from making exaggerated claims regarding the effectiveness of their treatment. For example, although Lovaas (1987) claimed that many of the children he treated “recovered” from autism, this conclusion is questionable. For one thing, because Lovaas didn’t randomly assign children with autism to experimental and control groups, his findings are vulnerable to an alternative explanation: perhaps the children in the experimental group had higher levels of functioning to begin with. Indeed, there’s evidence that this was the case (Schopler, Short, & Mesibov, 1989). The current consensus is that ABA isn’t a miracle cure for the language deficits of children with autism, but that it can be extremely helpful in some cases (Herbert, Sharp, & Gaudiano, 2002).

Two-process theory: putting classical and operant conditioning together

Up to this point, we’ve discussed classical and operant conditioning as though they were two entirely independent processes. Yet the reality is much more complicated. In everyday life, classical and operant conditioning often interact with one another. To see how, let’s revisit the question of how people develop phobias. We’ve pointed out that certain phobias arise in part by classical conditioning: a previously neutral stimulus (the CS) - like a dog - is paired with an unpleasant stimulus (the UCS) – a dog bite – producing the CR of fear. So far, so good. Yet this neat and tidy scheme doesn’t answer an important question: Why doesn’t the CR of fear eventually extinguish? Given what we’ve learned about classical conditioning, you might expect the CR of fear to gradually fade away over time with repeated exposure to the CS of dogs. Yet this often doesn’t happen (Rachman, 1977). Many people with phobias remain deathly afraid of their feared stimulus for years, even decades. For example, only about 20% of untreated adults with phobias ever get over their fears (American Psychiatric Association, 2000). Why?

Enter two-process theory to the rescue as an explanation for this mystery (Mowrer, 1947). According to two-process theory, we need both classical and operant conditioning to explain the persistence of phobias and other anxiety disorders over time. Here’s how it works. First, people acquire phobias by means of classical conditioning. Second, once people are phobic, they start to avoid their feared stimulus any time they see it. For example, if they have a dog phobia, they may cross the street whenever they see someone walking toward them with a huge German shepherd. When they do this, they experience a reduction in anxiety—a sense of relief—which negatively reinforces their fear. Nevertheless, ABA researchers haven’t been immune from making exaggerated claims regarding the effectiveness of their treatment. For example, although Lovaas (1987) claimed that many of the children he treated “recovered” from autism, this conclusion is questionable. For one thing, because Lovaas didn’t randomly assign children with autism to experimental and control groups, his findings are vulnerable to an alternative explanation: perhaps the children in the experimental group had higher levels of functioning to begin with. Indeed, there’s evidence that this was the case (Schopler, Short, & Mesibov, 1989). The current consensus is that ABA isn’t a miracle cure for the language deficits of children with autism, but that it can be extremely helpful in some cases (Herbert, Sharp, & Gaudiano, 2002).
Cognitive Models of Learning

Up to this point, we've omitted one word when discussing how we learn: thinking. That's not entirely accidental, because the early behaviorists didn't believe that thought played much of a causal role in learning.

WATSON, SKINNER, AND THOUGHT

Actually, Watson and Skinner held two somewhat different views on this matter. Watson (1913) was an advocate of methodological behaviorism. According to this school of thought, psychology should focus exclusively on overt (that is, observable) behaviors. From Watson's perspective, thinking and emotion lay outside the domain of scientific psychology. There's an old joke about two methodological behaviorists who meet at a conference. They find themselves attracted to each other and end up sleeping together. Upon awakening, one of them asks, "That was great for you. How was it for me?" The point here is that methodological behaviorists studied only what they could observe: what you see is what you get.

In contrast, Skinner (1953) was a proponent of radical behaviorism. For radical behaviorists, overt behavior, thinking, and emotion are all governed by the same laws of learning, namely classical and operant conditioning. For Skinnerians (the term often used for radical behaviorists), thinking and emotion are behaviors, they are just covert (that is, unobservable) behaviors. One frequent misconception about Skinner, held not only by many students but even some psychology professors, is that he didn't believe in thinking. In fact, Skinner isn't merely one of the most famous of all psychologists; he is also one of the most misunderstood (DeBell & Harless, 1992; Wyatt, 2001; see Table 3).

To the contrary, Skinner clearly thought - he wouldn't have objected to our use of that word here - that humans and other intelligent animals think, but he believed that thinking was no different from any other behavior. At times, Skinner went even further. In a talk to the American Psychological Association given only 8 days before his death, Skinner (1960) likened proponents of cognitive psychology, who believe that thinking plays a central role in causing behavior (see Chapter 1), to pseudoscientists. Cognitive psychology, he argued, invokes unobservable and ultimately meaningless concepts - like the "mind" - to explain behavior. By doing so, Skinner said, it doesn't get us any closer to the true causes of behavior, any more than invoking a mysterious higher power gets us any closer to explaining the origin and development of species.

S-O-R PSYCHOLOGY

Today, few psychologists share Skinner's exceedingly harsh assessment of cognitive psychology. In fact, a substantial majority of psychologists now agree that the story of learning in humans is incomplete without at least some role for cognition, that is, thinking (Bolles, 1979; Kürsch, Lynn, Vigorito, & Miller, 2004). Over the past two or three decades, psychology has moved increasingly away from a simple S-R psychology to a more complex S-O-R-R psychology, with "O" being the organism that interprets the stimulus before producing a response (Woodworth, 1929). For S-O-R R psychologists, the link between S and R isn't mindless or automatic. Instead, how the organism responds to a stimulus depends on what this stimulus means to the organism. The S-O-R principle helps to explain a phenomenon we've probably all encountered. You've probably had the experience of giving one of your friends a mildly critical piece of feedback ("It bothers me a little bit when you show up late") and another one of your friends the same feedback, but found that they reacted quite differently. Perhaps one of your friends accepted your gentle criticism gracefully with a polite apology, whereas the other became defensive or even argumentative.

In attempting to explain these different reactions, Skinnerians would probably invoke your friends' different learning histories. Perhaps your first friend had repeatedly been reinforced by others for apologizing ("That's so nice of you to apologize; I really appreciate it"), whereas your second friend had repeatedly been reinforced by others for becoming defensive when criticized ("Oh, I'm really sorry I brought that up; I'll try to be less critical of you in the future"). In contrast, S-O-R R theorists, who believe that cognition is central to explaining at least some forms of learning, would contend that the differences in your friends' reactions stem from their differences in how they interpret your criticism. Your first friend may have viewed your criticism as constructive feedback, whereas your second friend may have viewed it as a personal attack.

