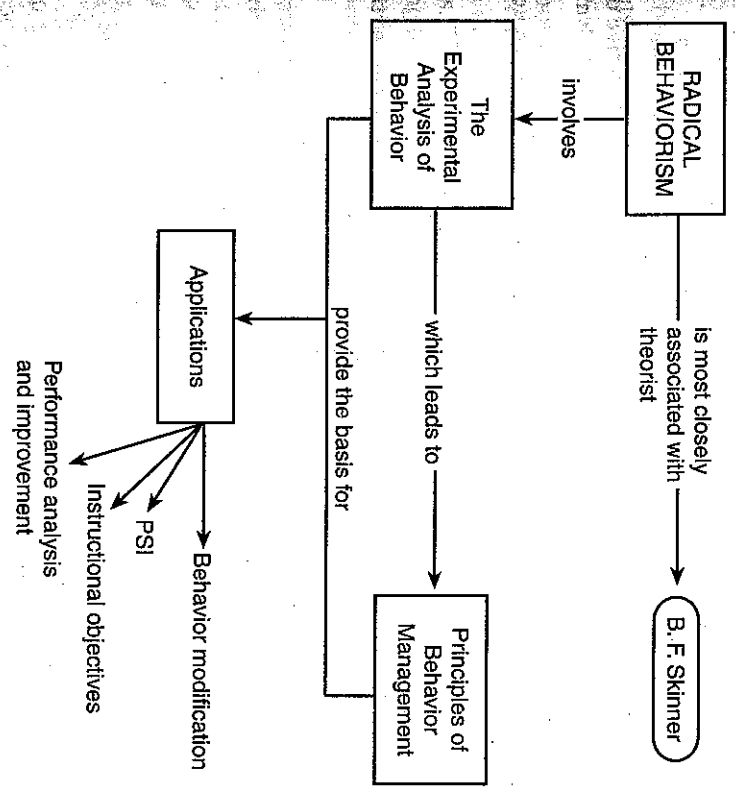


2

Radical Behaviorism



The Experimental Analysis of Behavior

Respondent and Operant Behavior
Contingencies of Reinforcement

Step Four: Implement Procedures and Record Results
Step Five: Evaluate Progress and Revise as Necessary

Principles of Behavior Management

Strengthening or Weakening

Contributions of Behaviorism to Instruction

Operant Behaviors

Changing Behavior through Behavior Modification

Strengthening a Response:

Positive Reinforcement

Strengthening a Response:

Negative Reinforcement

Weakening a Response: Punishment

Weakening a Response:

Reinforcement Removal

Teaching New Behaviors

Shaping

Chaining

Discrimination Learning and Fading

Maintaining Behavior

Fixed Ratio Schedules

Variable Ratio and Variable

Interval Schedules

Planning a Program of Behavior Change

Change

Step One: Set Behavioral Goals

Step Two: Determine Appropriate Reinforcers

Step Three: Select Procedures for Changing Behavior

Improving Performance in Organizational Systems

The Behaviorist Perspective on Learning: Issues and Criticisms

Verbal Behavior

Reinforcement and Human Behavior

Intrinsic Motivation

Conclusion

Suggested Readings

Reflective Questions and Activities

Consider these scenarios.

■ **Department X**

As part of an organization-wide quality improvement effort, the head of a department sends her office manager and staff to training on the use of electronic mail. In addition to procedures such as logging on to the organization intranet to receive and send mail, the training included procedures for accessing the World Wide Web and locating and downloading information from the department's web page.

Within weeks after the training, the office manager routinely checks and reads her e-mail messages, but she continues to use paper memos and office mail to correspond and conduct business. The department is large, and

some days the office manager puts as many as a half-dozen memos—each only a few lines long—in people's mailboxes.

■ **Mr. Tanner's Class**

Mr. Tanner's fourth grade class reflects the ethnic diversity of his rural neighborhood—part Anglo American, Native American, Inuit, and African American. There are about as many boys as girls, and the range of their abilities is considerable. As in most classes, the students work at different rates, a few rarely participate in group assignments, and some seem to chronically misbehave.

Posted on the bulletin board in the class are these five rules (Everton et al., 1994):

1. Be helpful and polite.
2. Respect the property of others.
3. Listen while others speak.
4. Respect all people.
5. Obey school rules.

At the beginning of each school year, Mr. Tanner discusses the rules with the students, and together he and the students determine what the consequences will be for failure to follow them.

■ **Boot Camp**

Recruits are quick to learn at Boot Camp, USA. Besides doing assigned chores in their barracks, they get in shape with daily 5-mile runs and calisthenics. They learn to load, fire, dismantle, and clean their weapons. Performing their duties well can lead to privileges such as a day's pass to town, but breaking the rules inevitably leads to such consequences as extra push-ups, more miles to run, or forfeited time off.

It may not seem at first that these scenarios have much in common. Yet all of these situations illustrate (or will, with some fleshing out) the basic tenets of radical behaviorism.

The notion of behaviorism was introduced into American psychology by John B. Watson (1913). Watson promoted the view that psychology should be concerned only with the objective data of behavior. The study of consciousness or complex mental states, Watson argued, is hampered by the difficulty of devising objective and functional indicators of these phenomena. At some point, one is forced to consider the facts of behavior. These, at least, can be agreed upon because they are observable by anyone. To illustrate, suppose, in the scenario Boot Camp, that Private Johnson draws barracks duty one week, which consists of mopping and waxing the barracks floor each day. For completion of the task with no demerits (which means those floors were spotless!), she earns commendations every day and is awarded a pass to go off base Friday night. What can we conclude from this scenario?

Did Private Johnson do such a good job because she looked forward to a fine meal at a local Italian restaurant instead of army food for one night? Or maybe she just takes pride in her work. The fact that any number of inferences are possible when we attempt to understand Private Johnson's mental state and the reasons for her behavior is precisely the problem Watson noted. Stick to the facts of behavior: She completed the assigned task, the results were spotless, she earned commendations, she was awarded a pass.