S-O-R R theorists don't deny that classical and operant conditioning occur, but they believe that these forms of learning usually depend on thinking. Let's imagine that we classically conditioned a person using a tone paired repeatedly with an electric shock: tone-shock, tone-shock, tone-shock, and on and on. As we noted earlier in the chapter, the person - unless he or she is a psychopath - will show a pronounced skin conductance response to the tone alone, which extinguishes gradually over time. But what do you think would happen if we suddenly informed the subject that "Don't worry - no more shocks are coming"? If you guessed that the skin conductance response extinguishes much more
rapidly, you'd be right (Grings, 1973). This phenomenon of cognitive conditioning, whereby our interpretation of the situation affects conditioning, suggests that conditioning is more than an automatic, mindless process (Brewer, 1974).

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

**LATENT LEARNING**

One of the first serious challenges to the radical behaviorist account of learning arose from research conducted by Edward Chase Tolman (1886–1959), who is one of the unsung giants of modern psychology (Photograph 27). Although few psychology undergraduates (aside from those at the University of California at Berkeley, where the psychology building bears his name) have ever heard of Tolman, his contribution to the psychology of learning is difficult to overestimate.

Tolman suspected that, contrary to Watson, Thorndike, and others, reinforcement wasn’t the be-and-end-all of learning. To understand why, let’s imagine that we asked you a question based on your reading of the previous paragraph: “After what psychologist is the University of California at Berkeley psychology building named?” If you’ve been paying attention, you hopefully answered “Tolman.” Yet before we asked that question, you knew the answer, even though you hadn’t had the chance to demonstrate it. According to Tolman (1932), you had engaged in latent learning, that is, learning that isn’t directly observable (Blodgett, 1929). We learn many things without showing them. Putting it a bit differently, there’s a crucial difference between competence – what we know - and performance – showing what we know (Bradbard, Martin, Endsley, & Halverson, 1986).

Why is this distinction important? Because it implies that reinforcement is not necessary for learning. To demonstrate this point systematically, Tolman and Honzik (1930) ran three randomly assigned groups of rats through a maze over a three week period (see Figure 12). One group–always received reinforcement – cheese – when it got to the end of the maze. A second group never received reinforcement when it got to the end of the maze. The first group made far fewer errors; there’s certainly no great surprise there. But Tolman and Honzik’s third group of rats was the most interesting. This group received no reinforcement for the first 10 days, and then started receiving reinforcement starting on the 11th day. As you can see in Figure 12, the rats in this group showed a large and abrupt drop in their number of errors upon receiving their very first reinforcement. In fact, within only a few days the number of their errors was not significantly different – and was even slightly less than – the number of errors among the rats always receiving reinforcement.

According to Tolman, this finding means that the rats in the third group had been learning all along. They just hadn’t bothered to show it because there was nothing to be gained. Once there was something to be gained – cheese they suddenly became miniature maze masters.

How did they do it? According to Tolman (1948), the rats had developed cognitive maps – that is, spatial representations – of the maze. If you’re like most undergraduates, you were hopelessly confused the first day you arrived on campus. Perhaps you went to your first class, and then got lost in the middle of campus trying to make it to your second class. Perhaps you later started walking confidently toward what you thought was the campus library, only to realize that you were headed directly toward the cafeteria. Over time, however, you probably developed a mental sense of the layout of the campus, so that you now hardly ever become lost. That internal spatial blueprint, according to Tolman, is a cognitive map (Photograph 28).

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

The latent learning research of Tolman and others struck a serious blow to strictly behavioral models of learning, because this work suggested that learning could occur without reinforcement. It also suggested that thinking, in the form of cognitive maps, plays a central role in at least some forms of learning.

**OBSERVATIONAL LEARNING**

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

Observational learning makes awfully good evolutionary sense, because it spares us the expense of having to learn everything first-hand (Bandura, 1977). The authors of your book are not particular experts in skydiving, but from our observations of people who have gone skydiving we have the distinct impression that it’s generally advisable to have a parachute on before one jumps out of a plane. Note that we did not have to learn this useful tidbit of advice by trial and error. If we had made such an error, we wouldn’t be here to tell you about it. As a result, observational learning can spare us from serious, even life-threatening, mistakes. Nevertheless, observational learning can also facilitate our learning of maladaptive habits.

**Observational learning of aggression.** In classic research in the early 1960s, Alfred Bandura and his colleagues demonstrated that children can learn to act aggressively by observing aggressive role models (Bandura, Ross, & Ross, 1963). In one study, they exposed preschool boys and girls to an adult (the model) whom they placed in a room with a large Bobo doll, a doll that bounces back to its original position after being hit (Bandura, Ross, & Ross, 1961). The experimenters randomly assigned some children to watch the adult model by attacking the Bobo doll in much the same fashion. Their compatriots got to observe the adult model emulating the Bobo doll. Bottom two panels: a boy and a girl emulating the adult model by attacking the Bobo doll in much the same fashion.
adult model playing quietly and ignoring the Bobo doll, and others to watch the adult model punching the Bobo doll in the nose, hitting it with a mallet, sitting on it, and kicking it around the room. As though that weren’t enough, the model in the latter condition shouted out insults to the Bobo doll while inflicting violence: “Sock him in the nose,” “Kick him,” “Poke.” (Photograph 29)

Bandura and his co-workers then brought the children into a room with a variety of appealing toys, including a miniature fire engine, jet fighter, and a large doll set. Just as the children began playing with these toys, the experimenter interrupted them, informing them that they needed to move to a different room. This interruption was intentional, as the investigators wanted to frustrate the children to make them more likely to behave aggressively. Then the experimenter brought them into a second room, which contained a Bobo doll identical to that they had seen previously. On a variety of dependent measures, Bandura and colleagues found that previous exposure to the aggressive model triggered significantly more aggression against the Bobo doll than did exposure to the nonaggressive model. The children in the former condition hit and yelled at the doll much as the adult in the film clip had done, and they even imitated many of the adult model’s verbal insults. In a later study, Bandura and his colleagues (Bandura et al., 1963) found essentially the same results when they displayed the aggressive models to children on film rather than in person.