B. F. Skinner, a major proponent of radical behaviorism, followed Watson's lead in emphasizing behavior as the basic subject matter of psychology (Skinner, 1938, 1974). But Skinner's work differed in a fundamental way from Watson's and others' work contemporary with and immediately following Watson. In the early days of behaviorism, the concept of association permeated theories about learning. It was assumed that a response (R) came to be established, or learned, by its association with an environmental stimulus (S). Edwin R. Guthrie, for instance, believed that, "Stimuli which are acting at the time of a response tend on their reoccurrence to evoke that response" (1933, p. 365). This has been called one-trial learning because, according to Guthrie, it is the very last stimulus before a response occurs that becomes associated with that response.

Whereas Guthrie's ideas were never fully elaborated, Clark L. Hull's S-R theory of behavior became "fearsomely complex" (Leahy & Harris, 1997). Hull believed that responses become attached to controlling stimuli, but some of these stimuli must be internal because it was not always possible to observe an external stimulus for all responses. Thus, Hull proposed intervening variables such as habit strengths and argued that observed behavior was a function of these as well as environmental variables such as degree of hunger (drive), size of reward (stimulus-intensity dynamism), and so on.

Finally, E. C. Tolman believed that behavior was guided by purpose, which led to his being called a purposive behaviorist. According to Tolman (1948), organisms do not acquire S-R bonds simply by contiguity or reward; they selectively take in information from the environment and build up cognitive maps as they learn. This helped to account for latent learning, in which rats who explored a maze for several trials found the food on a subsequent trial as quickly as rats consistently reinforced in the maze.

Tolman's cognitive maps and Hull's habit strengths, however, smacked of mentalism to Skinner. One cannot directly observe cognitive maps in a rat's mind; they must be inferred from the rat's behavior. Likewise, one cannot directly observe habit strengths; they must be inferred from the rat's persistence in a learned behavior. Skinner argued that such inferences were neither necessary nor desirable.

B. F. Skinner's approach to the psychology of learning was to set out in search of functional relationships between environmental variables and behavior. In other words, he believed that behavior could be fully understood in terms of environmental cues and results. Cues serve as antecedents to behavior.



B. F. Skinner

setting the conditions for its occurrence. Results are the consequences of behavior which make it more or less likely to reoccur. What might go on in the mind during learning, then, is immaterial to understanding or describing it.

Skinner's approach to understanding learning and behavior is commonly described using the metaphor of a black box (Figure 2.1). That is, the learner is a black box and nothing is known about what goes on inside. However, knowing what's inside the black box is not essential for determining how behavior is governed by its environmental antecedents and consequences.

Consider Private Johnson again, for example. It may well be that she thought of Italian food while mopping floors, but explaining her behavior does not require making reference to those thoughts. Skinner went so far as to argue that theories of learning simply get in the way of collecting empirical data on behavior change (Skinner, 1950). He denied, in fact, that radical

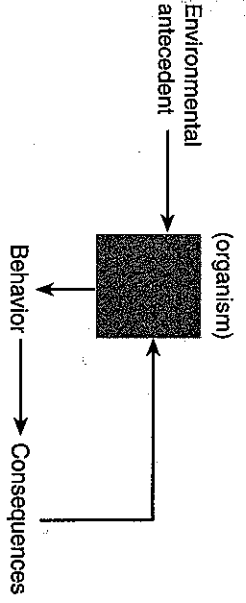


FIGURE 2.1 The Black Box Metaphor of Behaviorism

behaviorism should even be thought of as a theory; rather, it is an experimental analysis of behavior (Skinner, 1974).

The Experimental Analysis of Behavior

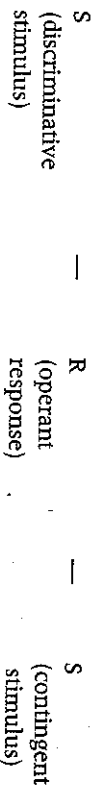
By systematically observing behavior and manipulating environmental variables surrounding it, Skinner set about to discover the laws that govern learning. He defined learning as a more or less permanent change in behavior that can be detected by observing an organism over a period of time. Suppose, for instance, that the office manager in Organization X is seen logging on to the office intranet once a day. Over time, her incidence of retrieving e-mail messages increases to once every half-hour or so. From observations of her behavior, it can be said that the office manager has learned to access e-mail on a regular and frequent basis.

Respondent and Operant Behavior

Skinner distinguished two classes of behavior, respondent and operant, and it is the latter that drew most of his attention. **Respondent behavior**, studied by Pavlov in his famous classical conditioning experiments, refers to *behavior that is elicited involuntarily in reaction to a stimulus*. Pavlov's dogs salivating to food is one example, as is a child's startled reaction to a loud noise. By contrast, **operant behavior** is simply *emitted by an organism*. Skinner contended that all organisms are inherently active, emitting responses that operate on their environment. Most behavior is of this type. Birds pecking at insects in the grass, circus animals performing tricks in the ring, and students raising their hands in class are all examples of operant behavior.

Contingencies of Reinforcement

To understand why some operants are expressed while others are not, Skinner argued that we must look at the behavior in relation to the environmental events surrounding it. That is, we should look at the antecedents and consequences of behavior. Although antecedents set the context for responding, the consequences of a response are critical in determining whether it ever occurs again. If a dog puts its nose in a bee's nest and gets stung, for example, you can be sure the dog will be wary of repeating the behavior. What Skinner proposed, then, was a basic S-R-S relationship, as shown below:



This relationship provides the framework from which all operant learning laws are derived. Because the nature of the contingent stimulus determines what happens to the response, whether it is reinforced or lost, Skinner referred to learning principles as the contingencies of reinforcement (Skinner, 1969).

The concept of reinforcement, central to Skinner's behaviorism, was initially expressed by E. L. Thorndike as the Law of Effect:

When a modifiable connection between a single situation and a response is made and is accompanied by a satisfying state of affairs, that connection's strength is increased. When made and accompanied by an annoying state of affairs, its strength is decreased. (1913, p. 4)

Put simply, behavior is more likely to reoccur if it has been rewarded, or reinforced. Similarly, a response is less likely to occur again if its consequence has been aversive. In order to understand learning, then, one must look for the change in behavior that occurred and determine what consequences of the behavior were responsible for the change. In the case of the dog, for example, the consequence of putting its nose in a bee's nest was aversive, and so it learned not to do that anymore. As for the office manager, she learned to retrieve e-mail messages frequently during the day. What could be the consequence responsible for strengthening that behavior? Suppose the manager received at least one message every time she logged on and the content of the messages was information important to her job. It is likely that both the receipt of the messages and their content comprised the stimulus that was reinforcing the office manager's behavior.

It is useful at this point to re-emphasize the functional nature of Skinner's contingencies of reinforcement. That is, reinforcement as a consequence of behavior functions to enhance the probability of that behavior reoccurring. But if this probability has not been enhanced, then reinforcement cannot be said to occur. In the same vein, anything that does enhance this probability functions as a reinforcer. To illustrate, consider the following two examples:

1. E-mail is sent to the office manager throughout the day, but she never logs on to retrieve any of the messages from the intranet.
2. The office manager checks e-mail with increasing frequency during the day, but she receives either no messages or ones that were directed to her by mistake.

In the first example, even though praise was contingent on the act of logging on and checking e-mail, the office manager does not increase her logging-on behavior. In this case, although receiving messages is presumed to be reinforcing, it does not function as a reinforcer. In example 2, on the

other hand, the office manager's logging-on behavior does increase, but because of what consequence? In this example, it is likely that the reinforcing consequence (receiving pertinent messages) occurs at irregular times, so that the behavior of logging on is reinforced only some of the time. (The usefulness of intermittent reinforcement is discussed later in this chapter.) Sometimes, what serves as a reinforcer is counterintuitive, as when a child keeps misbehaving despite the parent's disapproving actions. This happens because we tend to think of reinforcement as reward, and reward has generally positive connotations.

The point is, reinforcement is defined in terms of its function, its effect on behavior. Thus, we must be wary of everyday language usage of Skinner's principles, which may not precisely match his scientific meanings.

Principles of Behavior Management

Through systematic experimental manipulation of the contingencies of reinforcement, Skinner formulated learning principles to account for the strengthening or weakening of existing behaviors as well as the learning of altogether new ones. In addition, he studied reinforcement schedules to determine how learned behaviors are maintained over time. Although Skinner conducted most of his own research with animals, his principles of reinforcement have held equally well where human behavior is concerned. Since these principles are as often applied to the management of learning and behavior as to their understanding, it is perhaps easiest to discuss them in detail from that perspective.

Strengthening or Weakening Operant Behaviors

The basic principles of reinforcement describe the simple strengthening or weakening of a response already in the repertoire of the learner. That is, observation reveals whether the learner is not displaying some desired behavior often enough or is exhibiting some undesired behavior all too often. In the first instance, the desired behavior becomes a target for strengthening; in the second, the goal is to weaken the undesired behavior. As has already been discussed, the nature of the stimulus contingent on the response is an important factor in the behavior's occurrence.

But Skinner discovered a second factor that was also important. The contingent stimulus could be presented immediately after a response to influence the reoccurrence of that response, as in the receipt of e-mail causing the office manager to log on more frequently during the day. Or the contingent stimulus can be removed following a response, with a subsequent effect on the reoccurrence of the response. This would be the case, for

example, if the office manager learned to delete messages regularly to avoid overloading her mailbox and causing her system to crash. Crossing the presentation or removal of the contingent stimulus with the nature of that stimulus—whether satisfying or aversive—yields a set of basic principles for strengthening or weakening behavior, as shown in Figure 2.2. Let us consider, first, those principles that strengthen a response, followed by those that weaken it.

Strengthening a Response: Positive Reinforcement. **Positive reinforcement** refers to the presentation of a reinforcer (satisfying stimulus) contingent upon a response that results in the strengthening of that response. Several examples of positive reinforcement have already been discussed. Receiving e-mail reinforced the office manager's use of the intranet; commendations and an off-duty pass reinforced Private Johnson's completion of her daily floor-mopping task. Other examples of positive reinforcement can be readily observed in classrooms, at home, in social situations, or on the job. Dog trainers, for instance, reinforce "at attention" behavior with dog treats. Employers reinforce beyond quota production on an assembly line with bonus pay. I reinforce my husband with chocolate bars for cleaning the bathtubs each week. One question that all these examples raise, however, is what precisely may serve as reinforcers? And how is one to determine which reinforcer to choose for a given situation?

Satisfying S		Aversive S	
S presented contingent upon R	Positive Reinforcement Example: Worker earns bonus for ideas that improve company performance (R strengthened)	Punishment Example: Sailor gains eight-inch dingy for rigging on gully (R weakened)	
S removed contingent upon R	Reinforcement Removal Example: Driver must pay stiff fine for parking in a restricted area (R weakened)	Negative Reinforcement Example: Student exempts weekly quizzes by performing well on daily homework (R strengthened)	

FIGURE 2.2 Basic Principles of Reinforcement

Types of Reinforcers. A **primary reinforcer** is one whose reinforcement value is biologically determined (Figure 2.3). Food, for example, is a biological requirement of all living organisms, and hungry animals will exhibit all sorts of behavior to obtain it. In the well-known Skinner box (Skinner, 1938), food-deprived rats learned to press levers in order to activate a food magazine which dispensed small food pellets. Although primary reinforcement does not function extensively in human learning, it has proven quite useful in some cases. Wolf, Risley, and Mees (1964) reported using bits of food to reinforce wearing his glasses by an autistic boy.

More important in accounting for human learning is the concept of conditioned reinforcers. **Conditioned reinforcers** are those that acquire their reinforcement value through association with a primary reinforcer. Thus, they have been conditioned to be reinforcing. Examples of conditioned reinforcers include gold stars, money, and praise. Praise is a special case of conditioned reinforcement, in that it is not a tangible item that can be saved up or used in trade, like money or baseball cards. For that reason, it has been termed a social reinforcer and shown to have powerful effects on human behavior. Ludwig and Maehr (1967), for example, demonstrated that making simple statements of approval regarding students' performance in a physical education class led to their making many more positive statements about themselves. Likewise, psychology students discovered that the incidence of seat belt use dramatically increased when grocery store checkers said to customers, "Be sure to buckle up. Remember, [store name] cares about your safety, too" (J. Bailey, personal communication).

The Relativity of Reinforcers. In reviewing the conditions under which positive reinforcement influences behavior, David Premack (1959) demonstrated that behaviors in which learners already engage to a high degree may be used to reinforce low-frequency behaviors. This procedure of making

Primary Reinforcer	Conditioned Reinforcer
... a stimulus whose reinforcement value is biologically determined	... a stimulus that acquires reinforcement value through association with a primary reinforcer
Examples: Food Sleep	Examples: Money Gold Stars

FIGURE 2.3 Types of Reinforcers

high-frequency behaviors contingent upon low-frequency behaviors in order to strengthen the low-frequency behavior has come to be known as the **Premack principle**. It is simply a type of positive reinforcement, and one effectively exploited by parents everywhere. "You can watch TV (high-frequency behavior) as soon as you finish your homework (low-frequency behavior)."