**Media violence and real-world aggression.** The Bandura studies and scores of later studies of observational learning led psychologists to examine a theoretically and socially important question: Does exposure to media violence, such as films or movies, contribute to real-world violence— or what Bushman and Anderson (2001) call “violence in the real world”? The research literature addressing this question is as vast as it is confusing, and could easily take up an entire book. So we’ll only briefly summarize some of the key findings and issues here.

Hundreds of researchers using correlational designs have reported that children who watch many violent television programs are more aggressive than other children (Wilson & Herrnstein, 1985). These findings, though, don’t demonstrate that media violence causes real-world violence (Freedman, 1984). They could simply indicate that highly aggressive children are more likely than other children to tune into aggressive television programs. Alternatively, these findings could be due to a third variable, such as children’s initial levels of aggressiveness. That is, highly aggressive children may be more likely than other children to both watch violent television programs and to act aggressively.

Investigators have tried to get around this problem by using longitudinal designs, which track individuals’ behavior over time. Longitudinal studies have shown that children who watch many violent television shows commit more aggressive acts years later than do children who watch fewer violent television shows, even when children are equated in their initial levels of aggression (Huesmann, Moise, Podolski, & Eron, 2003). (Figure 13). These studies offer somewhat more compelling evidence for a causal link between media violence and aggression than do simple correlational studies, but even they don’t prove the existence of this link. For example, it’s possible that an unmeasured personality variable, like impulsivity, or a social variable, like weak parental supervision, accounts for these findings. Moreover, just because variable A precedes variable B doesn’t mean that variable A causes variable B (if you really want to impress your friends at parties, you can tell them that the error of concluding that variable A causes variable B because variable A precedes variable B is called the post hoc ergo propter hoc fallacy, which we can translate as the “after this, because of this fallacy”). For example, if we found that most common colds start with a scratchy throat and a runny nose, we shouldn’t conclude that scratchy throats and runny noses cause colds, only that they are early signs of a cold.

Still other investigators have tried to examine whether the link between media models and later aggression holds up under strictly controlled conditions within the laboratory. In most of these studies, researchers have exposed subjects to either violent or nonviolent media presentations, and then examined whether subjects in the former groups behaved more aggressively, such as by yelling at the experimenter or delivering electric shocks to another subject when provoked. In general, meta-analyses (see Chapter 3) of these studies strongly suggest a causal association between media violence and laboratory aggression (Wood, Wong, & Chachere, 1991).

Finally, some investigators have conducted field studies of the link between media violence and aggression. In field studies, researchers examine the relation between naturally occurring levels of exposure to media violence and aggression in the real world. For example, sociologist David Phillips (1983) found that the number of homicides increased by approximately one-eighth following widely publicized boxing matches. Moreover, he found that when a white boxer defeated an African-American, the victim of the murder was more likely to be an African-American, whereas the converse was true when an African-American boxer defeated a White. Nevertheless, some researchers have questioned these findings because the spike in homicides was evident only on the third day after these fights, but not on other days (Baron & Reiss, 1985). Thus, it’s possible that these results were due to chance.

Another investigator (Mitchell, 1986) conducted a field study of a small, isolated mountain town in Canada that had no television prior to 1973 (she called it “Notel,” short for “No Television”). Compared with school-age children in two other Canadian towns that already had television, children in Notel showed a marked increase in physical and verbal aggression two years later. Nevertheless, these findings are difficult to interpret in light of a potential confound: at about the same time that Notel received television, the Canadian government built a large highway that connected Notel to nearby towns. This highway might have introduced the children in Notel to negative outside influences, including crime from other cities.

So what can we make of the literature on media violence and aggression in the “real world”? We have four lines of evidence—correlational studies, longitudinal studies, laboratory studies, and field studies—each with its own strengths and weaknesses. Correlational, longitudinal, and field studies tend to be strong in external validity, that is, generalizability to the real world, and weak in internal validity, that is, the extent to which they permit cause-and-effect inferences. Laboratory studies, in contrast, tend to be weak in external validity and strong in internal validity. Yet despite their shortcomings, all four types of studies point in the direction of at least some causal relation between media violence and aggression (Anderson et al., 2003). Scientific conclusions are usually the most convincing when we base them on findings from very different research designs, each with a slightly different set of imperfections (Shadish, Cook, & Campbell, 2002). As a result, most psychologists agree that media violence contributes to aggression in at least some circumstances (Anderson & Bushman, 2002; Bushman & Anderson, 2001).

Nevertheless, as we’ll learn in Chapter 12, it’s equally clear that media violence is only one small piece of a complex and multifaceted puzzle. We can’t explain aggression by means of media violence alone because the substantial majority of individuals exposed to high levels of such violence don’t become aggressive (Herrnstein & Wilson, 1985).
buttons, and grabs her money from the slot at the bottom of the machine. Now it’s your turn, and you know exactly what to do. You learned by watching. But how?

The question of how our brains engage in observational learning is still shrouded in mystery. Nevertheless, neuroscientists have recently begun to pinpoint a potential physiological basis for imitation: mirror neurons, which can be active when another monkey performs an action, such as reaching for an object, a group of neurons in its prefrontal cortex, not far from its motor cortex (see Chapter 4), become active (Rizzolatti, Fadiga, Gallese, & Fogassi, 1996). These cells are termed mirror neurons because they’re the same cells that would become active had the monkey performed the same movement. It’s almost as though these neurons are “imagining” what it would have been like to be in the behavior.

Mirror neurons appear to be remarkably selective in their activation. They don’t light up when a monkey sees another monkey that remains stationary, nor do they light up when a monkey sees a piece of food that another monkey grabbed. Instead, they light up only when a monkey sees another monkey engaging in an action, like grabbing a piece of food. Moreover, these neurons seem to be tuned to extremely specific behaviors. For example, investigators have found one mirror neuron in monkeys that fires only when either the monkey himself or a person he’s observing grabs a peanut, and a different mirror neuron that fires only when either the monkey himself or a person he’s observing eats a peanut (Winerman, 2005).

Using PET scanning, researchers have identified a similar mirror neuron system in humans (Gallese & Goldman, 1998), although they’ve yet to identify specific individual mirror neurons, as they have in monkeys (Photograph 30). No-one knows for sure what mirror neurons do or why they’re in our brains. But some neuroscientists have conjectured that such neurons play a central role in our capacity for empathy (Azar, 2005; Ramachandran, 2000). When you see an athlete suffer an injury during a televised sporting event, like a baseball player grimacing in agony after a bruising slide into home plate, you wince in pain along with him. In some sense, you may be “feeling his pain,” because the mirror neurons in your brain that correspond to his motor areas are becoming activated.

Some authors have gone further to speculate that mirror neuron abnormalities play a central role in infantile autism (see Chapter 3), which is marked not only by deficits in language and thinking, but in the capacity to adopt the perspective of others (Dingeldey, 2005). Interestingly, one group of investigators found that the mirror neuron areas of autistic individuals become less active than those of non-autistic individuals when observing people’s hand movements (Theoret et al., 2005). Still, such findings are only correlational. They don’t necessarily show that mirror neuron deficits cause or contribute to autism; perhaps they are merely a consequence of the fact that autistic individuals are less interested in others’ actions than are non-autistic individuals.

Even so, the discovery of mirror neurons may ultimately provide valuable insights into how we and other intelligent animals learn from others. This discovery also helps us to appreciate that even when we’re alone, we’re often not really alone. Even when you’re sitting by yourself on your couch watching television, your brain and the brain of that baseball player sliding into home plate may well be in sync, with your mirror neurons and his lighting up in unison.

Latent learning and observational learning were by no means the only shots fired across the bow of behaviorism. Another was fired by a mysterious German psychologist during the First World War.

## INSIGHT LEARNING

During World War I, the German government assigned Wolfgang Kohler (1887-1967) to the Canary Islands, not far off the coast of Africa (you might recall from Chapter 5 that Kohler was one of the founders of Gestalt psychology). There, he served as director of a primate facility. Some scholars believe that Kohler also served as a spy for the German government while there (Ley, 1990), but nobody knows for sure.

Around the same time as psychologists were conducting the first latent learning studies, Kohler (1925) was busily posing various problems to four chimpanzees. His favorite of the four was an Einstein of ape named Sultan, who was especially adept at solving puzzles. For example, in one case Kohler placed a tempting bunch of bananas outside of the cage, well out of Sultan’s reach, along with two bamboo sticks inside of the cage. Neither stick was long enough to reach the bananas. After what appeared to be some heavy-duty pondering, Sultan suddenly figured out the solution: stick one bamboo stick inside the other, creating one extra-long bamboo stick (Photograph 31).

In another case, Kohler suspended a bunch of bananas from the ceiling of the cage, well out of reach of his hungry chimps. At the same time, he placed several boxes in the cage. Again, after some thought, the chimps quickly figured out the answer to the problem: pile the boxes on top of one other, treating them as what Kohler called “climb-up-ables,” ascend to the highest box, and then jump up to grab the bananas (Photograph 32).

What was notable, according to Kohler, was that his chimpanzees appeared to experience the “aha reaction” we discussed earlier. Their solutions to his problems didn’t appear to reflect trial and error, as it did with Thorndike’s cats, but rather insight. That is, their solutions seemed to resemble what we saw in Figure 8 (p.000). The chimps seemed to suddenly “get” the solution to the problem, and from thereon in they got it right just about every time.

Still, Kohler’s findings and conclusions weren’t without their shortcomings. Because Kohler only videotaped some of his chimpanzees’ problem-solving, it’s difficult to rule out the possibility that at least some of this his chimps had engaged in trial and error before...
CONTINUITY vs. CONTINGENCY
Both latent learning and insight learning provided compelling evidence that learning is more than just an automatic, reflexive process. Yet another persuasive piece of evidence for the role of cognition in learning derives from research on conditioning and how it works.

Contiguity. Some early psychologists, such as the behaviorist Edwin Guthrie (1886–1959), believed that all learning was simply a matter of contiguity. That is, learning depends simply on associating stimuli with responses that are close to them in time (Guthrie, 1930). So, according to Guthrie, if we run away from a scary-looking cat the first time we see it, we’re more likely to do it again in the future. So long as stimulus (cat) and response (running away) are close to each other in time, we’re more likely to repeat that response each time we see that stimulus. Guthrie turned out to be wrong.

Blocking. The first hint that contiguity wasn’t the whole story came from research on a classical conditioning paradigm called blocking (Kamin, 1969). If we repeatedly present a rat with a CS of a light, followed by a UCS of an electric shock, it will eventually begin to exhibit a CR of fear every time it sees the light (in these studies, researchers typically measure fear by the extent to which the animal stops pressing a bar for food in the presence of the CS). That’s standard aversive conditioning. But imagine that we now introduce another CS – a tone that occurs at exactly the same time as the light – and pair it repeatedly with the light, along with the electric shock again as the UCS. What happens when we now present the second CS – the tone? (Figure 15).

The answer is surprising: nothing. The rat shows no response at all the tone, and happily keeps pressing away at the bar for food. What happened? Because the tone was completely redundant with the light, the light blocked the effects of the tone.

The research on blocking is important because it indicates that contiguity by itself can’t explain learning. For a stimulus to be effective in producing learning, it must predict new information. Because the second CS – the tone didn’t predict anything new that the first CS – the light – didn’t, learning didn’t take place. Redundant information isn’t informative. This redundancy principle applies to many domains of human learning. Shortly after the attacks of September 11, 2001, the U.S. government Department of Homeland Security introduced a color-coded scheme of terrorist threat levels, with green being low, blue being guarded, yellow being elevated, and so on. The scheme was spectacularly unsuccessful, and quickly became the butt of jokes on late-night talk shows. Had the Department of Homeland Security boxed up on their psychology of learning, they might have known why.

Because the colors are completely redundant with the words for threat levels (low, guarded, elevated, and so on), they don’t convey any new information. As a consequence, almost nobody remembered them (Photograph 33).