Choosing a Reinforcer. The Premack principle illustrates well the need to observe learners in order to determine what reinforcer is likely to be most effective. In the case of the Premack principle, there is an empirical basis for selecting the reinforcer: The behavior serving as reinforcement is one the learner has been observed doing frequently. In other cases, it is often a matter of an educated guess on the basis of what is observed. Young children seem to like colored stickers and gold stars. Soldiers go off base when given the opportunity. Many adults appear to work hard, or take on additional tasks, in order to earn more money. These all have the potential, then, of serving as effective reinforcers. But only by selecting one—whatever seems most appropriate, given the learner and the behavior to be reinforced—and applying it, can one be absolutely sure of its effect. If it works, use it; if it does not, try another.

Cueing a Learned Behavior. Sometimes, a learned behavior is not exhibited, and therefore not available for reinforcement, until it is cued in some way. The case of the office manager offers a good example. Although she reads her e-mail, she doesn't send any, despite having learned how to do so during training. To evoke the appropriate response, the department chair sends the office manager, from another location, a message that requires an immediate reply. This is the discriminative stimulus. Unable to provide that reply in any way other than by e-mail, the office manager sends a return message supplying the requested information. Her response is promptly reinforced by the department chair's follow-up message, which says, "Thanks for the information. It was very helpful!"

Strengthening a Response: Negative Reinforcement. Refer to Figure 2.2. Note that in two cells, which are diagonal to one another, the behavioral principle results in the response being strengthened. Both principles are known as reinforcement, and reinforcement always results in behavior increases. In contrast to positive reinforcement, though, **negative reinforcement strengthens a response through the removal of an aversive stimulus contingent upon that response**. Remember that positive reinforcement was the presentation of a satisfying stimulus following a response.

The principle of negative reinforcement was initially discovered in experiments with rats in a Skinner box. The rats learned to press a lever, not for food this time, but to turn off a shock that was being delivered through bars

on the floor of the cage. Thus, bar-pressing, a behavior that increased in frequency, was negatively reinforced by removal of the aversive stimulus, shock.

Examples of negative reinforcement are harder to find than examples of positive reinforcement. As a result, its applicability is not as easily evident. Consider, however, one of the principles behind seat belts. In most cars, a bell chimes or a buzzer sounds until the driver fastens the seat belt. Fastening the belt turns off the sound (which, in my car, is quite irritating). An increase in seat belt fastening, then, can be said to be negatively reinforced by the removal of the sound.

Other examples of negative reinforcement include the student who sits closer and closer to the front of the room in order to see the blackboard, and the child who finally starts brushing his teeth regularly so that his mother will stop nagging. In the first instance, sitting in front leads to the cessation of fuzzy vision. In the second, teeth-brushing brings an end to nagging.

Weakening a Response: Punishment. While two cells of Figure 2.2 display principles of reinforcement that result in a strengthening of behavior, the two other cells contain principles for weakening an existing behavior. **Punishment is the presentation of an aversive stimulus contingent upon a response that reduces the rate of that response.** No doubt examples of punishment immediately spring to mind. A father spanks a child for taking something that did not belong to him. The drill sergeant hollers, "Twenty more push-ups! Let's go!" to the hapless recruit grousing in the back row of the formation. A teacher yells at the student who was talking with a neighbor instead of studying. In all instances, the individual administering punishment for some misbehavior does so with the expectation that the behavior will stop and not be repeated.

Although punishment has the effect of stopping behavior, and in fact is so-called because it has that effect, it also appears to have unfortunate side effects. First, its effectiveness tends to be short-lived. That is, the behavior being punished may come to an immediate halt at the time punishment is administered, but this does not mean it has been necessarily forgotten. The student may quit talking in class when yelled at, only to do it again at another time, perhaps more surreptitiously. A dog I once had provides another good example of this. Shadow was not permitted to jump on the furniture, and she was smacked with a rolled-up newspaper if she tried. My husband and I thought we had stopped this behavior altogether (and proud we were of our success in using behaviorist principles!). But one day when I was home alone, I walked into the living room, and although there was no dog in sight, the rocking chair was rocking furiously!

Azin and Holz (1966) discussed other, more serious, problems with the use of punishment to reduce undesirable behavior. When punishment involves a particularly aversive stimulus or induces pain, it can lead to unde-

sirable emotional responses being conditioned. If fear is elicited, then avoidance or escape behavior may be negatively reinforced inadvertently (Skinner, 1938). Running away and truancy are good examples. A child does poorly in school, is punished severely, and then manages to escape or avoid the punishment by leaving home or cutting class.

The emotional side effects of punishment that is painful are not limited to fear, however. Aggression and anger may result, particularly in individuals who are characteristically aggressive (Azrin, 1967). Moreover, punishment can serve as a model for aggression. In a series of studies examining aggressive behavior in children, Bandura, Ross, and Ross (1961, 1963) demonstrated that those who observed others being aggressive were more likely to be aggressive themselves. This is further supported by evidence from studies of abusive families; by and large, parents who are abusive were themselves abused as children (Steinmetz, 1977; Strauss, Gelles, & Steinmetz, 1980).

Finally, a long history of punishment may cause physical or psychological harm. Especially in situations where the aversive stimuli cannot be avoided or escaped from, the phenomenon of **learned helplessness** may result. This refers to the *passive acceptance of events seemingly beyond one's control*, a phenomenon first demonstrated in a now classic experiment conducted by Seligman and Maier (1967). In their study, conducted in two phases, unpredictable and painful shocks were administered to dogs. For some of the dogs, escape from the shock was possible through a panel in the cage. For the others, escape was not permitted, no matter what they did. In the second phase of the study, the dogs were placed in one of two compartments of a box. A tone sounded to warn of impending shock in that compartment, which the dogs could escape by jumping the barrier into the second compartment. The dogs who had been allowed previously to escape the shock learned quickly to jump the barrier each time they heard the tone. The dogs who had previously been prevented from escaping the shock, however, made little attempt to escape under these new conditions.