Contiguity. The final nail in the coffin of the idea that contiguity explains learning comes from ingenious work by Robert Rescorla (1967, 1988). In this research, Rescorla wanted to distinguish between two different processes in classical conditioning: contiguity – the closeness in time between the CS and UCS – or contiguity – the extent to which the CS predicts the UCS (Rescorla & Wagner, 1972). Rescorla astutely observed that high levels of contiguity between CS and UCS can occur without any contiguity between them. To see why, look at Figure 16. There, you’ll see a series of CSs (tones) and UCSs (shocks) that occur in close proximity to one another, but in which the correlation between CSs and UCSs are zero. That is, in this case, the presence of the CS doesn’t predict the UCS at all.

To find out whether contiguity is sufficient to account for classical conditioning, Rescorla (1967) presented rats with several different sequences of CSs (tones) and UCSs (shocks) (see Figure 17). In all of them, the contiguity between CS and UCS remained the same, because the CS was equally close in time to the UCS in all cases. Yet the contingency – or correlation – between CS and UCS varied, with this association being low in some cases and high in others. That is, in some cases CS barely predicted the UCS at all; in others, it predicted it quite well.

Rescorla found that contingency made a big difference in learning. The better the CS predicted the UCS, the more the rats showed. So when we hold contiguity constant, contingency matters. This finding is important because it suggests that classical conditioning isn’t merely a mechanical, automatic process of connecting CSs to UCSs, as many early behaviorists believed. Instead, classical conditioning and perhaps all forms of learning occur when organisms experience surprise, process that, when they find out that a stimulus predicts something novel (Kamin, 1968, Rescorla, 1995).

So from a cognitive perspective on learning, organisms try to determine contingencies between stimuli: does this stimulus tell me something useful or not? If it does, or if it does, will learning occur (Miller & Matzel, 1988). Still, this doesn’t mean that all forms of learning require cognition. Because scientists have observed classical conditioning in very simple animals, such as our sea snail friend Aplysia (Cazem, Hawkins, & Kandel, 1983) and perhaps even in single-celled organisms such as protozoa (Bergstrom, 1969), it’s likely that certain forms of conditioning are automatic or mechanical (Kirsch et al., 2004). When it comes to humans and other intelligent animals, however, conditioning probably depends heavily on thinking.
For many decades, most behaviorists regarded learning as entirely distinct from biology. The animal’s learning history and genetic make-up were like two ships passing in the night. Yet we now recognize this view as naive, because our biology influences the speed and nature of our learning in complex and fascinating ways. Here are three powerful examples.

**CONDITIONED TASTE AVERSIONS**

In the 1970s, University of Pennsylvania psychologist Martin Seligman went out for dinner with his wife. He ordered a filet mignon steak flavored with Sauce Bearnaise, his favorite sauce. Approximately 6 hours later, while at the opera, Seligman felt nauseated and became violently ill. He and his stomach recovered, but his love of Sauce Bearnaise didn’t. From then on, Seligman couldn’t even think of, let alone taste, Sauce Bearnaise without feeling like throwing up (Seligman & Hager, 1972).

The Sauce-Bearnaise syndrome, also known as the phenomenon of conditioned taste aversion, refers to the fact that classical conditioning can lead us to develop avoidance reactions to the taste of food. Yet before reading on, ask yourself a question. Does Seligman’s story contradict the other examples of classical conditioning we’ve discussed, like that of Pavlov and his dogs? (Photograph 34).

In fact, it does in at least three ways (Garcia & Hankins, 1977). First, in contrast to most classically conditioned reactions, which require repeated pairings between CS and UCS, conditioned taste aversions typically require only *one trial* to develop. This difference makes good evolutionary sense. We wouldn’t want to have to experience horrific food poisoning again and again to learn a conditioned association between taste and illness. Not only would doing so be incredibly unpleasant, but in some cases, we’d be dead after only the first trial. Second, the delay between CS and UCS in conditioned taste aversions can be as long as 6 or even 8 hours (Rachlin, 1991). Again, this makes good evolutionary sense, because food poisoning often sets in many hours after eating toxic food. Third, conditioned taste aversions tend to be remarkably specific, and show little evidence of stimulus generalization. One of the authors of your book’s earliest childhood memories is that of eating a delicious piece of lasagna and then becoming violently ill several hours later. For over 20 years, he avoided lasagna at all costs while thoroughly enjoying spaghetti, manicotti, veal parmigiana, pizza, and virtually every other kind of Italian food. He finally forced himself to get over his lasagna-phobia, but not without a momentous struggle.

Many conditioned taste aversions aren’t rational. For example, such aversions are a particular problem among cancer patients who undergo chemotherapy, which frequently induces nausea and vomiting. As a consequence, these patients frequently begin to avoid any food that preceded chemotherapy, even though they realize that it bears no logical connection to the treatment. Fortunately, health psychologists (see Chapter 9) have developed a clever way of getting around this problem. Capitalizing on the specificity of conditioned taste aversions, they get cancer patients to eat an unfamiliar food of which they aren’t fond – prior to the chemotherapy. In general, the taste aversion becomes conditioned to the unfamiliar food rather than to the patient’s preferred foods (Andresen, Birch, & Johnson, 1990).

In an especially ingenious article, John Garcia and one of his colleagues helped to unravel the mystery of conditioned taste aversions (Garcia & Koelling, 1966). Interestingly, other scientists considered their findings so implausible that numerous journals rejected their paper outright (Stertenberg, 2003) before a relatively obscure outlet, *Psychonomic Science* finally accepted it. Nevertheless, Garcia eventually got his measure of intellectual revenge. His article has been cited approximately 1100 times by other researchers in their publications, which is an astonishingly small number considering that the modal number of citations for a psychology journal article is 0 (very few psychology articles are cited as many as 100 times). In psychology, as in other sciences, revolutionary ideas aren’t always well received, at least initially.

Garcia and his co-author found that rats that had been exposed to X-rays – which make them feel nauseated – developed conditioned fear reactions to the taste of water, whereas rats that had been exposed to bright lights and buzzers don’t (Garcia & Koelling, 1966). The bottom line is that conditioned taste aversions make evolutionary sense. In the real world, poisoned drinks and foods, not sights and sounds, make animals feel sick. As a consequence, animals develop conditioned taste aversions only to stimuli that tend to trigger nausea in the real world (Figure 18).

This finding contradicts the assumption of *equipotentiality* – the claim that all CSs can be paired equally well with all UCSs – a belief held by many traditional behaviorists (Plotkin, 2004). Garcia and others had found that certain CSs, such as those associated with taste, are easily conditioned to certain UCSs, such as those associated with nausea. Psychologists call this phenomenon *belongingness*: certain stimuli are more likely than others to go together with certain responses (Thorndike, 1911; Rachman, 1977). Recall that following his night out with his wife, Martin Seligman felt nauseated at the thought of Sauce Bearnaise, but not at the thought of opera singers (in contrast, those of you who feel nauseated at the very thought of going to the opera might experience a different reaction).

**PREPAREDNESS**

A second serious challenge to the equipotentiality assumption comes from research on phobias. If we look at the distribution of phobias in the general population, we find something curious: the most widespread phobias aren’t those with which people have had the most frequent negative experiences. Phobias of the dark, heights, snakes, spiders, deep water, and blood are commonplace, even though many people who fear these stimuli have never had a frightening encounter with them. In contrast, phobias of razors, knives, the edges of furniture, owens, and electrical outlets are extremely rare, although many of us have had annoying, painful, or embarrassing experiences with them.

Seligman (1971) argued that we can explain the distribution of phobias in the population by means of preparedness: we are evolutionarily predisposed to fear certain stimuli more than others. According to Seligman, that’s because certain stimuli, like steep cliffs and poisonous animals, posed a threat to our early human ancestors (Ohman & Mineka, 2001). In contrast, household items and appliances didn’t. In the words of Susan Mineka (1993), prepared fears are “evolutionary memories,” that is, emotional legacies of natural selection.

In one intriguing demonstration of preparedness, Mineka and Cook (1993) showed lab-reared rhesus monkeys, who had no previous exposure to snakes, a videotape of other monkeys reacting in horror to snakes. Within less than half an hour, the monkeys had acquired a fear of snakes by means of observational learning (surprisingly, rhesus monkeys who’ve never been exposed to snakes show no fear to them). By means of some clever editing, Mineka and Cook altered the videotape to show the same monkeys reacting in horror to flowers, a toy rabbit, a toy snake, or a toy crocodile. They then showed these new videotapes to different groups of rhesus monkeys. The monkeys who observed these altered videotapes acquired fears of the toy snake and
toy crocodile, but not to the flowers or toy rabbit. From the standpoint of preparedness, this finding is entirely understandable. Snakes and crocodiles were dangerous to primate ancestors, but flowers and rabbits weren’t (Ohman & Mineka, 2003). (Photograph 35).

Preparedness may also render us likely to develop illusory correlations between fear-provoking stimuli and negative consequences (Tomarken, Mineka, & Cook, 1995). Recall from Chapter 3 that an illusionary correlation is a statistical mirage; it’s the perception of an association between two variables when this association is absent. One team of investigators administered intermittent electrical shocks to subjects – some of whom feared snakes and some of whom didn’t – while they were watching slides of snakes and damaged electrical outlets. The pairings of the slide stimuli with the shocks were entirely random, so that the actual correlation between them was zero. Yet subjects with high levels of snake fear perceived a marked correlation between the occurrence of the snake slides, but not the electrical outlets, and the electric shocks. Subjects with low levels of snake fear showed no such tendency toward illusionary correlation (Tomarken, Sutton, & Mineka, 1995).

If you think back to the Great Fourfold Table of Life we discussed in Chapter 3 (see p. ...), the highly snake-fearful subjects probably attended too highly to the uppermost lefthand cell of the table (Figure 19). Because they were afraid of snakes, they were on the lookout for any threatening stimuli that might be associated with snakes. As a consequence, they overestimated co-occurred with electric shock. Interestingly, they showed no such overestimation for electrical outlets, even though such outlets are more closely linked in our minds than snakes to electric shock. This finding suggests that preparedness may be at work, because snakes, but not electrical outlets, posed threats to our ancestors (Tomarken et al., 1995). Nevertheless, the laboratory evidence for preparedness hasn’t been completely consistent. For example, when researchers have paired either prepared stimuli - like snakes or spiders - or unprepared stimuli - like flowers or mushrooms - with electric shocks, they haven’t always found that subjects more rapidly acquire fears to the prepared than unprepared stimuli (Davey, 1995; McNally, 1987). Moreover, some authors have proposed that preparedness findings may be due to an alternative explanation: latent inhibition. As the raccoons had apparently reverted to an evolutionarily selected behavior, namely, rinsing. They were treating the tokens like little pieces of food, like the small hard shells that raccoons extract from the beds of ponds and streams (Timberlake, 2006). Breland and Breland (1961) referred to this phenomenon as instinctive drift: the tendency for animals to return to evolutionarily selected behaviors following repeated reinforcement. Researchers have observed various forms of instinctive drift in a number of other animals, including rats (Powell & Curley, 1984). The reasons for such drift aren’t fully understood. Nevertheless, instinctive drift demonstrates that reinforcement has its limits. When it comes faces to face with evolution, evolution often emerges victorious.
extraordinary claims regarding this technique's potential. For example, one Web Site (http://www.sleeplearning.com/) informs visitors that

Sleep learning is a way to harness the power of your subconscious while you sleep, enabling you to learn foreign languages, pass exams, undertake professional studies and implement self-growth by using techniques based on research conducted all over the world with great success...It's the most incredible learning aid for years.

The Web site offers a variety of CDs that can purportedly help us to learn languages, stop smoking, lose weight, reduce stress, or become a better lover, all while we're comfortably catching up on our zzzzs. The site even goes so far as to say that the CDs work better when people are asleep than awake.

These assertions are certainly quite remarkable. Does the scientific evidence for sleep-assisted learning stack up to its proponents' claims?

As is so often the case in life, things that sound too good to be true often are. Admittedly, the early findings on sleep-assisted learning seemed to yield encouraging results. For example, one group of investigators exposed sailors to Morse Code (a shorthand form of communication that radio operators sometimes use) while asleep. These sailors mastered Morse Code three weeks faster than did other sailors (Simon & Emmons, 1955). Numerous other studies from the former Soviet Union also appeared to provide support for the claim that people could learn new material, such as words or sentences, while listening to tape recordings during sleep (Aarons, 1976). (Photograph 39).