When individuals perceive that their actions have little effect on aversive events, they, too, begin to exhibit symptoms of learned helplessness. In the context of learning, experiencing repeated failure or constant belittlement of their efforts can lead students to say, "I can't do this. I'm not a good reader" (or writer, or test-taker, or what have you).

With so many problems associated with punishment, under what conditions can it be useful? Azin and Holz (1966) suggested that punishment has an advantage over other procedures when there is a need to stop a behavior quickly. For example, if a child is about to injure herself by picking up a hot iron, a fast slap on the wrist or loud "NO!" may be the most effective way to gain her attention and stop her in the act. Similarly, Corte, Wolf, and Locke (1971) found punishment to be the most effective procedure for eliminating self-injurious behavior in retarded children.

Finally, when used sparingly, punishment has the advantage of conveying information about what behaviors are considered appropriate or inappropriate in given situations (Azrin & Holz, 1966; Walters & Grusec, 1977). Sometimes, individuals simply are not aware that their behavior is unacceptable; it may be that the rules are different from what they have been accustomed to. This may happen particularly in multicultural situations, when, for example, ways of interacting that are socially acceptable at home or in one's neighborhood are not acceptable at school. It is for these situations that some behaviorists also recommend a warning precede punishment and reasons accompany it to explain why certain behaviors are not tolerated (Walters & Grusec, 1977).

Weakening a Response: Reinforcement Removal. Whereas one way to reduce the frequency of behavior is to present an aversive consequence, another, perhaps more effective means is to take away reinforcement when the behavior occurs (see Figure 2.2). Removing reinforcement can be done with the principles of response cost and timeout. However, a special case of reinforcement removal, which involves the absence of reinforcement, is discussed first.

Extinction occurs when previously existing contingencies of reinforcement are taken away, thereby causing a reduction in the frequency of a response. In other words, reinforcement that has been maintaining some behavior is simply stopped. For example, a teacher stops paying attention to a student madly waving his arm in the air, and he eventually gives up. Or, a pet owner ignores a dog's whining and the dog eventually stops.

When extinction is used as a procedure for weakening some undesirable behavior, the key to its success is persistence. As most pet owners have undoubtedly experienced, the dog that is being ignored will redouble its efforts for attention at first. Woe to the owner who gives in at this point, however! Delaying attention simply serves as an intermittent schedule of reinforcement, which we will see later in the chapter has the effect of greatly strengthening behavior. With extinction, it is important to consistently withhold reinforcement; eventually the behavior will lessen. As with punishment, it is also useful to reinforce some alternative, desirable response concurrent with extinguishing the undesirable behavior. In that way, learners are being rewarded for something even while they have lost reinforcement for something else.

Response cost, like extinction, involves the removal of reinforcement contingent upon behavior. But in the case of response cost, this is done by exacting a fine, requiring the offender to give back some previously earned reinforcer. It can have a strong and rapid effect on reducing certain behaviors for some people, depending on the history of the person and the value of the fine (Weiner, 1969). In society, for example, the fine for minor infractions of

the law is usually monetary. To be effective, fine amounts should be set high enough to reduce the likelihood of repeat behavior, but it is certainly true that, no matter what the fee, it may have less effect on a rich person or one who has been successful at avoiding payment.

Response cost applied in a school setting can be seen in the following example. On a class field trip, Ms. Johnson was in charge of the six third grade boys most likely to cause trouble. The morning of the trip, she told them what rules of conduct they were to follow, that they would earn stickers for good behavior, but that they would have to give back a sticker every time they broke a rule. After warning one boy twice for the same behavior, Ms. Johnson said, upon the third occurrence, "You know what the rules are, right?" The little boy said yes and tearfully handed her the only sticker he had earned so far. The happy outcome to this story is that the boy behaved without incident the rest of the day and earned the big treat Ms. Johnson had been saving for last.

The final principle involved in reducing behavior, **timeout**, does so by removing the learner, for a limited time, from the circumstances reinforcing the undesired behavior. In some situations, it is very difficult to determine precisely what consequence is responsible for maintaining some behavior. It may be the case, moreover, that several events follow a behavior and all have some reinforcing effect. In a typical classroom, for example, a student's acting out, accompanied by "Watch me!" may cause the teacher to stop class and the other students to laugh, both of which may contribute to its re-occurrence. Stopping the behavior, then, may take more than simply ignoring it (extinction). Yet other conditions may not make response cost an appropriate alternative.

In cases such as these, individuals may be removed altogether from the sources of reinforcement. Wolf, Risley, and Mees (1964) used timeout to virtually eliminate temper tantrums thrown by an autistic boy. Every time a tantrum occurred, they isolated him in a room by himself for slightly longer than the tantrum had been. Sohnick, Rincover, and Peterson (1977) added further evidence to the effectiveness of timeout, but noted that it can be reinforcing instead of punishing in some circumstances. Imagine, for example, a noisy classroom. The disruptive behavior of one student causes the teacher to put him out in the quiet hallway with his assignment. The next time the class is noisy, this student acts out again, with the same result. What appears to have happened is not timeout at all; rather, the disruptive behavior has been negatively reinforced by the student's escaping the noisy classroom for the quiet hallway.

Sulzer and Mayer (1972) suggested that for timeout to be most effective, the following conditions should be met. Timeout should not be used from an aversive situation (illustrated in the example above). It should provide for removal of all reinforcement, it should be consistently maintained, and the

time period should be kept short (a general rule of thumb is one minute for each year of the learner's age). Finally, like extinction and punishment, time-out should be used with other procedures that reinforce alternative, desirable behaviors.

Depicted in Figure 2.4 is a concept tree for principles of behavior management. It illustrates in a visual way what attributes are shared by certain principles (e.g., those that strengthen behavior) and what attributes are unique to each one (e.g., high-frequency behavior as reinforcer is unique to the Premack principle). The tree also includes, for each principle, an example illustrating its use or occurrence.