Nevertheless, these early positive reports neglected to rule out an important alternative explanation: the tape recordings may have awakened the subjects! The problem is that almost of the studies showing positive effects didn’t monitor subjects’ electroencephalograms (EEGs; see Chapter 4) to ensure that they were actually asleep while listening to the tapes (Druckman & Swets, 1988, 1994). When researchers have monitored subjects’ EEGs to make sure that they’re fully asleep, they’ve typically produced little or no evidence for sleep-assisted learning. Therefore, to the extent that sleep-learning tapes actually “work,” it’s probably because subjects hear snatches of them while drifting in and out of sleep. As for that quick fix for reducing stress, we’d recommend just going to bed and forgetting about the tapes.

ACCELERATED LEARNING

Still other companies promise consumers ultra-fast techniques for learning. These methods, known as Superlearning or Suggestive Accelerative Learning and Teaching Techniques (SALTT), supposedly allow people to pick up new information at anywhere from 25 to several hundred times their normal speed of learning (Wenger, 1983). SALTT relies on a mixture of several different techniques, such as inducing expectations for enhanced learning (telling students that they’ll learn more quickly), getting students to visualize information that they’re learning, playing classical music during learning, and even breathing in a regular rhythm while learning (Lotanov, 1978). When combined, these techniques supposedly allow learners to gain access to intuitive and creative aspects of their minds that otherwise remain inactive.

Again, however, the evidence for the effectiveness of SALTT doesn’t come close to matching the extraordinary claims. Almost all studies show that SALTT doesn’t result in enhanced learning (Dipani & Job, 1980; Druckman & Swets, 1988). Moreover, even when researchers have reported positive results for SALTT, these findings have been open to several alternative explanations. That’s because many of the studies conducted on SALTT compared this method with a control condition in which the students did little or nothing.

As a result, the few positive results reported for SALTT could be attributable to placebo effects (see Chapter 3), especially because one of the major components of SALTT is raising learners’ expectations. These scattered positive results could also be due to the Hawthorne effect (again, see Chapter 3), because all of the students exposed to SALTT knew that they were being studied, and knew that the experimenter expected them to learn faster (Druckman & Swets, 1998).

**CRITICAL THINKING QUESTION**

If you were studying the effects of accelerated learning methods, like SALTT, how would you attempt to rule out the possibility of the Hawthorne effect?

**LEARNING STYLES**

Few claims about learning are as widespread as the belief that all individuals have their own learning style — their preferred means of acquiring information. According to proponents of this view, some students are “analytical” learners who excel at breaking down problems into different components, whereas others are “holistic” learners who excel at viewing problems as a whole. Still others are “verbal” learners who prefer to talk through problems, whereas others are “spatial” learners who prefer to visualize problems in their heads (Cassidy, 2004; Desmbedt & Valcke, 2004). Moreover, some educational psychologists have claimed that they can dramatically boost learning by matching people’s learning styles to different methods of instruction. So, for example, children who are verbal learners should learn much faster and better with written material, whereas children who are spatial learners should learn much faster and better with visual material. As appealing as these assertions are, they haven’t held up well in careful research. For one thing, it’s difficult to assess learning style reliably (Stofer, 1992; Stahl, 1999). As you’ll recall from Chapter 3, reliability refers to consistency in measurement. In this case, researchers have found that different measures designed to assess people’s learning styles often yield very different answers about people’s preferred mode of learning. In part, that’s probably because few people are purely analytical or holistic learners, verbal or spatial learners, and so on; most of us are a mixture of both kinds of styles. Moreover, studies have generally revealed that tailoring different methods to people’s learning styles doesn’t result in enhanced learning (Kavale & Forness, 1987; Tarver & Dawson, 1978). Like a number of other fads in popular psychology, the idea of learning styles appears to be more fiction than fact (Stahl, 1999).

**FACT AND FICTION IN PSYCHOLOGY SELF-TEST 4**

(1) Many conditioned taste aversions are acquired only in a single trial.
(2) Most research now suggests that the assumption of equipotentiality, held by many traditional behaviorists, is false.
(3) The phenomenon of preparedness helps to explain why virtually all major phobias are equally prevalent in the general population.
(4) With progressively more reinforcement, animals typically drift further and further away from their instinctual patterns of behavior.
(5) There is little evidence that people can learn new information while sound asleep.

Answers printed upside down on the bottom of the following page.
**Habitation** pages 000-000

- Habitation refers to the process by which we respond less strongly over time to repeated stimuli.
- The converse of habituation is sensitization, which refers to responding more strongly over time to repeated stimuli.

**Classical conditioning** pages 000-000

- Classical conditioning was discovered largely by accident by the Russian physiologist Ivan Pavlov.
- Classical conditioning is a form of learning in which animals come to respond to a previously neutral stimulus that had been paired with another stimulus that elicits an automatic response.

**Critical thinking questions.**

Can you think of any other alternative explanations for the gender differences in symptom reports of men and women?
Critical Points

CHAPTER 7 LEARNING: HOW NURTURE CHANGES US

• Many fears and phobias appear to stem in part through classical conditioning. John B. Watson and Rosalie Raynor’s etiologically questionable case study of Little Albert provided an existence proof of this point, although not all researchers successfully replicated their observations.
• Research also indicates that phobias can be eliminated through deconditioning.