Teaching New Behaviors

The principles discussed in the previous section concerned behaviors that were already present to some degree in the learner's repertoire. One might say that the learner already knew the behavior; what was learned seemed to be the frequency with which the behavior was to be performed. But how are behaviors learned that are not already present in the organism's repertoire? Bar-pressing, for example, is not a behavior that rats do in their natural environment. Similarly, one could watch a pigeon in a Skinner box for a long time without ever seeing it turn around in a complete circle. In Mr. Tanner's class, students are unlikely to spontaneously exhibit a complex behavior such as the fox trot. If the students, the rat, and the pigeon never exhibit the behavior targeted for reinforcement, how does it come to be acquired? Behaviorists have defined three principles for teaching new, and in many cases, complex behaviors: shaping, chaining, and fading.

Shaping. Shaping refers to the reinforcement of successive approximations to a goal behavior. It involves positive reinforcement, in that a reinforcer is presented contingent upon desired behavior. But in the case of shaping, the desired behavior reinforced each time only approximates the target behavior. And successively closer approximations are required for the reinforcement to be presented (Reynolds, 1968). To teach a rat to press a bar, then, one might first reinforce proximity to the bar, then raising a paw, extending the paw toward the bar, touching the bar, and finally, pressing the bar. As soon as the rat has made the correct response—in this case, pressing the bar—then the principle of positive reinforcement is followed. That is, each bar press is reinforced until the desired frequency of behavior is exhibited.

Harris, Wolf, and Baer (1967) demonstrated the effectiveness of shaping to teach new behaviors to children. They selected climbing on the jungle gym for shaping in a little boy who spent no time on it. Teacher attention was the contingent reinforcer. Thus, teachers paid attention to the little boy first when he went near the jungle gym, then when he touched it, climbed on it, and finally, climbed on it extensively.

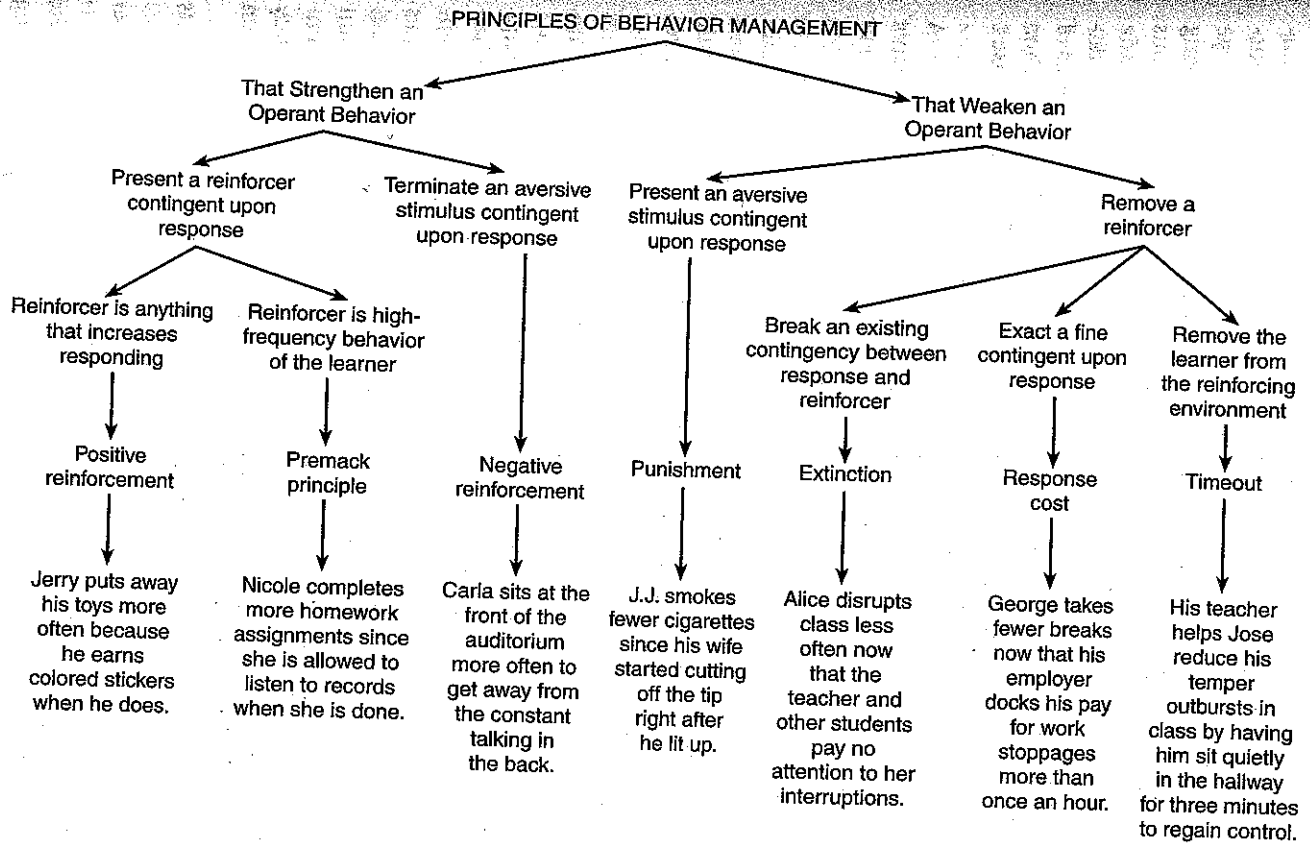


FIGURE 2.4 A Concept Tree for Principles of Behavior Management

Shaping has also been found to be particularly effective in teaching autistic children. Wolf, Risley, and Mees (1964), for example, trained an autistic boy in speech acquisition, using bits of food to reinforce making eye contact, producing any sound, producing specific sounds, and finally saying complete words and sentences. In this example, however, as in the previous ones, it could still be argued that the learners were capable of producing the desired response; they just did not. Bar-pushing, in other words, is not a difficult response. Climbing on a jungle gym was well within the capabilities of the small boy. Even the autistic boy could produce sounds that were then shaped into language. Is shaping as effective with truly difficult responses, which are not initially within the capabilities of the learners?

That the answer is yes can be illustrated with the following example. A waiter at a Moroccan restaurant served tea with dessert by raising the teapot high above his head and pouring the tea into tall, narrow glasses on a very low table, where we diners were sitting on floor cushions. He spilled nary a drop, and so, of course, we marvelled at his skill and asked how he had learned to pour tea in such a manner. His reply went something like this. "Well, naturally, I couldn't do it at first without spilling tea all over the place. So, I tried holding the teapot only slightly above the glasses. When I could pour without spilling, I moved the teapot up a few inches. And I kept repeating this process until I could do it with the teapot over my head." Successive approximations had been reinforced until the goal behavior was achieved. In this case, the ability to make the response at one level of approximation served as the reinforcer to attempt the next approximation.

The above example also illustrates a factor critical to the success of shaping. The waiter did not attempt a more difficult approximation until he had mastered the easier one. Similarly, in shaping any new behavior, a closer approximation to the goal should not be reinforced until the previous one has been firmly established. If too large a step is expected of the learner at once, the behavior may break down and shaping may have to resume at the point where the learner has repeatedly demonstrated success. Finally, it is also important in shaping to ensure that reinforcement is delivered immediately contingent upon the desired response. Any delays can result in some random behavior being reinforced and becoming conditioned.

Skinner (1948) called this superstitious behavior and demonstrated its inducement by delivering noncontingent reinforcement to pigeons. That is, he offered food at random intervals, not dependent upon the animal's behavior. Whatever the pigeon happened to be doing at the moment reinforcement arrived, however, became more likely to reoccur because of the reinforcement. As a result, Skinner observed the inadvertent conditioning of all sorts of weird behavior, and he argued that the simple contiguity between response and stimulus could account for the learning of superstitious behavior in humans. For example, you buy a new pen with which to take a

particular test, and you score well on the test. Scoring well rewards your use of that pen, and so you begin to attribute good performances to the causally irrelevant pen when, in fact, good performance was contingent upon your study behavior.

Chaining. Whereas shaping is used to teach new behaviors that are relatively simple and continuous in nature, **chaining** serves to *establish complex behaviors made up of discrete, simpler behaviors already known to the learner*. A typical example of chaining in human behavior is learning a new dance. Each dance step may be acquired through shaping, but then the steps are strung together in sequence through forward or backward chaining. In other words, one might begin by practicing the last step in the dance and then progressively add the steps that precede it (backward chaining). Or one could start with the first step and progressively add steps that follow until the entire dance can be performed (forward chaining).

Memorizing long passages of prose is another typical example of forward chaining. Sentences are added in succession until the entire passage can be repeated without error. Finally, reassembling their weapons after cleaning is a behavioral chain that is probably acquired through forward chaining by the soldiers in the scenario, Boot Camp.

Discrimination Learning and Fading. To this point very little has been said about the control the setting has over learning except in terms of the consequences of behavior. Behaviors are acquired and exhibited because they are reinforced; nonreinforced behaviors tend not to occur, at least in the setting where they have been ignored or punished. This is an important distinction. Individuals are clearly able to distinguish between settings in which certain behaviors will or will not be reinforced. A playful slap on the back may produce grins from the guys in the gym, but it is likely to have a quite different effect on one's commanding officer or teacher. Thus, something besides the behavior itself must be learned, and these are the cues, or discriminative stimuli (SDs), which signal to the learner when and where the behavior is to be performed.

Most learning in formal instructional situations is accompanied by cues. School bells signal the end of classes; getting up to leave before they ring is a behavior likely to be punished. Thus, staying in one's seat is reinforced before the bell rings; moving about the halls is reinforced after it rings. The bell simply acts as a cue to indicate what behavior is appropriate and will be reinforced (or conversely, what behavior is inappropriate and will be punished).

Discriminations are often learned, then, by a behavior being reinforced in the presence of one stimulus and being punished in the presence of another. Alternatively, a different behavior may be reinforced in the presence of the second stimulus. Motor vehicle drivers, for example, must learn to

stop at a red light and go on the green light. Thus, the S^D for stopping is a red light, and the S^D for going is a green light. In either case, however, errors can sometimes be extremely costly, so that applying the simple principles of positive reinforcement and punishment may not be the most effective for establishing the discrimination.

In his studies with pigeons, Terrace (1963a, 1963b) demonstrated that almost errorless discrimination performance could be achieved with fading. He first taught the pigeons to peck a red key, so that red became a discriminative stimulus for pecking. Then he turned off the key, which caused the pigeons to stop pecking, and gradually lengthened the intervals during which the key was dark. The darkened key then became the discriminative stimulus for not pecking. Finally, Terrace slowly faded in a green light in place of the darkened key. Since the pigeons never pecked the dark key, and the fading was so gradual from darkened key to well-lit green key, the green key came to be established as the S^D for not pecking.

The concept of fading as it has been applied to human performance has come to refer to the fading out of discriminative stimuli used to initially establish a desired behavior (Sulzer & Mayer, 1972). In other words, the desired behavior continues to be reinforced as the discriminative cues are gradually withdrawn. A classic example of fading used in instruction can be seen in Skinner and Krakower's (1968) *Handwriting with Write and See* program. In this program, children trace letters in an instructional workbook. Gradually, portions of the letters, which serve as the discriminative stimuli for forming the right shapes, are faded, thus requiring the children to compose increasingly more of each letter. Reinforcement is accomplished through a special chemical reaction between the pens used by the children and the paper. They form a black line when their letters are correct, but the paper turns orange when the pen moves from the prescribed pattern.

Other examples of fading can be seen in the gradual reduction of verbal cues given by a laboratory instructor as students work through a set of procedures for staining slides or in the withdrawal of physical cues given by a golf pro showing a beginner how to hold and swing a golf club. Job aids in industrial settings are also good examples of fading. As employees become more proficient in their assigned duties, they rely less and less on the cues provided by the aid.

Maintaining Behavior

If we consider that the job of instruction is not only to bring about desired changes in behavior, but to maintain them as well, then we must determine what conditions will be most effective for behavior maintenance. A typical behaviorist approach to the question would be to find some high-frequency, persistent behavior occurring naturally and to study the consequences re-

sponsible for its maintenance. One good example is people playing the slot machines at Las Vegas or Reno. Some will stand there for hours, doing nothing but pumping coins or tokens into the machines and pulling the handle. Every so often, the player receives a payoff, accompanied by flashing lights and ringing bells. So what is going on here?

Skinner was apparently in search of a means to economize on the costs of feeding his experimental subjects when he made an interesting discovery (Leahy & Harris, 1997). When he reinforced only some of the bar-pressing responses made by his rats, rather than reinforcing every response, the behavior became much more resistant to extinction. In other words, continuous reinforcement, while necessary to establish a response in the first place, was not essential to maintaining that response. In fact, intermittent reinforcement worked much better for that purpose. By systematically investigating schedules of reinforcement, Ferster and Skinner (1957) were able to determine what pattern of reinforcement gave rise to what sort of behavior maintenance.