Operant conditioning pages 000-000

• Operant conditioning is learning that is controlled by its consequences.
• Operant conditioning differs from classical conditioning in three major ways: (1) the response is emitted by the organism rather than elicited from it, (2) the reward is contingent on the animal’s behavior, and (3) the organism’s responses most involve the skeletal muscles rather than the autonomic nervous system.
• Thorndike’s Law of Effect tells us that if a response, in the presence of a stimulus, is followed by a reward, it is likely to be repeated. According to this law, operant conditioning involves the gradual “stamping in” of S-R connections.
• Thorndike discovered this law in his classic research on cats and puzzle boxes. This work appeared to indicate that cats learned through trial-and-error rather than insight.
• B. F. Skinner pioneered the study of operant conditioning through his development of the Skinner Box, which permitted a cumulative record of the animal’s behavior.
• Reinforcement refers to any outcome that strengthens a response.
• There are two types of reinforcement: positive, which involves the presentation of a pleasant outcome, and negative, which involves the withdrawal of an unpleasant outcome.
• Negative reinforcement shouldn’t be confused with punishment, which refers to an outcome that weakens a response.
• Punishment must also be distinguished from the disciplinary practices that are often associated with it, because some forms of discipline are actually reinforcing.
• Classical conditioning also appears to contribute to the acquisition of fetishes in animals and perhaps humans.
• Many disgust reactions are probably acquired by classical conditioning.
• According to Skinner, punishment has several disadvantages. It only tells the organism what not to do, what to do. In addition, punishment often creates anxiety, which interferes with future learning. Punishment can also teach the organism to become sneakier about which situations in which to exhibit forbidden behavior. Finally, punishment can provide a model for children’s aggressive behavior.
• Although studies indicate that parental punishment is associated with childhood behavior problems, this correlational research is open to multiple interpretations.
• Punishment seems to work best when it is delivered consistently and follows the desired behavior promptly.
• A discriminant stimulus is any stimulus that signals the presence of reinforcement.
• Acquisition, extinction, spontaneous recovery, and stimulus generalization and discrimination apply to operant conditioning as well as classical conditioning. These similarities have led some scholars to propose that operant and classical conditioning may not be as different as once thought, although it is worth noting that these two forms of learning appear to depend on different brain areas.
• Skinner uncovered numerous principles of reinforcement, including the principle of partial reinforcement, which indicates that behaviors reinforced only occasionally are slower to extinguish that behaviors that we reinforce continually.
• Skinner also discovered various schedules (contingencies) of reinforcement, including fixed ratio, fixed interval, variable ratio, and variable interval schedules.
• These schedules tend to yield distinctive patterns of responding; for example, fixed interval schedules tend a scalloped pattern of responding, whereas variable ratio schedules tend to yield the highest overall rate of responding.
• The gambler’s fallacy is the incorrect belief that random events have a memory. Along with variable ratio schedules, it probably contributes to some individuals’ susceptibility to gambling.
• Behaviors train animals to learn habits through shaping by means of successive approximations (shaping), with which we reinforce progressively closer version of a desired response.
• According to the Premack Principle, we can reinforce lower frequency behaviors with higher frequency behaviors.

Cognitive models of learning pages 000-000

• Watson was an advocate of methodological behaviorism; he believed that psychology should focus exclusively on overt behavior, and exclude thinking. Skinner, in contrast, was an advocate of radical behaviorism; he believed that psychology should examine thinking, but he regarded thinking as a behavior, subject to the same laws of conditioning as all other behaviors.
• S-O-R psychologists reject Skinner’s belief that thinking is no different from any other behaviors. They accord a central role to the organism’s interpretation of stimuli.
• Tolman’s work on latent learning, which demonstrated that animals can learn without reinforcement, represented a major challenge to the radical behaviorist view of learning.
• Tolman believed that animals develop cognitive maps – spatial representations – of the world around them. Such maps, he argued, are central to maze learning.
• Many psychologists regard observational learning – learning by watching others – as an important form of latent learning.
• Research suggests that individuals can acquire aggressive behavior by means of observational learning.
• Many superstitions may stem from operant conditioning; they may arise when behavior is linked to reinforcement by sheer coincidence.
• An important application of operant conditioning is the use of token economies: systems, often set up in psychiatric hospitals, for reinforcing appropriate behaviors and extinguishing inappropriate behaviors.
• Using shaping, behaviorists have also used operant conditioning techniques to teach language to autistic individuals.
• Two-process theory involves both classical and operant conditioning, and helps to explain why many phobias do not extinguish. Individuals may acquire fears through classical conditioning, then avoid situations that trigger anxiety, thereby negatively reinforcing their phobic behavior.
• Research from correlational studies, longitudinal studies, laboratory studies, and field studies suggest that media violence contributes to aggression. Although each type of research has its flaws, they all point in the same direction. Nevertheless, media violence is only one of many causal contributors to aggression.
• Kohler’s work suggested that apes can learn through insight, and later work with humans suggests the same conclusion. This research calls into question Thorndike’s conclusion that all learning occurs through trial and error.
• Some early behaviorists argued that all learning depends on contiguity, that is, proximity between stimuli and responses.
• Nevertheless, research on blocking indicates that contiguity cannot by itself explain learning. The CS must predict new information to lead to learning.
• Rescorla’s work on the CS-UCS contingency points to the same conclusion. CSs that are highly predictive of UCSs lead to the best learning.
Biological Influences on Learning  pages 000-000

- Most psychologists have increasingly recognized that our biology, especially our genetic endowment, influences learning.

- Conditioned taste aversions refer to the phenomenon whereby classical conditioning can lead us to develop avoidance reactions to the taste of food.

- Studies of accelerated learning techniques have typically yielded negative results. Early reports of successful learning during sleep appear to have led researchers to believe that sleep facilitates learning; however, more recent studies have suggested that sleep does not necessarily enhance learning.

- John Garcia and his colleagues showed that individuals can learn new behaviors while sound asleep.

- Psychologists call this phenomenon of instinctive drift: following repeated reinforcement, some animals tend to return to evolutionarily selected behaviors.

- Preparedness can also lead us develop illusory correlations between fear-provoking stimuli and negative consequences.

- Nevertheless, laboratory research on conditioned taste aversions has not been entirely consistent, and some researchers have suggested alternative explanations for findings.

- In the process of training animals to perform tricks, the Brelands discovered the phenomenon of instinctive drift: following repeated reinforcement, some animals tend to return to evolutionarily selected behaviors.

Learning Fads: Do They Work? pages 000-000

- Proponents of sleep-assisted learning claim that individuals can lead new material while sound asleep.

- Nevertheless, most research on sleep-assisted learning is negative. Early reports of successful learning during sleep appear to be attributable to a failure to carefully monitor subjects’ EEGs to ensure that they were actually asleep while listening to the tapes.

- Studies of accelerated learning techniques also show few or no positive effects. Positive reports appear to be attributable to placebo effects, Hawthorne effects, and other artifacts.

- Research on preparedness also contradicts the equipotentiality assumption, because it suggests that we are evolutionarily predisposed to fear some stimuli more than others.

- Preparedness can also lead us develop illusory correlations between fear-provoking stimuli and negative consequences.

- Nevertheless, laboratory research on conditioned taste aversions has not been entirely consistent, and some researchers have suggested alternative explanations for findings.

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