Although behaviorists have investigated reinforcement schedules and invented new ones since Ferster and Skinner's original experiments, four basic schedules remain. These are determined on the basis of whether reinforcement is contingent upon a given response (called a ratio schedule) or upon the passage of time (called an interval schedule). In addition, reinforcement can occur regularly, after a fixed amount of time or number of responses, or it can occur irregularly, after a variable amount of time or number of responses. Taking these characteristics together, we have four possible schedules, as shown in Figure 2.5: fixed ratio, fixed interval, variable ratio, and variable interval.

Reinforcement occurs consistently	Reinforcement is contingent upon Responses	
	Fixed Ratio Example: Students earn points for every skill mastered	Fixed Interval Example: Worker is paid every two weeks
Reinforcement occurs intermittently	Reinforcement is contingent upon Time	
	Variable Ratio Example: Slot machines pay off after a random number of pulls on the lever	Variable Interval Example: Drill sergeant makes spot-check inspections

FIGURE 2.5 Types of Reinforcement Schedules

Fixed Ratio Schedules. Continuous reinforcement, i.e., reinforcing every desired response, amounts to the same thing as a fixed ratio schedule of one (FR1). Ratio schedules of reinforcement are those in which the reinforcer is delivered contingent upon the response made by the learner. A fixed ratio schedule, therefore, requires the learner to make so many responses before reinforcement is delivered. Quota systems on factory assembly lines are examples of fixed ratio schedules. For every fifteen widgets produced (FR15) or for every 300 chickens inspected (FR300), employees earn a standard wage credited toward their pay. This type of reinforcement schedule tends to produce a response pattern like the one shown in Figure 2.6A. In other words, responding occurs at a high and steady rate, since the more employees produce, the quicker they earn more money. Animals responding on a fixed ratio schedule also show a tendency to pause immediately following reinforcement. While this phenomenon has not been demonstrated consistently

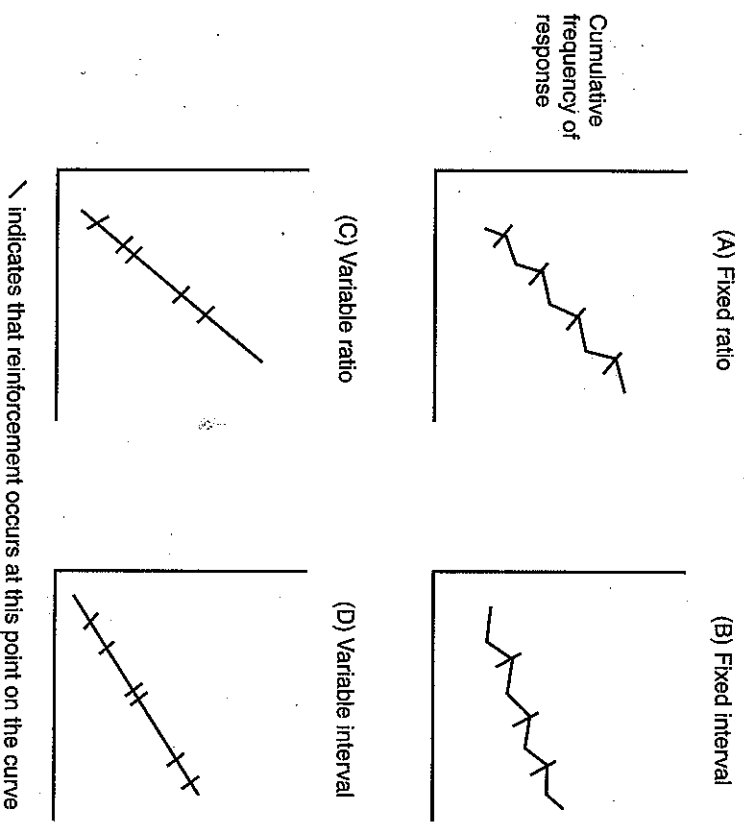


FIGURE 2.6 Response Patterns Produced by Different Types of Reinforcement Schedules

with humans, studies have shown that it can occur. For example, I typically put myself on an FR15 schedule when grading undergraduate assignments, getting up for a snack or a short walk after each fifteen papers graded. Getting started again after the break, however, generally entails a pause before I am fully focused on the task once again.

Fixed Interval Schedules. As indicated, time is the determining factor for an interval schedule of reinforcement. For a fixed interval schedule, then, reinforcement is delivered after some fixed period of time, such as 5 minutes (FI 5 min) or 10 days (FI 10 days). A commonly cited example of this type of schedule is the procedure by which many professors are tenured and promoted. Although tenure and promotion are ostensibly tied to performance, they are typically awarded, or become available for award, at particular times, such as after so many years in rank. As a result, performance over time may take on the characteristic “scallop” typically produced by a fixed interval schedule (Figure 2.6B). In other words, responding becomes more frequent as the time for reinforcement nears. Weekly quizzes can produce a similar pattern, with students spending more time studying as the time for the quiz draws near.

Variable Ratio and Variable Interval Schedules. In variable schedules, the time or number of responses required for reinforcement is varied from reinforcement to reinforcement. Thus, a VR5 schedule means that, on the average, reinforcement is delivered for every five responses, but one time it may be given after the second response and the next time after the eighth response. Similarly, a variable interval schedule of 5 minutes (VI 5 min) means that reinforcement may be given after 3 minutes, then after 7 minutes, then after 4 minutes, and so on, creating an average interval of 5 minutes.

Variable schedules typically produce the highest and steadiest rates of responding, with variable ratio schedules producing the highest of all (Figure 2.6, C and D). The slot machine example provided earlier demonstrates the effect of a variable ratio schedule; typically, payoffs are scheduled to occur after some average number of pulls on the lever. (This average, by the way, is set high enough so that the money taken in is always more than the money paid out.) In a classroom setting, teachers can assure steadier rates of studying or homework completion by administering pop quizzes on the average of once a week (VI 5 days), or by collecting and spot-checking assignments (e.g., every third assignment, on the average, for a VR3 schedule).

Planning a Program of Behavior Change

To this point, principles have been discussed that relate the incidence of behavior to its environmental cues and consequences. Learning has been